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CeMESS | Centre for Microbiology
and Environmental Systems Science

CeMESS REPORT 2026

CeM²ESS REPORT 2026

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**WE LIVE
SCIENCE**

CeMESS

THE CENTER FOR MICROBIOLOGY AND
ENVIRONMENTAL SYSTEMS SCIENCE

Microbes play a key role in sustaining life on Earth, yet they remain the least studied of all life forms. Microbiomes drive all major global biogeochemical cycles and are directly linked to the health of plants, animals, and humans. Microbes and their myriad functions shape both environmental and engineered ecosystems. Like microbes, humans engineer the environment around them, rapidly altering global biogeochemical cycles, contaminating their surroundings, transforming environmental systems, and driving climate change – all key areas of our research.

At the Centre for Microbiology and Environmental Systems Science, we take a planetary health approach, exploring the connections between human health and ecosystem health through the lens of microbiome and environmental science. We focus on the functional roles of microbial communities in complex systems, including soils, oceans, fresh waters, and engineered systems, where they drive biogeochemical cycles and transform contaminants, as well as on pollutant dynamics under current and future climatic conditions. We also study host-microbiome interactions in humans and animals from the organismic perspective. Ultimately, we seek to understand the processes that connect environmental and human health, helping to address some of the most pressing challenges of our time.



Andreas Richter
Head of CeMESS



Matthias Horn
Vice Head of CeMESS



Thilo Hofmann
Vice Head of CeMESS



Michael Wagner
Vice Head of CeMESS



Annina Müller Strassnig
Head of CeMESS Office

DIRECTORS' STATEMENT

Over the past seven years, CeMESS has grown from an interdisciplinary research initiative into an internationally recognized Centre with a unique working philosophy: we radically share everything. Laboratories, instruments, staff, knowledge and data are pooled across research groups, making collaboration a daily practice and enabling researchers in microbiology, ecology, pollutant dynamics, and climate science to work together on the same problems.

This report summarises the Centre's research, scientific community, and infrastructure. Since 2019, we have built 25 research groups, founded the Doