



## ***Book of Abstracts***

**Jahrestagung der Österreichischen Bodenkundlichen  
Gesellschaft 2025**

**Annual Meeting of the Austrian Soil Science Society  
2-3.12.2025, Innsbruck**

# ORAL PRESENTATIONS

## Keynote

2.12.2025

### *Entwicklung der Bodenforschung in Österreich seit Entstehung der Österreichischen Bodenkundlichen Gesellschaft*

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In dem Keynote-Vortrag wird versucht, die fachliche Entwicklung der Bodenforschung in Österreich anhand der Mitteilungen der Österreichischen Bodenkundlichen Gesellschaft seit 1954 zu analysieren und darzustellen. Sehr klar bilden sich die Funktionen der ÖBG in den Publikationen – Mitteilungen und den 47 Exkursionsführern - ab. Die ÖBG als Institution beschäftigte sich über die Jahrzehnte immer mit Bodensystematik und Bodenentwicklung – auch als „Hüterin“ der Österreichischen Bodensystematik, die in den Jahren 1969, 2001 und 2011 publiziert wurde. Tatsächlich decken die Aktivitäten der ÖBG praktisch alle Fachgebiete der Bodenkunde ab. Besondere Akzente setzte die ÖBG insbesondere in der Bodenbiologie, Radioökologie, Analysenmethoden, Klima und Wasserhaushalt und dem Bodenschutz.

Der zweite Teil der Keynote beschreibt Ergebnisse einer Analyse im Web of Science, die im Juli 2025 durchgeführt wurde. Dabei wurden die Keywords „Soil“ AND „Austria“ (in allen Kategorien, also auch „Affiliation“) kombiniert. Das Ergebnis waren 9100 Publikationen seit 1974, die in 10-Jahresschritten bezüglich Subthemenfeldern ausgewertet wurden. Die Zahl der Publikationen in Österreich stieg von der ersten Dekade 1974-1985 bis 2015-2025 enorm an. Tatsächlich wurden 2015-2025 mehr als die Hälfte aller seit 1974 zum Thema Boden und Bezug zu Österreich publizierten Arbeiten veröffentlicht! Das Thema „Soil Carbon Dynamics“ führt dabei weit vor „Hydroclimatic Modeling“, „Forest Dynamics“, „Phytoremediation“ und „Microbial Biocontrol“. Eine Auswertung der Institutionen, an denen die Autor\*innen tätig sind/waren, ergab die größten quantitativen Publikationsbeiträge durch die Universitäten: BOKU, Universität Wien, Universität Innsbruck und TU Wien.

Chancen und Zukunftsthemen der Bodenforschung runden die Keynote ab.

3.12.2025

## Session I: Soil Biology & Soil Functions - Focus on processes, functions, and methodological innovations

ID26

### ***The Invisible Cost of Forest Harvesting: Short- and Long-term Impacts on Greenhouse Gas Emissions and Soil Microbial Community***

**Armin Malli**<sup>1</sup>, Maximilian Behringer<sup>2</sup>, Michaela Djordjevic<sup>1</sup>, Klaus Katzensteiner<sup>2</sup>, Vanessa Landsteiner<sup>1</sup>, Gabriele Walli<sup>1</sup>, Raffaella Wettl<sup>1</sup>, Barbara Kitzler<sup>1</sup>

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<sup>2</sup> BOKU University, Institute for Forest Ecology, Austria

Forest soils of Austria's Flysch zone are highly productive but susceptible to compaction from mechanized timber harvesting. Soil compaction alters soil structure, affecting water retention, gas exchange, microbial communities, and greenhouse gas (GHG) dynamics. This study compared the effects of different timber harvesting techniques on soil functions, with emphasis on GHG fluxes (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O), microbial community structure, and long-term recovery potential of these parameters.

At the Steinplattl experimental site (Klausen-Leopoldsdorf, Austria), we performed a controlled before-after study at a beech stand thinned using three harvesting methods: harvester-forwarder with bogie track operation (H+), harvester-forwarder with wheel operation (H-), and tower cable yarder (MC). From 2022-2024, we conducted intensive 3-weekly GHG measurements on the treatments (H-, H+, MC) and the thinned stand (C = control). Additional 24h GHG-monitoring at an adjacent beech stand and skid trails from a thinning 8 years prior (C16 and H16) assessed long-term recovery trajectories. Soil samples from all treatments and control plots were analyzed every 6 weeks for microbial biomass carbon and nitrogen (MBC/MBN), phospholipid fatty acid (PLFA) profiles, and physical properties.

Significant treatment effects were observed across all measured parameters. N<sub>2</sub>O emissions were 4-fold higher on harvester skid trails (H+/H-) compared to control plots, reaching levels comparable to fertilized arable land, while MC revealed emission peaks following rainfall events. CH<sub>4</sub> uptake was reduced in all trafficking treatments, with H+ becoming a net CH<sub>4</sub> source. CO<sub>2</sub> emissions were 40% higher in H+ compared to C likely due to increased decomposition and faster growth of pioneer plants (sedges, grasses, etc.). H16 showed partial recovery with reduced N<sub>2</sub>O emissions and recovered CH<sub>4</sub> uptake. However, high potential for hot moment emissions persisted, with CO<sub>2</sub> emissions remaining comparable to H+. PLFA analysis revealed increased gram-negative bacteria and vesicular arbuscular mycorrhiza (VAM) in H+, indicating higher nutrient availability and faster adaptation towards the altered vegetation on skid trails. Total PLFA was highest in H+. Microbial biomass showed no difference between H+ and control plots, and H16 demonstrated slower but full MBC/MBN recovery on non-bogie track skid trails. However, older trails still exhibited elevated VAM levels, reflecting persistent vegetation shifts. Bogie tracks (H+) can mitigate soil physical impacts compared to wheel operations (H-) with potential beneficial effects on microbial communities but show elevated GHG emissions. Cable yarding (MC) produced minimal disturbance in most parameters but showed high N<sub>2</sub>O emission potential after rainfall. Soil GHG emission effects were most pronounced for ground-based harvesting techniques in the first year after thinning. While microbial biomass indicated recovery within 8 years after harvester-forwarder wheel operation, GHG dynamics and vegetation composition remain altered for decades. Results emphasize the importance of permanent skid trail networks, appropriate harvest timing, and site-adapted technology selection for sustainable forest management on compaction-prone soils.

**ID27**

***Microbial characterization of Tangel Humus and the influence of bioinformatic pipeline selection on metabarcoding results***

**Theresa Rzehak<sup>1</sup>, Nadine Praeg<sup>1</sup>, Giulio Galla<sup>4</sup>, Alois Simon<sup>5</sup>, Clemens Geitner<sup>3</sup>, Julia Seeber<sup>2</sup>, Heidi C. Hauffe<sup>4</sup>, Paul Illmer<sup>1</sup>**

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Tangel humus is characterized by strongly reduced carbon turnover and the accumulation of organic matter, resulting in the formation of thick organic layers. However, the underlying causes of this organic matter accumulation remain poorly understood, and insights into the microbial community within Tangel humus are still lacking. Thus, we conducted a detailed investigation of microbial diversity, activity and abundance across different layers of a Tangel humus profile in the Wetterstein mountains (Tirol, Austria), together with analysis of chemical properties.

Our results showed nutrient-poor conditions, especially in deeper humus depths, and a clear microbial zonation along the depth profile of 50 cm. Specifically, microbial diversity declined with depth, accompanied by pronounced shifts in microbial community composition. The observed decrease in microbial abundance and diversity, together with the established nutrient deficiencies in deeper depths, likely contributes to the reduced C-turnover and Tangel humus formation.

Because metabarcoding results depend on bioinformatic processing, we further evaluated how pipeline selection influences diversity outcomes. Since no universally standardized bioinformatic pipeline for metabarcoding analysis exists, results may vary depending on the chosen pipeline and parameter settings. Thus, we compared the processing of fungal ITS2 sequences derived from environmental samples using an ASV-inferring pipeline and an OTU-based pipeline with different similarity thresholds. This comparison revealed inconsistent diversity estimates and taxonomic composition when processing settings were not harmonized between pipelines. Across all approaches, differences in taxon abundance heterogeneity and detection capacity were evident. Based on these findings, we provide practical recommendations for improving reproducibility and comparability in future metabarcoding studies.

## ID14

### *Discovering New Bacterial Taxa from Soil and Rhizosphere*

Fatemeh Qasemnejadlangerodi<sup>1</sup>, Maraike Probst<sup>1</sup>, Christian Rinke<sup>1</sup>

<sup>1</sup> Universität Innsbruck, Department of Microbiology, Austria

Soil and the rhizosphere harbor complex microbial communities, making it challenging to capture the full diversity of microbes through sequencing. Despite these difficulties, it remains fascinating to search for taxa that have not yet been detected or are currently unculturable, as such efforts can lead to the discovery of new metabolic pathways and the production of unique biomolecules, a process known as bioprospecting.

In this study, twenty rhizosphere, twenty rhizosphere extract, and twenty bulk samples were obtained from four agricultural fields in Tirol, Austria. DNA was extracted and sequenced using Illumina HiSeq (2×150 bp; 50 M reads for 45 samples, 100 M for 15) and Oxford Nanopore Technology for three samples. To identify the microbial community present in the rhizosphere, the tool singleM was employed on the raw reads. FastQC and Metaspades were used for quality control and trimming. Binning of assembled contigs was done using Aviary, bin quality was assessed with CheckM, and taxonomic assignments were made using GTDB-Tk.

First, we attempted to improve the quality of our assemblies by combining Nanopore and Illumina short reads for three test samples. This approach improved key assembly metrics, such as higher N50 values and an increased number of contigs over 10 kb. However, incorporating Nanopore data did not considerably enhance bin recovery of MAGs, suggesting it may not be necessary to sequence the remaining 57 samples with long reads.

In total, we recovered eight high-quality MAGs, along with several medium- and low-quality MAGs. Here, we explore the extracted (low-quality) MAGs using bioinformatic tools (Binchicken) to obtain as many high-quality genomes as possible from soil metagenomes. Furthermore, we are going to present metabolic reconstruction and potential for novel biomolecule production in soil microbial communities.

## Session II: Soil Biology in Transition - Contributions on climate extremes, anthropogenic influences, biodiversity, resilience

ID41

***Topsoil, but not subsoil shows the largest effects on physical, chemical and biological soil properties after implementation of a 13-years alley cropping system in temperate climate***

**Klaus Jarosch<sup>1</sup>, Heike Haslwimmer<sup>2</sup>, Felix Herzog<sup>1</sup>, Juliane Hirte<sup>1</sup>, Simon Hofer<sup>1</sup>, Ellen Kandeler<sup>2</sup>, Adrien Mestrot<sup>3</sup>, Simon Oberholzer<sup>1</sup>**

<sup>1</sup> Agroscope, Switzerland

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<sup>3</sup> University of Bern, Switzerland

Agroforestry systems are increasingly recognised as possible strategies to abate and mitigate climate change. Among those, alley cropping systems (ACS) offer a wide range of ecosystem services both on the tree strip as well as on the cultivated arable strip. The objective of this study was to determine how soil organic carbon (SOC) stocks, microbial activity and nitrogen and phosphorus dynamics in soils and microorganisms differ in distances from trees and sampling depth down to 0.8 m in a 13-years old ACS in central Switzerland. For each soil property, tree effects and their spatial range into the arable strip were analysed using a transect sampling design. The SOC accumulation rate was equal to  $0.2 \pm 0.08$  Mg C ha<sup>-1</sup> yr<sup>-1</sup> and was mostly driven by accumulation in the tree strip. Topsoil (0-0.2 m, equivalent to 2'000 Mg soil ha<sup>-1</sup>) contained only around 30% of the total SOC stock (0.8 m sampling depth as reference), stressing the relevance of subsoil sampling for adequate evaluation of SOC accumulation in ACS. Two soil types were sampled and the carbonate rich soil consistently showed higher SOC accumulation rates than the carbonate poor soil. Similar availability of carbon, nitrogen and phosphorus in the subsoil suggested no competition for these nutrients below 0.2 m soil depth, but differences in soil microbial biomass and soil respiration suggested altered SOC dynamics between the arable strip and the tree strip in the subsoil.

ID19

***Seedling establishment failure of Alpine conifers is mainly driven by osmotic and temperature stress following a prescribed fire***

**Markus Neurauter<sup>1</sup>**, Zhiyi Chen, Moritz Stegner, Ilse Kranner, Stefan Mayr, Ursula Peintner

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Climate change is leading to more frequent wildfires, which not only affect mountain forest stands but also their rejuvenation and afforestation after fire events. In this study we investigated whether post-fire conditions would hinder seedling establishment of Alpine conifers and which fire-induced changes in edaphic parameters could be responsible.

At the experimental site in Praxmar (Tyrol, 1 600 m a.s.l.) two plots were established with one serving as a control and one subjected to a prescribed fire induced by litter ignition. Seeds of *Picea abies*, *Pinus cembra* and *Larix decidua* were sown every ten days over seven weeks on both plots and seedling establishment and soil parameters were monitored. The prescribed fire led to lower establishment of all three species. On the fire plot, *Pinus cembra* had best establishment right after the fire, while seedling of *Picea abies* and *Larix decidua* reached a peak in establishment one month after the fire. Increased electrical conductivity (EC) was observed right after the fire, with values declining to control levels over the observation period. Fire had little effect on pH and no elevation of toxic compounds was observed through inductively coupled plasma optical emission spectrometry (ICP). ICP only found increases in non-toxic metals, such as Mg, Ca and K, which showed the same declining trends as EC values over time. Surface temperature was also elevated on the fire plot, with extreme values decreasing over time like EC values.

We therefore conclude that the main driver of delayed establishment of *Picea abies* and *Larix decidua* was primarily caused by lower osmotic potential due to higher salt concentration (which washed out over time) and temperature extremes and not changes in pH or increases in toxic cations. *Pinus cembra* was likely able to overcome unfavorable environmental conditions due to its massive seeds with rich endosperm.

**ID32**

***Drought soil legacies and grassland responses to subsequent drought***

**Michael Bahn**<sup>1</sup>, Natalie J. Oram<sup>2</sup>, Jesse Radolinski<sup>3</sup>, Marie-Louise Schärer<sup>1</sup>, Maud Tissink<sup>1</sup>

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<sup>3</sup> Arkansas State University, USA

Droughts are affecting ecosystems worldwide and are expected to become increasingly frequent and intense in the near future. While the detrimental impacts of droughts on terrestrial ecosystems are well documented, it is largely unknown whether and how drought effects on soils can alter ecosystem responses to subsequent drought. We will present several case studies which demonstrate that drought effects on soil microbial communities not only affect soil functioning in response to recurrent drought, but can also have legacy effects on grassland productivity and how it is affected by subsequent drought. Furthermore, we will showcase recent advances in testing for drought legacy effects on soil properties related to plant water availability, highlighting that scenarios of frequent and more intense drought can lead to reduced plant water access even following rain events and during subsequent dry periods. Our findings suggest that drought soil legacies induced by repeated and / or severe drought can have major implications for the functioning of grassland ecosystems and their response to subsequent drought.

## Session III: Soil Ecosystem and Landscape Dynamics

ID38

### *The state of the art in mechanistic soil-landscape modelling*

Arnaud Temme<sup>1</sup> & Alessia Giarola<sup>1</sup>

<sup>1</sup> Universität Innsbruck, Department of Geography, Austria

The development of soils in response to the soil forming factors is empirically well established. Many dozens of case-studies have explored the impacts of each factor individually, and sometimes of multiple factors jointly. The digital soil mapping revolution used this knowledge – and abundant modern remote sensing datasets - to provide more and more accurate maps that have benefited our use and management of soils.

But our mechanistic understanding of soil formation is lagging behind these statistical accomplishments. As a discipline, we are not currently able to calculate or simulate how over time a soil develops from a given parent material, given climatic, biotic and landscape setting. This lack of development is limiting our ability to test our conceptual understanding, and our ability to explore what will happen under scenarios for future climate and management.

In this contribution, I will share thoughts on the reasons for this lacking development on the mechanistic side, summarize the state of the art in landscape-scale soil modelling, and indicate directions for future development. I will share findings from several example soil-landscape modelling studies to illustrate what currently works well, and what does not work well, with special reference to the open-source soil-landscape model LORICA. Finally, I will share a few practical notes regarding the accessibility of open-source software and the use of soil-landscape models by interested but inexperienced researchers.

***Controls of soil inorganic carbon accumulation in managed desert soils***

**Wajdi Allagui<sup>1</sup>, Nadhem Brahim<sup>2</sup>, Manel Allani<sup>2</sup>, Boutheina Zougari<sup>6</sup>, Hatem Ibrahim<sup>5</sup>, Roland Bol<sup>4</sup>, Hamouda Aichi<sup>3</sup>, Wolfgang Wanek<sup>1</sup>**

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Soil inorganic carbon (SIC) constitutes 70–75% of the total carbon pool in oasis agrosystems, emphasizing its critical role as a long-term carbon sink in arid regions. While SIC accumulation aligns with patterns observed in calcareous soils global driven by high evaporation, alkaline conditions, and irrigation practices. This study reveals unique dynamics shaped by topography-management interactions and mineralogical complexity and biological sources. Unlike previous reports, SIC distribution in our study area showed no clear depth dependent trend or pH or geological source. Notably, topography and management history interact significantly: modern oases exhibit higher SIC at upslope positions due to limited leaching and in situ carbonate precipitation, while traditional oases show downslope SIC enrichment. with  $\delta^{13}\text{C}_{\text{SIC}}$  values ranging from -8. ‰ To -5. ‰, indicating contributions from biological sources. SOC content correlated negatively with  $\delta^{13}\text{C}_{\text{SIC}}$ , suggesting microbial respiration and root-derived  $\text{CO}_2$  partially drive carbonate precipitation, particularly in surface layers.  $\delta^{13}\text{C}_{\text{SIC}}$  signatures in traditional oases reflected stronger biological contributions compared to modern systems, potentially linked to legacy SOC inputs from long term organic amendments. So that we found a SIC biological sources up to 30% in the traditional oasis. Topography and management interactions further modulated SIC dynamics: modern oases exhibited upslope SIC enrichment (pH-driven in situ precipitation), while traditional systems showed downslope accumulation from centuries (Gypsum precipitation). Cation relationships diverged between systems: modern oases displayed  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  co-precipitation (calcite dominance), whereas traditional oases revealed  $\text{Mg}^{2+}$  depletion (dolomitization) and gypsum driven  $\text{Ca}^{2+}$  SIC decoupling. Gypsum and SIC interactions showed dual competitive/cooperative dynamics in PCA, with management practices critical for stabilizing SIC against gypsum-induced dissolution.

These findings underscore SIC's dual origin in oasis soils, integrating biological (SOC derived  $\text{CO}_2$ ) and geochemical (evaporation, precipitation) processes. Enhancing SIC sequestration requires strategies balancing  $\text{Ca}^{2+}$  availability, gypsum control, and SOC management to optimize biogenic carbonate formation. This work advances mechanistic understanding of SIC dynamics in anthropogenic arid ecosystems, emphasizing the need to incorporate biological carbon pathways into soil carbon models.

## Session IV: Science Communication & Open Topics

ID29

### *SOIL:OurInvisibleAlly*

**Maria Legner**<sup>1</sup>, Primoz Simoncic, Reka Rozsnyoi, Frederic Berger, Silvia Stanchi, Michele Freppaz, Borut Vrscaj, Eva Zagorac, Pia Hoefflerle, Anze Japelj, Sinan von Stietencron, Julius Hecher<sup>1</sup>

<sup>1</sup> Klimabündnis, Austria

The overuse of natural resources and the effects of climate change are accelerating soil degradation in the Alpine region, highlighting the need for more sustainable land management. Although data and solutions exist, change remains slow and uneven—partly due to limited soil literacy and ineffective knowledge dissemination. But which other factors may be responsible? *SOIL:OurInvisibleAlly* (09.2024–08.2027), funded by the EU’s Interreg Alpine Space Programme, addresses this question while promoting sustainable soil management (SSM) through both scientific and artistic means.

The project identifies and synthesizes best SSM practices across the Alps and collaborates with twelve pilot sites representing different land-use contexts. These activities aim to preserve or restore soil ecosystem services (SES) and strengthen soil resilience. Knowledge is shared through two complementary pathways: (1) “train-the-trainer” workshops for advisors, municipal staff, and educators, and (2) cultural events combining scientific content with aesthetic experiences. This dual approach makes soil knowledge more inclusive, accessible, and engaging for audiences that might otherwise remain uninvolved.

A conceptual framework links soil natural capital, soil functions, and SES, emphasizing their interdependence and the role of human interventions in shaping soil resilience. The framework guides project activities and fosters a shared understanding of human–soil interactions, illustrating how sustainable practices enhance soil functions and ensure the long-term provision of ecosystem services.

Expected results include empowered multipliers who disseminate SSM knowledge to local stakeholders and improved soil literacy and engagement among the wider public. During the presentation, we will introduce the conceptual framework, showcase early project outcomes, and present examples of integrating soil themes into artistic and cultural events to strengthen soil stewardship across Alpine communities.

**ID37**

***Listening to the soil – Potentials and Limitations of Podcasts in Soil Communication***

**Laura Bräunig<sup>1</sup> & Christoph Genzel<sup>1</sup>**

<sup>1</sup> Soilcast, Podcast über Boden, Umwelt, Klima, Germany

The protection and importance of our soils is paramount, particularly in the light of climate change and population growth. In addition to scientific research, it is crucial to raise public awareness of the significance of maintaining healthy soils. In this context, podcasts have emerged as an effective tool for engaging wider audiences in scientific topics. Consequently, soil science associations and related institutions are seeking innovative ways to incorporate such formats into their communication strategies to improve the outreach.

Soilcast is the first German-language podcast exclusively dedicated to making soil science content accessible to a broad audience. It was launched three years ago and has with its easy accessibility high potential to bring the importance of healthy soils and soil mechanisms to public attention. The podcast team has found ways to present both basic knowledge and current scientific research in audio form to the interested public.

Thanks to more than 150 published podcast episodes, it is now possible to draw on a rich repertoire of experience that includes both the technical-conceptual and methodological-didactic aspects of science communication. The lecture classifies the podcast medium in modern science communication and uses practical experience to illustrate the possibilities and limitations of this medium in soil communication.

## **ID51**

### ***BodenXR – Mit Extended Reality den Tiroler Boden erleben***

**Katharina Peer<sup>1</sup>**

<sup>1</sup> LFI Tirol

Das BodenXR-Projekt des LFI Tirol bringt digitale Innovation in die bodenkundliche Ausbildung und macht unsichtbare Prozesse sichtbar. Mithilfe von Mixed Reality können die Teilnehmenden die unterschiedlichen Bodentypen, deren Struktur und die Wechselwirkungen zwischen Pflanzen, Wetter, Düngung und Mikroorganismen auf interaktive und realitätsnahe Weise erleben.

Die Erfahrung dauert je nach Intensität zwischen 8 und 25 Minuten und ist in vier Module unterteilt:

1. Einführung: Eine kurze Einführung verdeutlicht die Bedeutung des Bodens für die Tiroler Landwirtschaft und weckt das Interesse der Teilnehmenden.
2. Bodentypen entdecken: Vier typische Tiroler Bodenprofile – Rendzina, Auboden, Ranker und Braunerde – werden in 3D visualisiert. Die Teilnehmenden können den Aufbau und die Standortfaktoren dieser Böden erkunden und erhalten praxisorientierte Einblicke in die Vielfalt der Tiroler Böden.
3. Gesunder Boden: In einem spielerischen Modul lernen die Teilnehmenden, wie Pflanzen, Mikroorganismen und landwirtschaftliche Maßnahmen den Boden beeinflussen. Interaktive Elemente und Gamification fördern das Verständnis für nachhaltige Bodenbewirtschaftung und laden zum Ausprobieren ein.
4. Abschluss: Eine kompakte Zusammenfassung rundet die Erfahrung ab und gibt einen Ausblick auf die Wichtigkeit gesunder Böden für die Zukunft der Landwirtschaft.

BodenXR kombiniert wissenschaftliche Erkenntnisse, praxisnahe Anwendung und digitale Technologien. Die Anwendung ist für das Meta Quest 3 optimiert und bietet ein benutzerfreundliches Design, das auch für Einsteiger:innen zugänglich ist. Dank Extended Reality (XR) wird das Lernen orts- und zeitunabhängig, spannend und praxisorientiert.

Mit diesem Projekt trägt das LFI Tirol zur Digitalisierung der Landwirtschaft bei und stärkt das Bewusstsein für eine nachhaltige Nutzung von Böden – ein wichtiger Schritt für die Zukunft der Tiroler Berglandwirtschaft. Das Projekt entstand in Kooperation mit der Landwirtschaftskammer Tirol und dem Land Tirol, wurde vom Land Tirol gefördert und von MediaSquad programmiert.

## Session V: Interactions in Soil Ecosystems - Focus on soil fauna–microorganism–plant interactions, root microbiomes

**ID13**

### ***Recovery of ectomycorrhiza in a subalpine forest after eight years of simulated summer drought***

**Ute Birgit Lackinger<sup>1</sup> & Ursula Peintner<sup>1</sup>**

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Climate change is expected to intensify summer droughts, posing a challenge to the resilience of forest ecosystems and the symbiotic networks on which they depend. Ectomycorrhizal (ECM) fungi are important symbiotic partners for trees and have a crucial impact on their growth and nutrition. While they impact tree health and drought tolerance, their long-term response and recovery following a drought period remains poorly understood.

The present study was carried out at Kaserstatt Alm (Austria, Tyrol, 2,000 meters above sea level) in a mixed subalpine forest dominated by *Picea abies* and *Larix decidua*. We investigated the recovery dynamics of ECM fungal communities and soil properties after eight years of experimental summer drought. We were especially interested in the question if and how these factors recovered after the drought alleviation. The objective of the present study was to ascertain the trajectories of microbial and soil recovery after percurrent drought.

ECM communities were quantitatively assessed based on soil cores. Root tips were sorted in to morphotypes and then identified based on rDNA ITS sequencing approaches. Fine root dry weight per liter soil was assessed to monitor growth of mycorrhized roots. Soil organic matter (SOM), pH, water content, the C/N ratio were analysed as important soil parameters.

The findings reveal that while the soil parameters returned to pre-drought levels in the recovery year, ECM community composition diverged between drought and control plots. These results suggest the presence of potential legacy effects and raise new questions about the stability and adaptability of belowground symbioses in a changing climate.

***Metabolic profiles and plant-microbe associations of winter wheat under different water regimes in conventional and organic cropping systems***

**Juliana Jäggle**<sup>1</sup>, Rafaela Feola Conz<sup>2</sup>, Martin Hartmann<sup>2</sup>, Elena Kost<sup>2</sup>, Hans-Martin Krause<sup>3</sup>, Dominika Kundel<sup>3</sup>, Jochen Mayer<sup>4</sup>, Paul Mäder<sup>3</sup>, Hannier Pulido Barrios<sup>2</sup>, James W. Sims<sup>2</sup>, Johan Six<sup>2</sup>, Katharina Keiblinger<sup>1</sup>

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Climate change impacts, such as drought, affect agriculture and put global food security at risk. Plants can adapt to drought inter alia through changes in their metabolism and interaction with soil microorganisms via root exudates. Contrasting cropping systems can harbor distinct soil microbiomes with potentially different capabilities to sustain crop growth under abiotic stresses like drought. This study assessed differences in plant metabolic responses and plant-microbial associations in response to drought in winter wheat across conventional and organic cropping systems. Thereby aiming to elucidate if certain cropping systems exhibit higher resistance to drought. Rainout-shelters were installed under winter wheat cultivation in three cropping systems (conventional, conventional integrated, and biodynamic) in the DOK long-term field in Switzerland. At three growth stages (stem elongation, flowering, and ripening) leaf and root tissues as well as root-associated and rhizosphere soil samples were collected. The plant metabolome was assessed via an untargeted GC-MS and LC-MS/MS analysis. Soil microbial diversity was analyzed by metabarcoding of prokaryotic and fungal ribosomal markers. The growth stage had the strongest influence on the plant tissue metabolome. Whereas the cropping systems had a small influence on the plant metabolome, the water regimes (drought versus rainfed) had a stronger influence on the plant metabolite composition, with a more pronounced influence in the roots compared to the leaves. Plant-microbe associations were explored by calculating Spearman correlations between the root metabolome and the root and rhizosphere microbiome. Several genera from both root and rhizosphere showed strong positive ( $r > 0.7$ ) correlations with several metabolites, such as sugars, sugar derivatives, and secondary metabolites. These metabolites correlated with several genera, including some known for being plant-growth-promoting bacteria and fungi. Our findings provide insights for future studies that aim to elucidate the formation of plant-microbe associations that can improve the tolerance of plants against drought stress.

***The role of phytosiderophore exudation, root-associated microbiome and other root traits for efficient zinc-uptake in barley***

**Uxue Otxandorena Iregi<sup>1</sup> & Andreea Spiridon<sup>1</sup>**, David Aleksza<sup>1</sup>, Alireza Golestanifard<sup>1</sup>, Michael Santangeli<sup>1</sup>, Carmen Escudero-Martinez<sup>2</sup>, Dagmar Woebken<sup>3</sup>, Timothy S. George<sup>4</sup>, Joanne Russell<sup>4</sup>, Tim Causon<sup>1</sup>, Stephan Hann<sup>1</sup>, Christian Stanetty<sup>5</sup>, Nicolas Kratena<sup>5</sup>, Eva Oburger<sup>1</sup>

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A nutritious and healthy diet relies on consuming cereals with sufficient micronutrient content, making the production of nutrient-rich crops a crucial agricultural goal. Identifying key strategies for plant micronutrient acquisition is essential, and this is especially critical for regions where a high soil pH limits micronutrient bioavailability.

Plants can enhance nutrient uptake by releasing root exudates that facilitate nutrient mining. Barley, along with other gramineous plants, employs a strategy based on phytosiderophores (PS), metal-chelating agents released by roots into the soil. While the role of these compounds in iron acquisition is well known, our understanding of their function in zinc (Zn) nutrition is still limited. Furthermore, root-associated microorganisms can also impact the plant's micronutrient status either by directly mobilizing micronutrients or enhancing general plant health. Plants can also improve zinc uptake by expanding soil exploration through adaptation of their root morphology.

This study aimed to identify key root traits for an efficient Zn acquisition in barley. Sixteen barley genotypes with diverse genetic backgrounds were grown in a Zn-deficient soil. We quantified total carbon, nitrogen, and PS exudation, along with assessing root morphology, plant biomass traits, and the expression levels of genes involved in Zn uptake. Amplicon sequencing of the 16S rRNA gene and the ITS2 region was conducted to explore the root-associated microbiome. Our results revealed a positive correlation between PS exudation and Zn concentration in barley shoots, suggesting a potential role in plant Zn nutrition. While root-associated microorganisms were influenced by the plant's Zn status and genotype, we found only subtle microbial differences between Zn-efficient and less efficient genotypes, providing little indication of their role in Zn uptake. These findings provide valuable insights into complex plant-soil-microbe interactions for nutrient-rich crop production.

## Session VI: Monitoring of Soil Life, Agricultural Practices, Soil Health

ID25

### ***Applying eLTER Standard Observations to Agricultural Ecosystems: A Case Study from the AGES Soil Tillage Trial in Fuchsenbigl***

**Anna Wawra<sup>1</sup>, Taru Sandén<sup>1</sup>, Heide Spiegel<sup>1</sup>**

<sup>1</sup> AGES, Austria

The AGES soil tillage trial is one of ten Austrian long-term research sites contributing to the biodiversity monitoring programme of the European Long-Term Ecosystem Research (eLTER), coordinated by the Environment Agency Austria. This project focuses on evaluating the newly proposed eLTER Standard Observation (SO) protocols, which have undergone review by international experts.

The harmonisation process aims to establish robust methodologies for assessing the current state and future trends of the Earth's system. These protocols are designed to ensure broad spatiotemporal coverage, while offering high impact, operational feasibility, and cost-efficiency. The eLTER SOs cover five spheres: geosphere, hydrosphere, biosphere, sociosphere, and atmosphere.

In 2025 and 2026, biodiversity monitoring activities at the AGES site will include a comprehensive assessment of key biodiversity indicators. These will cover vegetation surveys, flying insect diversity via malaise trap and metabarcoding, soil and water environmental DNA (eDNA) analyses, and acoustic monitoring of birds and bats.

The presentation will highlight insights and experiences from the first vegetation monitoring season, providing a practical perspective on the implementation of eLTER protocols in the field.

***Soil fauna on mountaintops: first insights from the 'GLORIA Extended' samplings in South Tyrol (Italy)***

**Michael Steinwandter**<sup>1</sup>, Jacopo Breschi, Andreas Hilpold, Julia Seeber

<sup>1</sup> Eurac Research, Institute for Alpine Environment, Italy

For 25 years now, the 'GLORIA' programme has been studying how plant communities living on mountaintops are changing around the world. It has therefore become a standard method for assessing on plants on mountains. In 2020, an additional soil fauna module was introduced: 'GLORIA Extended'. To our knowledge, this protocol has only been used twice: in the Gesäuse National Park in Styria (Austria), and in South Tyrol (Italy).

There are two GLORIA target regions in South Tyrol: (1) the Dolomites and (2) the Texel Group. Each target region consists of four isolated mountain peaks at four different elevations above the natural tree line. Five metres below each summit, we installed four pitfall traps in each of the four cardinal directions (i.e. 16 traps in total), which remained active for three weeks. We also conducted suction sampling for small invertebrates living in the ground vegetation.

Preliminary results from the four highest peaks show significant differences between their soil faunal communities. Mean abundances (as activity density) and taxa numbers decrease with increasing elevation. Coleoptera (mainly Carabidae and Staphylinidae) were most dominant of the total community reaching even >70% on the three highest peaks. Other dominant groups were arachnids such as Araneae (Gnaphosidae, Linyphiidae, and Lycosidae) and Opiliones (Phalangiidae). Taxa such as Isopoda and Chilopoda were absent from the higher peaks, reaching their elevation limits. Further, we could find more macro- and mesofauna specimens on the south-facing than on the north-facing slopes.

These first insights into the compositions of the soil fauna already reveal a highly diverse communities up to the high alpine and low-vegetated sites at 3000 and more metres in elevation. While data analyses are ongoing, we expect new findings of alpine soil fauna as globally such remote peaks and high alpine sites have rarely been sampled before.

***A long road to soil recovery: earthworms and soil structure in 18-year-old forest skid trails***

**Maximilian Behringer**<sup>1</sup>, John Koestel<sup>2</sup>, Bart Muys<sup>3</sup>, Karin Wriessnig<sup>1</sup>, Markus Bieringer<sup>1</sup>, Matthias Schlögl<sup>1</sup>, Klaus Katzensteiner<sup>1</sup>

<sup>1</sup> BOKU University, Austria

<sup>2</sup> Agroscope Reckenholz, Switzerland

<sup>3</sup> KU Leuven, Belgium

Soil compaction can impair soil health and ecosystem functioning for decades, yet the processes of biological and structural recovery remain poorly understood. In a controlled field experiment on clayey temperate forest soils in the Flysch zone of the Vienna Woods, we assessed long-term effects of ground-based timber harvesting on earthworm communities and soil structure. We compared freshly trafficked skid trails with those created 18 years earlier at the same site. Earthworms were sampled in the ruts and adjacent undisturbed plots. Additionally, undisturbed soil cores from 5 and 15 cm depths were collected for X-ray imaging to quantify porosity and structural attributes.

Five earthworm species were identified (*Aporrectodea rosea*, *Dendrobaena depressa*, *Dendrodrilus rubidus*, *Lumbricus rubellus*, and *Octolasion lacteum*). Abundance was highest on 18-year-old skid trails, particularly of endogeic and juvenile anecic individuals, while adult anecics remained reduced. Epigeic species were generally scarce due to the mull humus dynamic.

Porosity declined sharply after trafficking but recovered near the surface (from 14.4% to 12.2% at 5 cm) within 18 years, with only partial recovery at 15 cm (from 13.5% to 7.1%). Other structural indicators (biopores, pore anisotropy,  $\Gamma$ -connectivity, bulk density) showed similar trends, but the anisotropy of rock fragments did not recover, likely constraining small-scale water and air flow.

Our results demonstrate that earthworms can recolonize compacted forest soils and indicates that they substantially improve structure near the surface, yet subsoil compaction effects persist for decades. The resulting contrast between a biologically active top layer and a dense, compacted subsoil has lasting implications for soil functioning and sustainable forest management.

**ID17**

***Microbial Predators in Soil: Cercozoa across Agricultural Land Use Intensities***

**Lea Wellinger<sup>1</sup>, Christoph Rosinger<sup>1</sup>, Katharina Keiblinger<sup>1</sup> & Gernot Bodner<sup>1</sup>**

<sup>1</sup> Universität für Bodenkultur Wien (BOKU), Austria

Cercozoa are among the most dominant soil protists, contributing to soil food web processes through predation on bacteria, fungi, algae and other protists. However, Cercozoa have been overlooked in many soil microbial studies, particularly in agricultural systems.

In this study we used a molecular approach with Cercozoa-specific primers to explore Cercozoa diversity and functional community composition on an on-farm site in Absdorf, Austria. Investigated agricultural systems were topsoils under contrasting land-use intensities and vegetation cover: conventional arable, no-till organic arable, vegetated field margin, organic market gardening.

Results showed significant differences in diversity, indicative genera, prey preference and cell size distribution in the systems. Conventional arable soil had least diverse community and highest relative abundance of small-celled bacterivores, while no-till arable exhibited a community more similar to the field margin soil with intermediate diversity and higher abundance of larger-celled eukaryotes. Interestingly, market gardening soil exhibited a distinct community with highest richness and relative abundance of larger-celled eukaryotes.

These findings highlight the effect of agricultural land use intensity on soil protist communities, potentially further implicating soil food web dynamics in agricultural soils.

ID40

***Multi-marker metabarcoding for soil biodiversity assessments at Swiss long-term soil monitoring sites***

**Florian Gschwend**<sup>1</sup>, Florine Degruene<sup>2,3,4</sup>, Jonathan Donhauser<sup>5,6</sup>, Jürg Enkerli<sup>1</sup>, Maria Fernández-Bravo<sup>1,7</sup>, Beat Frey<sup>5</sup>, Thierry Heger<sup>2</sup>, Anna-Sofia Hug<sup>8</sup>, Janine Moll-Mielewicz<sup>8</sup>, David Singer<sup>2</sup>, Franco Widmer<sup>1</sup>

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Long-term soil biodiversity monitoring can help to identify environmental and soil management factors that promote or threaten soil organisms. However, comprehensive soil biodiversity assessments remain challenging due to the enormous diversity of soil organisms, even though fast methodological advances have been made in the last years. Multi-marker soil DNA-metabarcoding represents a promising approach to address this task by allowing parallel assessments of several groups of organisms using genetic tools. With this approach we surveyed five groups of organisms at 28 sites of the Swiss Soil Monitoring Network covering arable land, permanent grassland, and forest at a single time point. The five groups studied included bacteria, fungi, protists, nematodes, and arthropods. Overall, we detected 31'647 molecular taxa (amplicon sequence variants, ASVs) providing the most comprehensive survey of soil biodiversity at Swiss soil monitoring sites to date. Depending on the group of organism, we were able to assign 47.7-79.8% of these ASVs at the family level revealing that a large proportion of soil biodiversity remains still poorly characterized. Divergent diversity patterns were obtained for the five groups of organisms with bacteria and fungi revealing highest richnesses in permanent grassland soils, while soil arthropod communities were most diverse in forest soils. Significantly distinct community compositions among land-use types were found for all groups of organisms, and community compositions significantly correlated for all groups of organisms ( $\rho=0.44-0.79$ ). Consequently, all groups of organisms allowed discrimination of the different soil habitats, represented here by land-use types and sites. Taken together these results demonstrate the usefulness of multi-marker metabarcoding for biodiversity assessments in various soil habitats, and notably to monitor highly complex communities indicative for land-use type and site-specific environmental conditions. To profit fully from the potential of molecular tools, further development of curated reference databases of genetic sequences are however needed.

***Microbes Are Unique: Divergent Land-Use Effects on Microbial vs Animal and Plant Diversity***

**Annabel Silvia Lindley<sup>1</sup>**, Theresa Rzehak<sup>1</sup>, Nadine Praeg<sup>1</sup>, Sophia Kössler<sup>1</sup>, Julia Seeber<sup>2,3</sup>, Paul Illmer<sup>1</sup>

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<sup>3</sup> EURAC Research, Italy

Soil microbial diversity plays a key role in ecosystem functioning, yet it may follow different patterns than above-ground biodiversity, e.g. when responding to disturbances. The central objective of this study is to investigate the impact of land use on soil microbial diversity and the relationship between it and that of plants and animals.

The study examines soil microbial communities across South Tyrol, Italy, by integrating data from Eurac's Biodiversity Monitoring South Tyrol (BMS) with newly collected field data. Prokaryote and fungal diversity were assessed by high-throughput sequencing (16S rRNA and ITS). Statistical analyses explored relationships between soil microbial diversity, soil properties, and soil invertebrate, plant and grasshopper biodiversity across native, extensively managed and intensively managed landscapes.

Findings showed a disconnection between microbial and animal diversity across land-use intensities. Microbial and plant diversity were negatively associated, and prokaryote diversity was highest in intensively managed soils, challenging the idea that greater diversity indicates ecosystem health. Furthermore, plant and animal diversity appeared unrelated to microbial community composition, which varied distinctly across land-use intensities.

Soil microbial diversity responds to land use in complex and sometimes counter-intuitive ways, highlighting the need to further research and consider these responses in conservation, land management, and ecosystem modelling.

## POSTER PRESENTATIONS (sorted by ID)

**ID7**

### ***An extracellular eDNA approach to evaluate tillage effects on soil biodiversity across functional groups***

**Philippe Belliard<sup>1</sup>**, Nadine Praeg<sup>2</sup>, Oskar Rennstam Rubbmark<sup>1</sup>, Michael Traugott<sup>1</sup>

<sup>1</sup> Universität Innsbruck, Department of Zoology, Austria

<sup>2</sup> Universität Innsbruck, Department of Microbiology, Austria

Soil biota drive many of the essential soil functions that underpin soil-based ecosystem services that are indispensable for sustainable agriculture. The assessment of soil biodiversity is therefore crucial to understand the effects of agricultural management practices, such as tillage, on biological soil health. Molecular techniques such as environmental DNA (eDNA) metabarcoding are widely used to study soil biodiversity and have proven effective for microbial soil organisms. To extend their potential to soil fauna, methodological adaptations are needed, particularly to accommodate the larger body sizes and different eDNA distribution patterns associated with faunal organisms.

In this study, we use eDNA metabarcoding based on the extraction of extracellular DNA (exDNA) from larger volumes of soil to enable the simultaneous assessment of soil microbial and faunal diversity. We apply this exDNA approach to assess the functional diversity of belowground communities in agricultural soils subjected to different tillage intensities. Employing an integrated metagenomic and metabarcoding approach, we target multiple groups of organisms – bacteria, fungi, nematodes, annelids, and arthropods – that occupy vital roles within the soil ecosystem. Faunal taxa will be assigned to functional categories, such as trophic roles and earthworm ecological strategies, and will be used to derive bioindicators, including nematode-based indices, for assessing soil health. Similarly, microbial community analysis will target key functional groups including symbionts, pathogens, and saprotrophs as well as genes associated with nutrient cycling, organic matter decomposition and other soil functions.

This research will advance our understanding of tillage impacts on functional soil biodiversity. Thereby it will support the development of integrated biotic soil health assessment tools to guide farmers, researchers, and advisors in evaluating sustainable soil management practices.

Track: [Monitoring of Soil Life, Agricultural Practices, Soil Health](#)

## ID10

### ***Reciprocal transport of carbon and nitrogen between plants and microbes in the grassland hyphosphere***

**Ellen Kandeler<sup>1</sup>**, Luise Brandt<sup>1</sup>, Anna Abrahão<sup>2</sup>, Ann-Christin Wicht<sup>3</sup>, Stefanie Schulz<sup>3</sup>, Michael Schloter<sup>4</sup>, Sven Marhan<sup>1</sup>

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<sup>4</sup> Technical University of Munich, TUM School of Life Sciences, Germany

In the plant-arbuscular mycorrhizal fungi (AMF) symbiosis, the plant exchanges photosynthetically fixed carbon (C) for nutrients (e.g., nitrogen, N) acquired by the fungus. This C may be transferred via fungal exudates to bacterial communities in the AMF hyphosphere, which assist the fungus in nutrient acquisition by decomposing organic substrates. In addition, saprotrophic fungi play a role in plant C uptake by rapidly processing rhizodeposits and channeling them into the hyphosphere. However, which microbes benefit from plant-fixed C in the hyphosphere and the temporal dynamics of this C allocation remain unclear. We developed 'hyphoboxes' that separate the (mycor)rhizosphere from the hyphosphere with a 50 µm mesh. A substrate compartment containing root litter and <sup>15</sup>N-labeled urea was isolated within the hyphobox by an air gap to restrict colonization to fungi and their associated bacteria. Hyphoboxes were buried in soil (Leptosol) for three months at an experimental grassland plot of the Biodiversity Exploratories in south-west Germany to allow establishment of microbial communities. We then performed <sup>13</sup>CO<sub>2</sub> pulse labeling of the aboveground plant biomass and sampled hyphoboxes 1, 3, and 7 days after labeling to explore the temporal dynamics of C allocation to hyphosphere microbes. As expected, we observed a reciprocal transport of plant-derived <sup>13</sup>C into the hyphosphere and of urea-derived <sup>15</sup>N into plant roots. We further characterized hyphosphere microbial communities by amplicon sequencing. Our findings provide new insights into the complex interactions between plants, fungi, and bacteria in belowground nutrient cycling.

Track: **Interactions in Soil Ecosystems - Focus on soil fauna–microorganism–plant interactions, root microbiomes**

## ID11

### ***The effects of pesticides and their mixture on soil functional genes and bacterial taxa – A search for sensitive genes***

**Ellen Kandeler<sup>1</sup>**, Fabian Stache<sup>1</sup>, Franziska Ditterich<sup>1</sup>, Carolin Huhn<sup>2</sup>, Hans-Peter Piepho<sup>1</sup>, Jakub Hofman<sup>3</sup>, Paula Hakes<sup>4</sup>, Christian Poll<sup>1</sup>

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<sup>4</sup> Wageningen University & Research, Soil Physics and Land Management Group, The Netherlands

Pesticides can have adverse effects on soil microorganisms, but they are underrepresented in the currently required OECD 216 test for environmental risk assessment of plant protection products. To detect pesticide effects and to identify sensitive functional and taxonomic genes we conducted a microcosm experiment with different pesticides (1x herbicide, 2x fungicide, 1x insecticide). We hypothesized that (I) functional genes involved in nitrogen cycling react sensitively to the pesticides and (II) that the effects of fungicides (Tebuconazole and Azoxystrobin) on functional genes and bacterial taxa are more pronounced than the effects of the herbicide (Glyphosate) and the insecticide (Cypermethrin). We hypothesize that (III) that the mixture treatment has a higher impact on the bacterial community than the single applied pesticides. The pesticides were applied in the lowest (1x PEC) and highest (10x PEC) recommended testing concentration according to the predicted environmental concentrations (PEC) and a 1x PEC mixture of all four pesticides in 4 replicates per treatment. A sandy soil (LUFA 2.3, 80 g dw, 35% max. WHC) was mixed with Luzerne powder (0.4 g). The microcosms were incubated at 20 °C and destructive soil sampling was conducted at days 0, 7, 14, 28 and 56. A multivariate statistical approach (Principal Response Curves) was used to identify sensitive genes across all time points and irrespective of concentration. The presence of pesticides, regardless of their concentration, did not exert an effect on soil respiration. However, bacteria replaced archaea in the process of ammonium oxidation (amoA) at day 28 in Glyphosate treatments probably due to functional redundancy of the microbial community. The multivariate statistical approach identified specific microbial markers (Bacteroidetes, Acidobacteria, bacterial  $\beta$ -glucosidase encoding GH3 gene) which showed high sensitivity against all pesticide treatments. While others were less sensitive in general or more sensitive to certain pesticides (beta-Proteobacteria, Firmicutes, AOB, AOA).

Track: [Monitoring of Soil Life, Agricultural Practices, Soil Health](#)

**ID12**

***The LOESS Project: Understanding and Strengthening Soil (Health) Education in Europe***

**Lucas Weinberg<sup>1</sup>, Suzanne Kapelari<sup>1</sup>, Lena Warrelmann<sup>1</sup>**

<sup>1</sup> Universität Innsbruck, Austria

Our soils face multiple challenges resulting from unsustainable land management practices and the impacts of climate change. Yet, soil and soil health education remain underrepresented in European curricula. The LOESS project (Literacy boost through an Operational Educational Ecosystem of Societal actors on Soil health), part of the EU Mission “A Soil Deal for Europe,” aims to bridge this gap by mapping existing educational resources, engaging diverse stakeholders through Communities of Practice (CoPs), and assessing the current level of soil-related knowledge across educational levels.

LOESS investigates educational needs among educators, learners, and the wider public across Europe. Based on these findings, the consortium of 20 partner institutions has developed courses for educators and the general public, as well as modules, materials, and digital tools for soil and soil health education. These resources address different educational stages while linking soil topics to global and local challenges such as climate change, biodiversity loss, and the Sustainable Development Goals, thereby strengthening soil literacy.

Furthermore, LOESS develops and tests pedagogical strategies that foster knowledge exchange between educators and learners and across diverse knowledge systems. Project activities take place in 16 countries, guided by principles of Community Engaged Research and Learning (CERL). To close the awareness gap, LOESS also organises campaigns and events to promote knowledge exchange, disseminate results, and enhance uptake, while providing recommendations and capacity-building measures for improved soil literacy.

This contribution presents key findings from the mapping process and provides insights into the educational resources and tools developed within the project.

Track: Science Communication and Open Topics

ID15

***Carbon Inventory South Tyrol (CIS): Quantifying and Assessing Soil Organic Carbon Stocks in Alpine Agricultural Landscapes***

**Alexander Schönafinger<sup>1</sup> & Georg Niedrist<sup>1</sup>**, Oussama Bouaicha<sup>2</sup>, Lorenz Stefan Hänchen<sup>3</sup>, Damiano Zanotelli<sup>2</sup>, Georg Wohlfahrt<sup>3</sup>, Massimo Tagliavini<sup>2</sup>, Tanja Mimmo<sup>2</sup>

<sup>1</sup> Eurac Research, Italy

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<sup>3</sup> University of Innsbruck, Austria

The Carbon Inventory South Tyrol (CIS) project addresses the urgent need for regional-scale assessments of soil organic carbon (SOC) stocks in agricultural landscapes, aligning with the European Union's climate neutrality targets for the land use, land-use change and forestry (LULUCF) sector by 2035. Focusing on the mountainous region of South Tyrol, Italy, CIS aims to quantify SOC stocks and assess their stability across diverse agricultural land uses, including grasslands, arable land, orchards, and vineyards.

The project employs a spatially explicit SOC mapping (SOCM) approach using machine learning techniques. This methodology integrates over 34,000 georeferenced soil data records from literature, institutional databases, and field surveys, covering more than 19,000 locations. Key parameters are SOC content, bulk density, and coarse fragment volume, which are essential for accurate stock modelling. Spatial covariates such as land use, topography, geology, and climate are used to predict SOC distribution and identify data gaps.

Preliminary results indicate that alpine grasslands and extensively used meadows exhibit the highest SOC levels, while intensively managed arable land and permanent crops show lower stocks. To address spatial uncertainties and gaps—particularly in remote and high-altitude areas—targeted field campaigns are underway. Additionally, the project incorporates CO<sub>2</sub> flux measurements using Eddy Covariance towers to evaluate the temporal stability of SOC and the role of land uses as carbon sinks or sources.

CIS is a collaborative effort led by Eurac Research in partnership with the University of Bozen-Bolzano and the University of Innsbruck. The project's outcomes will support evidence-based land management and carbon farming strategies, contributing to regional climate mitigation efforts and the broader EU Green Deal objectives.

Track: [Soil Ecosystem and Landscape Dynamics](#)

**ID16**

***Effects of tillage intensity and cover crops on soil health parameters and yield***

**Niklas Bruhn**<sup>1</sup>, Johannes Bartmann, Gernot Bodner, Katharina Keiblinger, Christoph Rosinger, Martin Schneider

<sup>1</sup> Universität für Bodenkultur Wien (BOKU), Austria

This study examines the effect of reduced tillage and cover cropping on key biochemical soil health parameters and yield stability. Therefore, various parameters important for soil health were examined, such as water balance, aggregate stability, humus and nitrogen content, microbial biomass and enzyme activity. In addition, yield and resulting revenue of the main crops cultivated since 2007 were determined.

In general, reduced tillage significantly improved soil health compared to conventional plowing. Due to the relatively short cultivation period of about two years, cover cropping, as expected, was no significant factor yet. Lower yields were only observed for direct seeding. Therefore, minimal tillage variants using a cultivator and disc harrow represent realistic alternatives to traditional plowing.

Track: [Monitoring of Soil Life, Agricultural Practices, Soil Health](#)

**ID18**

***From Rock to Root: Mineral weathering and nutrient dynamics in mountain forest soils***

**Simon Wagner<sup>1</sup> & Alois Simon<sup>1</sup>, Salim Belyazid<sup>2</sup>, Lisa Bischofer<sup>3</sup>**

<sup>1</sup> Amt der Tiroler Landesregierung, Abteilung Forstplanung, Austria

<sup>2</sup> University of Stockholm, Department of Physical Geography, Sweden

<sup>3</sup> Office of the Tyrolean Government, Department of Forest Planning, Austria

Mountain forest soils are key to nutrient cycling, carbon sequestration, and water regulation, yet their resilience under climate change remains uncertain. The SWIFT (Soil Weathering Rates in Forests) project examines interactions between mineral weathering and organic matter turnover across climatic and geological gradients in Tyrolean mountain forests. Using the process-based ForSAFE model and field data, SWIFT quantifies nutrient replenishment from weathering and organic matter transformation. The model is applied for the first time to Austrian forest soils, supported by detailed mineralogical, geological, and humus data from the Tyrolean Forest Site Classification project.

In comparisons between siliceous and calcareous sites, field measurements at calcareous sites revealed higher pH values in the ecto-organic humus layer than predicted by the model after fitting to current base saturations values. This discrepancy suggests that certain processes influencing soil solution chemistry may not be fully represented in the current ForSAFE parameterisation. This could be due to the representation of humus decomposition and organic acid dynamics within the decomposition module. Predictions were more accurate at pure calcareous sites, suggesting greater deviations when organic matter turnover and mineral weathering interact more complexly. Additional factors influencing the model outcome could be underestimated nutrient cycling via litter fall, unaccounted base cation inputs from atmospheric deposition, or enhanced biological activity and bioturbation. To evaluate the potential drivers, we performed ForSAFE simulations using parameter settings accounting for variations in foliage nutrient content, tree species admixture, and atmospheric base cation deposition.

The SWIFT modelling framework integrates geochemical and biological data with field experiments, ensuring consistent nutrient budgets and refined assessments of weathering contributions to tree nutrition across contrasting site conditions. This integrated approach strengthens understanding of nutrient dynamics and soil resilience in mountain forests, supporting climate-smart forest management.

Track: [Soil Ecosystem and Landscape Dynamics](#)

## **ID21**

### ***Mission: Soil Possible – Austria’s SoilBlitz on Soil Health***

**Sophia Götzinger**<sup>1</sup>, Peter Hoebe<sup>2</sup>, Amy Nieuwenstein<sup>2</sup>, Anna Paier<sup>1</sup>, Taru Sandén<sup>1</sup>, Fraukje Steffen<sup>2</sup>

<sup>1</sup> AGES, Research Soils and Agroecology, Department for Soil Health and Plant Nutrition, Austria

<sup>2</sup> Earthwatch Europe, Oxford, UK

Healthy soils are essential for sustaining ecosystems, agriculture, and human well-being—yet approximately 60% of soils are currently classified as unhealthy. As part of the Austrian Citizen Science Award 2025, the SoilBlitz Austria initiative empowered over 700 students across Austria to actively assess soil health using simple, hands-on methods (Soil Health Toolkit).

Between April and July 2025, students evaluated five key indicators: soil texture, colour, water infiltration rate, earthworm presence, and vegetation cover. To ensure consistent and independent implementation, teachers participated in train-the-trainer workshops introducing all methods and materials. Data at 397 locations was collected via a mobile app, documented, and scientifically validated. Students received immediate feedback and educational info cards summarising their results.

SoilBlitz Austria contributes to the development of harmonised soil health indicators within the Horizon Europe project BENCHMARKS, while fostering environmental awareness and motivation among young participants.

This initiative was carried out in collaboration with Earthwatch Europe, AGES – Austrian Agency for Health and Food Safety, OeAD – Austria’s Agency for Education and Internationalisation, and the Austrian Federal Ministry for Women, Science and Research. All materials and results are publicly accessible at [www.ages.at/soilblitz](http://www.ages.at/soilblitz) and [www.farming.earthwatch.org.uk/pages/soil-blitz-osterreich](http://www.farming.earthwatch.org.uk/pages/soil-blitz-osterreich).

Track: Science Communication and Open Topics

**ID23**

***Österreichische NIR-Bodenspektralbibliothek zur Bewertung von Bodengesundheit***

**Julia Fohrafellner<sup>1</sup>, Maximilian Lippl<sup>1</sup>, Armin Bajraktarevic<sup>1</sup>, Andreas Baumgarten<sup>1</sup>, Heide Spiegel<sup>1</sup>, Robert Körner<sup>1</sup>, Taru Sandén<sup>1</sup>**

<sup>1</sup> AGES – Austrian Agency for Health and Food Safety, Vienna, Austria

Der steigende Bedarf an Bodendaten und -informationen erfordert schnelle und kostengünstige Methoden zur Quantifizierung von Bodenparametern. Dies ist insbesondere im Kontext der Wiederherstellung der Bodengesundheit in Europa von hoher Relevanz. Die Nahinfrarot-Spektroskopie (NIR) hat sich als fähig erwiesen, bestimmte Bodenparameter mit hoher Genauigkeit vorherzusagen, während sie weniger kosten- und zeitintensiv ist als traditionelle Labormethoden.

Um Lücken in nationalen spektroskopischen Bodendaten zu schließen, haben wir die erste österreichische NIR-Bodenspektralbibliothek (680-2500 nm) auf Basis von Archivproben (n = 2129) erstellt, die alle pedoklimatischen Zonen Österreichs abdeckt. Anschließend haben wir eine Modellierung mittels partieller kleinster Quadrate (PLSR) durchgeführt, um die Nutzbarkeit des Datensatzes zur Bewertung von Bodenparametern im aktuellen Stadium zu testen.

Unsere Analyse zeigt, dass die österreichische NIR-Bodenspektralbibliothek derzeit nicht geeignet ist, die meisten der 14 untersuchten Bodenparameter mittels PLSR mit ausreichender Genauigkeit vorherzusagen. Dennoch lieferten das Modell für Gesamtstickstoff, CaCO<sub>3</sub>, organischer Kohlenstoff und Tongehalt zufriedenstellende Ergebnisse ( $R^2 > 0,7$ ).

Der Datensatz, bestehend aus Metadaten (z. B. Landnutzungstyp, pedoklimatischen Zonen oder Postleitzahl), Laborreferenzwerten und NIR-Spektren mit 1-nm-Auflösung, kann als Grundlage für weitere spektroskopische Analysen und Modellierungen genutzt werden. Wir stellen diese Arbeit öffentlich zur Verfügung, um aktiv zur Schließung von Bodendatenlücken beizutragen und die Erweiterung von Spektralbibliotheken als Basis für Bodengesundheitsbewertungen zu fördern.

Track: [Soil Ecosystem and Landscape Dynamics](#)

ID28

***Exploring Deposition Patterns and Sediment Characteristics of Dirty Snow Avalanches Using Structure-from-Motion Photogrammetry***

**Magdalena Koschmieder<sup>1</sup>, Johanna Mascher<sup>1</sup>, Arnaud Temme<sup>1</sup>**

<sup>1</sup> Universität Innsbruck, Department of Geography, Austria

Gravitational mass movements and hydrological processes erode material on hillslopes and transport it to areas of deposition. By doing so, they contribute to soil formation and shape landscapes on different time scales depending on their magnitude and frequency. Among these processes are debris flows and rainfall runoff, but also full-depth avalanches. In this case, it is not the material itself that moves, but it is rather the snow cover that can collect sediment as it glides over the ground. Avalanches that erode, transport, and deposit sediments are referred to as “dirty snow avalanches”.

While conventional field methods, such as snow sampling and mapping deposits on printed aerial images, have been applied to estimate the amount of soil erosion by dirty snow avalanches, the specific patterns of deposition they produce remain poorly quantified.

This study aims to bridge this gap by applying Structure-from-Motion photogrammetry in order to create Digital Elevation Models (DEM) of difference and map areas of deposition more accurately. Furthermore, snow sampling was employed to directly quantify the sediment volume transported by the avalanches as well as the sediment’s characteristics. Additionally, we analysed soil profiles at avalanche sites during the summer season to gain a deeper insight into the long-term impact of avalanches on soil development.

We present the results from the avalanches observed and sampled in the first season. This includes comparisons of DEMs of the time soon after the event and when the avalanche has melted. The soil profile analyses will be explored in future work to complement our understanding of sediment transport and soil development processes in avalanche areas.

Track: [Soil Ecosystem and Landscape Dynamics](#)

**ID30**

***As Glaciers Recede, Soils Emerge: Modelling the Dynamics of Proglacial Soil Formation***

**Sophie Barbara Stoffl<sup>1</sup>, Alessia Giarola<sup>1</sup>, Arnaud Temme<sup>1</sup>**

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Proglacial areas offer valuable insights into soil development in alpine environments as glaciers retreat due to climate warming, exposing new bedrock and initiating soil formation. These areas are dynamic, with soil development influenced by glacial retreat, erosion, topography and geomorphic processes. Understanding these processes is crucial for predicting soil evolution in alpine landscapes under climatic changes. Until now, our understanding has been based on point-specific soil samples in glacial forefields, but to gain a broader perspective, we aimed to simulate soil formation across entire areas.

We developed a new version of the soil and landscape evolution model LORICA, which integrates geomorphic and soil-forming processes, to simulate dynamic soil development in a proglacial area. This development incorporates a map of glacial extents since the Little Ice Age, enabling simulation of soil formation as the glacier retreats and soils progressively emerge. The model was applied to the Bachfallenferner study site in Tyrol, Austria, where both existing and self-collected soil samples were used as inputs.

Key processes in the proglacial mode include water erosion and deposition, physical and chemical weathering, clay dynamics, and carbon cycle, with parameters adjusted for glacier forefield conditions. The model also accounts for glacier-derived meltwater effects on soil development. Validation was performed using separate soil samples from Bachfallenferner to ensure independent testing.

This open-source modelling framework, validated using field data, proved promising in simulating how soils evolve in a fast-changing proglacial environment.

The approach complements traditional soil-sampling by providing a comprehensive, area-covering representation of soil formation. It is the first mechanistic model to simulate the successive development of soils in a glacier forefield, enhancing our understanding of soil dynamics in rapidly changing alpine proglacial environments.

Track: [Soil Ecosystem and Landscape Dynamics](#)

**ID31**

***Thermophilic Compost vs. Vermicompost: Contrasting Habitats for Predatory Protists***

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Protists are a diverse and integral part of the soil microbiome, acting as major consumers of other soil microorganisms. While they are an important part of the soil food web, they have been a blind spot in soil and compost microbiome research. This study is set out to investigate differences in taxonomic composition, diversity, functional traits and co-occurrence networks of Cercozoa, the dominant phylum of soil protists. Specific primers and amplicon sequencing were used to study Cercozoa in Thermophilic Compost, Vermicompost and agricultural soils that underwent application of Thermophilic Compost compared to soils without compost application.

Results showed that Thermophilic Compost and Vermicompost harbor distinct Cercozoan communities in terms of dominant and indicative taxa and functional group composition. Thermophilic Compost exhibited a higher relative abundance of Cercozoa that prey on bacteria, while Vermicompost was dominated by taxa that prey on eukaryotes (fungi, algae, other protists and nematodes). The composts did not differ in relative abundances of plant parasites or autotrophs. Moreover, compost type had a significant effect on morphology and cell size of the communities: Thermophilic Compost was dominated by small taxa with amoeboid/flagellate morphology, while the Vermicompost was dominated by large taxa with testate morphology. Cercozoan co-occurrence networks were more complex and connected in the Vermicompost soil, further highlighting differences in community structure. An indicator taxa analysis revealed that the application of Thermophilic Compost had a spillover effect on to the market gardening soil, which resulted in distinct community from the non-treated agricultural soils and Vermicompost.

Results of this study provide a first look into the function and structure of Cercozoa in composts, showing differences in soil food web players and the effect of composting on soil microbiomes of a previously elusive phylum of protists.

Tracks: [Monitoring of Soil Life](#), [Agricultural Practices](#), [Soil Health](#)

**ID33**

***The Evaluation of Citizen Science: A Case Study on the SoilPlastic App***

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Plastic pollution in soils is an environmental threat yet underexplored compared to marine ecosystems. Citizen Science (CS) can help fill this gap and engage the public. The SoilPlastic App allows users to record observations and photos of visible soil plastic. This thesis evaluates its use in the “Bunter Boden” project. The study had three objectives: (1) Determine if “Bunter Boden” data map plastic types, distribution, and quantities in soils, especially agricultural plastic. (2) Measure participants’ self-reported individual learning outcomes (ILOs) and demographic differences. (3) Capture teachers’ perspectives on implementation and students’ ILOs. Over 6,000 validated observations were collected, mainly from students. Results showed an urban bias: most plastics recorded were urban litter, while agricultural plastics and rural land uses were underrepresented. ILOs analysis (mixed methods) indicated positive learning gains overall, with significant gender and school-type differences: female students reported higher motivation for future environmental engagement and stronger pro-environmental behaviour than male students, and Polytechnical students reported lower pro-environmental behaviour than “Neue Mittelschule” students. Methodological challenges included data loss due to validation protocols, reliance on self-reports, low teacher participation, and competition-induced biases that affected data quantity and participant motivation. These findings demonstrate that well-designed CS projects can generate valuable environmental data and foster learning. However, targeted strategies—such as incentivising agricultural-site sampling, improving data verification methods, and enhancing teacher involvement after the project—are needed to address urban sampling bias and strengthen ILOs assessment. Concentrating limited resources on clear goals, whether maximising data quality or educational impact, may improve the effectiveness of future CS initiatives.

**Track:** [Monitoring of Soil Life, Agricultural Practices, Soil Health](#)

**ID35**

***Plant–Soil–Geomorphology Interactions in a Recently Deglaciated Alpine Valley (Sulden, Italy)***

**Zarah van Hout<sup>1</sup>, Wouter den Ouden<sup>1</sup>**

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Rising temperatures are accelerating the deglaciation of the Alps' glaciers, driving rapid changes in high-alpine environments. The retreat of large ice masses since the Little Ice Age has resulted in the expansion of proglacial areas throughout the region. Following this initial retreat, processes such as weathering, erosion, and the establishment of vegetation have contributed to the development of soils. While chronosequence studies have demonstrated that time since deglaciation is a key factor influencing soil development, geomorphology and vegetation establishment are increasingly recognised as equally relevant factors.

This study investigates the relationship between soil development, vegetation establishment, and geomorphic setting within a proglacial valley near Sulden, Italy. Fifty-three sampling points were recorded across an area of 2.6 km<sup>2</sup>, spanning from the glacier's maximum extent in 1818 to its current position. Field observations included an assessment of geomorphological processes as well as vegetation composition and coverage, while soil pH, organic matter, and carbon and nitrogen concentrations were measured from samples.

Preliminary results suggest that geomorphology, vegetation, and soil properties influence one another through complex interactions. Vegetation appears to accelerate organic matter accumulation and surface stabilisation, while geomorphic stability and soil chemistry, in turn, promote further plant establishment and diversification. The strength and direction of these plant–soil–geomorphology feedbacks remain under investigation, but early indications highlight their potential role in shaping alpine landscape evolution following deglaciation.

Track: [Monitoring of Soil Life, Agricultural Practices, Soil Ecosystem and Landscape Dynamics](#)

ID36

***Soil biodiversity monitoring of earthworms and enchytraeids across land-use types using DNA metabarcoding***

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Lumbricidae (earthworms) and Enchytraeidae (enchytraeids) are key soil animals that drive biogeochemical cycling and maintain a favorable soil structure. Traditional morphology-based assessments of these oligochates are time-consuming and require scarce taxonomic expertise, limiting scalability for large-scale biodiversity monitoring. Soil DNA metabarcoding offers a robust alternative, enabling rapid, non-invasive community profiling directly from bulk soil. Using mitochondrial 16S gene fragments and curated genetic reference databases, we assessed the diversity and community structure of earthworms and enchytraeids across 29 sites of the Swiss Soil Monitoring Network spanning three land-use types: arable land, grassland, and forest. Diversity and composition of both groups were strongly structured by soil physicochemical properties—especially pH—alongside climatic variables. Interestingly, earthworm alpha-diversity showed negative associations with total soil carbon and the carbon-to-nitrogen ratio, indicating sensitivity to organic matter regimes and nutrient stoichiometry. Indicator species analyses identified land-use-characteristic taxa including *Aporrectodea icterica*, *Lumbricus rubellus*, *Marionina communis*, *Fridericia bisetosa*, and *Fridericia connata* which were associated with grassland. *Allolobophora chlorotica*, *Enchytraeus dichaeus*, *Achaeta iberica*, *Protdrilus antipae*, and *Fridericia tuberosa* were associated with arable land and, *Octolasion cyaneum*, *Octolasion lacteum*, and *Cognettia chlorophila* with forest soils. We note that although individual indicator taxa have limited predictive value for broad-scale biodiversity responses to land-use change, together they clearly delineate community turnover across land-use types. In this regard, soil DNA metabarcoding stands out as a scalable and cost-effective approach for tracking soil macro- and mesofaunal diversity and informing land management. Nevertheless, ongoing curation and regionalization of genetic reference databases will be essential to improve taxonomic resolution and assignment accuracy for earthworms and enchytraeids through soil DNA.

Track: [Monitoring of Soil Life, Agricultural Practices, Soil Health](#)

ID39

***Correlation of DGT-P and conventional soil P tests with rye shoot biomass and P uptake across temperate soils with differential soil properties***

**Alireza Golestanifard**<sup>1,2</sup>, Markus Puschenreiter<sup>1</sup>, Robert Manglberger<sup>1</sup>, Marion Gotthard<sup>2</sup>, Herbert Eigner<sup>3</sup>, Bernhard Spangl<sup>4</sup>, Walter W. Wenzel<sup>1</sup>, Jakob Santner<sup>2,5</sup>

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Several phosphorus extraction methods have been implemented as soil P tests, but many studies have shown that correlation of extractable P with plant shoot biomass and P uptake is varying and sometimes poor. Novel infinite sink extraction methods like diffusive gradients in thin films (DGT) technique, may be superior in estimating plant P availability. Thirty arable soils in a wide range of soil groups were tested for soil characteristics, total and extractable P pools. Rye was grown for six weeks on these soils and analysed for shoot biomass and P concentrations in shoot. The relation between soil P and shoot biomass was fitted with the non-linear Mitscherlich function. Different soil P pools showed significant correlations with soil pH, texture and amorphous Fe oxide. High and significant correlations were also found among most of extractable soil P pools, with the remarkable exception of the calcium acetate lactate (CAL)-extractable P. In contrast to the previous studies in highly weathered soils with strongly adsorbed P, our results show, that for temperate soils with lower P buffering capacity, DGT-extractable P did not perform better than the best-performing conventional equilibrium-based extraction methods in correlating with plant available P and uptake, likely because water availability was not a limiting factor of P diffusion in our controlled pot experiment. We found that plant-available P in our experimental soils was in general rather quantity based (i.e. dominated by the amount of adsorbed P) than intensity-based (i.e. dominated by the soil solution P and its resupply by desorption). We conclude that the advantage of DGT technique over conventional chemical equilibrium-based approaches becomes less apparent when water availability is not a limiting factor of P diffusion and if P is not strongly intensity-controlled.

Track: [Soil Biology & Soil Functions - Focus on processes, functions, and methodological innovations](#)

**ID42**

***Learning approaches to enhance soil literacy and engagement***

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Soils are among the most vital yet undervalued components of the Earth's system - they sustain food production, regulate water and climate, store carbon, and support biodiversity. Yet more than 60% of European soils are considered unhealthy, highlighting the urgent need to strengthen soil literacy across society.

Our activities aim to enhance soil literacy, which is understood as the combination of knowledge, attitudes, and actions that enable responsible interaction with soil, among a wide range of stakeholders: teachers, students, policy makers, practitioners, and citizens. Through hands-on learning formats such as field workshops, school collaborations, and citizen science, complemented by digital tools like e-learning modules and interactive media, we strive to make soil science accessible, engaging, and relevant.

Beyond individual initiatives, our goal is to connect Austrian and European networks that promote soil awareness, education, and sustainable management. These efforts contribute to the objectives of the EU Soil Mission and Austria's national strategy for healthy soils and waters.

By combining scientific expertise with innovative communication and education formats, we aim to build a lasting community of practice that fosters informed and active stewardship of soils as a foundation for resilient ecosystems and societies.

Track: Science Communication and Open Topics

**ID43**

***Empowering Stakeholders to Drive Farming System Transition: Conversations on Agroecology***

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AGROECOLOGY, the European Partnership "Accelerating Farming Systems Transition: Agroecology Living Labs and Research Infrastructures," is a significant European research and innovation initiative involving the European Commission and 26 Member States, Associated Countries, and Third Countries, with a total of 72 partner organizations. The goal of AGROECOLOGY is to assist the agricultural sector in addressing the challenges of climate change, biodiversity loss, food security and sovereignty, and environmental sustainability, while ensuring agriculture remains profitable, sustainable, and attractive to farmers.

Transforming the agricultural sector to meet societal and policy demands requires bold and systemic changes. AGROECOLOGY fosters solutions that leverage natural and biological processes, blending state-of-the-art science, technology, and innovation with farmers' knowledge. By pooling resources from the European Commission and the involved member states and regions, the Partnership funds high-level research in Living Labs and Research Infrastructures, co-creating relevant knowledge and technologies aligned with the priorities of the Strategic Research and Innovation Agenda for the Farming System Transition.

To support these efforts, a range of activities is being implemented to inform, engage, and empower stakeholders. These activities aim to enhance capacities, raise awareness, and facilitate the exchange of knowledge and data. A key element of this effort is the Conversations on Agroecology which serve as foundational steps to strengthen agricultural knowledge and innovation systems (AKIS) for agroecology. These conversations foster collaboration and connections between Living Labs, Research Infrastructures and stakeholders across Europe.

The online Conversations on Agroecology are held monthly throughout the Partnership, enabling the mobilization and networking of agroecology actors in Europe and beyond. In 2024 and 2025, fourteen online conversations have already been organized on various themes, such as the role of AKIS for agroecology, agroecological transition, and the power of networks for agroecology. Through these monthly conversations, AGROECOLOGY engages diverse groups of actors, ensuring active involvement of institutional AKIS actors, farmers, and farming networks to ensure inclusive participation and drive progress toward sustainable food systems by 2030.

Track: Science Communication and Open Topics

**ID44**

***Combining historical data with field experiments to quantify element fluxes from Alpine forest ecosystems to agricultural land based on historical forest use practices***

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In the past, forests in Central Europe were used for more diverse purposes than they are today. Forest utilisation practices such as litter raking and lopping were widespread and practiced until the middle of the 20th century. Litter raking and the lopping of coniferous trees were both practised by the farmers to produce bedding material for their animals. The mixture of excrements and forest bedding material was later used as fertiliser for the fields. In total, a lot of material and thus carbon and nutrients were transferred through these practices from the forest into the agricultural system.

In Tyrol, detailed inventories of the forests were carried out around 1840, containing various information about the forest condition and management. Timber stocks, annual timber increment and harvest quantities were recorded, but also the annual amounts of biomass removed through litter raking and lopping. The recordings are accompanied by corresponding maps, that enable a clear spatial allocation of this information.

In order to investigate the ecological consequences of litter raking, field experiments were carried out on two test sites in the montane and subalpine altitudinal zones in Tyrol. To enable a differentiated quantification of the carbon stocks, ground vegetation, organic layers and mineral soil were sampled on random distributed sampling points. Additionally, we conducted a onetime litter raking intervention on randomly distributed 1 m<sup>2</sup> plots. We determined the weight of the removed organic material in the field and took subsamples to analyse carbon and nutrient content.

Combining historical inventory data with results from the field experiments and laboratory analyses enables a quantification of the historical element fluxes from forest to agricultural ecosystems. This transfer of significant quantities of organic material over centuries has strongly influenced both ecosystems for a long time with impacts persisting until today. These new data improve our understanding of the impacts of historical forest management in favour of agriculture on recent forest condition and provide background information for current sustainable forest management decisions.

Track: [Monitoring of Soil Life, Agricultural Practices, Soil Health](#)

**ID46**

***Identifying potentially drained agricultural soils and revealing their role in landscape water dynamics***

**Katharina Fischer<sup>1</sup>**, Irene Schwaighofer<sup>1</sup>, Thomas Brunner<sup>1</sup>, Abobakr Hussin<sup>1</sup>, Peter Strauss<sup>1</sup>, Thomas Weninger<sup>1</sup>

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Artificial drainage systems were historically installed to secure food supply and improve agricultural productivity by removing excess water from poorly drained soils. Present challenges like climate change and other ecological threats put pressure on these drained ecosystems. While effective for food productivity, drainage systems fundamentally alter soil hydrological regimes and can reduce ecosystem functions such as water storage, buffering capacity, and connectivity to groundwater.

Despite their relevance for soil processes, microbial activity, and biogeochemical cycling, the spatial extent of drained agricultural soils in Austria remains largely unknown. This study presents a GIS-based approach to predict potentially drained soils in Lower Austria through a weighted overlay of soil, topographic, and land use indicators (e.g., soil type, topographical wetness index, land use intensity). The weights are derived from feature overrepresentation in known drained areas. The resulting probability map identifies soils that are likely affected by artificial agricultural drainage.

These areas are then connected to data representing key soil hydraulic properties, such as air capacity, to estimate how much water may be discharged through drainage. The aim is to derive a simplified water balance at both landscape and regional scale to better understand how agricultural drainage influences the overall water cycle. This approach contributes to a broader understanding of how altered soil moisture regimes influence ecosystem functions and supports future modelling and interdisciplinary assessment of drained landscapes.

Track: [Soil Ecosystem and Landscape Dynamics](#)

**ID47**

***Geospatial data for advanced understanding of soil and landscape water balance***

**Irene Schwaighofer<sup>1</sup>**, Thomas Brunner, Stefan Forstner, Thomas Weninger

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Soil properties vary across diverse landscapes, reflecting complex interactions between environmental factors. Understanding these relationships is crucial for assessing ecosystem functions, carbon dynamics, and sustainable land use practices. Addressing the need for nationwide digital soil mapping and environmental modelling approaches, we developed a harmonized set of 181 raster covariates for Austria based on the SCORPAN framework. The dataset integrates information from various sources, including climate grids, soil surveys, geological and land cover maps, vegetation indices, and terrain derivatives derived from digital elevation models (DEMs). Each covariate was standardized to a common spatial reference and produced at 10, 25, and 100 m resolution, enabling multi-scale analyses across diverse environmental gradients. Automated and reproducible workflows in SAGA GIS, ArcGIS Pro, and R were developed and documented to ensure methodological consistency and interoperability. While a large part of the data sets are already freely accessible, the DEM derived part of the data will be published through a public repository to support transparent and reproducible geospatial analyses across research and practice. This comprehensive environmental predictor database provides a robust foundation for spatial modelling tasks such as wetland mapping, soil carbon estimation, biodiversity assessment, and land restoration planning. As a first demonstration application, an ongoing assessment of the probability of peat soil occurrence all over Austria is introduced.

Track: [Soil Ecosystem and Landscape Dynamics](#)

***Soil and genotype driven root exudation patterns in barley, faba bean, potato, and sweet potato***

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Exudate-driven rhizosphere processes are known to support key plant functions, including improved nutrient acquisition, enhanced water uptake, and the recruitment of beneficial microbes. Many studies investigated root exudation under abiotic stresses and have often associated increased exudation rates with improved plant resilience. However, our understanding of species and genotype specific exudation dynamics as well as the effect of soil type on exudation patterns, even under non-stress conditions, is still limited.

Therefore, this study assessed the effects of soil and genotype on exudate quality and quantity in three well-established crop species—barley (*Hordeum vulgare*), faba bean (*Vicia faba*), potato (*Solanum tuberosum*)—as well as in one emerging European crop, sweet potato (*Ipomoea batatas*). Four genotypes of each crop were grown in pots in three different European soils under controlled, stress-free conditions. Root exudates were collected using a soil-hydroponic-hybrid approach. In addition, shoot and root samples were collected for the analysis of biomass and root morphology. Total dissolved carbon and nitrogen concentrations were assessed with a liquid TOC analyser. Sugars, amino acids, and phenolic compounds were spectrophotometrically analysed. We hypothesized that (i) irrespective of crop species investigated, root exudation rates differ between genotypes and depend on soil type and that (ii) also, under stress-free growth conditions, exudation rates correlate positively with plant biomass production.

Results showed that soil type and genotype affected exudation patterns, but their influence varied by crop. Unexpectedly, plant growth was negatively correlated with exudation rates for most crops, likely reflecting a trade-off in carbon allocation between exudates and biomass accumulation. Root morphological traits partly correlated with root exudation rates, but no universal relationship between those traits and exudation was detected across the crops. Our results provide novel insights into belowground resource partitioning and expand the knowledge of soil- and genotype-specific root exudation patterns to previously underexplored crop species.

Track: Interactions in Soil Ecosystems - Focus on soil fauna–microorganism–plant interactions, root microbiomes

ID49

***Identifying drivers of earthworm diversity in arable land using citizen science***

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Earthworms play a key role in the soil ecosystem, but soil tillage can reduce earthworm numbers. However, the specific effects of soil tillage depth and frequency have not yet been sufficiently studied. Therefore, the following research questions arise: (I) What is the impact of soil tillage depth and frequency compared to machinery type such as plough, cultivator, disc harrow? (II) What is the impact of precipitation, soil type and soil texture in this context? To answer these questions, the SoilRise project (2024-2027) will use a citizen science approach to collect on-farm data such as earthworm parameters, soil properties and management practices. SoilRise uses a scheme with student and volunteering mentors to support citizen scientists in their sampling efforts and assist with earthworm identification. A total 153 sites were sampled in the categories of: Arable land (93 sites), Grassland/Meadow (36 sites) and Garden (24 sites) with 1606 adult earthworms of 26 species. The 26 species were already recorded for Austria plus *A. noctura* which was not listed in the definitive identification key of Christian and Zicsi (1999). Preliminary results from Arable fields in Austria, from autumn 2024 and spring 2025, indicate that tillage depth and frequency affected the community structure and reduced abundance of earthworms. The most abundant species on Arable land were *Aporrectodea caliginosa*, *A. rosea*, and *Allolobophora chlorotica*, found at 81, 79, and 23 sites, respectively. Results from tillage depth × precipitation showed an interaction and suggested that earthworm abundance is more dependent on shallow tillage (0-10 cm) in annual precipitation categories < 570 and 570-900 mm than > 900 mm. However, the results suggest that tillage depth may have a higher impact on earthworms than tillage machinery type, and this should be considered in future research.

**Tracks:** [Monitoring of Soil Life](#), [Agricultural Practices](#), [Soil Health](#)

**ID50**

***MIKRO MESO MAKRO***

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The “MIKRO-MESO-MAKRO” project aims to teach school students about soil biodiversity. Innovative educational methods are used to achieve this. Workshops, experiments, and field trips provide age-appropriate, practical, and interconnected food for thought for children and young people on the interrelationships of soil. The focus is on food production, compost production, and the role of soil biodiversity in this process. So-called “living environments” are created. Research questions are formulated and experiments carried out for each living environment (worm boxes for MACRO, composters for MESO, and root boxes for MICRO). These living environments are maintained by the students with the support of their teachers throughout the project period. Instructions and a project calendar are created for each group and explained on the day of the event. The project is being implemented in selected schools in Vienna. The overarching goal is to develop an exciting teaching concept, which, including the tasks and documents developed in the project, will be made available on an internet platform for both elementary schools and lower secondary schools, and thus be used in as many schools as possible in the future.

Track: Science Communication and Open Topics

**ID52**

***Effects of reduced air pressure on soil fungi***

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Alpine ecosystems are exposed to faster temperature changes than the global average and are strongly affected by climate change. Organisms in mountain systems are forced to adapt to warmer conditions or to move upwards, to maintain their thermal niche. As organisms move upwards, several physical parameters change: CO<sub>2</sub> concentration decrease, UV radiation increase and, of course, air pressure decrease. Atmospheric pressure is an often-overlooked abiotic factor that is known to affect plant physiology whereas the impact on soil microorganisms is not known so far. Thus, the present study aims to investigate the effect of reduced air pressure on the growth and secondary metabolite production of selected soil fungi.

A selection of seven fungal isolates were cultivated under controlled pressure conditions at 600 mbar corresponding to 2,500 meter above sea level (m a.s.l.) and compared with standard conditions of 570 m a.s.l. corresponding to a mean pressure of 1,020 mbar. Growth parameters of fungi were recorded to identify pressure-dependent differences and HPTLC (High-Performance Thin Layer Chromatography) was used to determine possible effects of air pressure on the formation of secondary metabolites.

The initial data show that a reduction in atmospheric pressure leads to species-specific changes in the growth of fungi and HPTLC analyses clearly proved a change in metabolite spectrum of the tested fungi. The next steps are to analyze the specific metabolites via GC-MS.

Air pressure will not replace known key factors influencing soil microbes, such as organic matter content, pH value, and water content. Nevertheless, our results show that air pressure, a factor that has been overlooked until now, must be considered in the future when investigating abundance, physiology, and diversity of soil microbes.

Track: [Soil Biology in Transition - Contributions on climate extremes, anthropogenic influences, biodiversity, resilience](#)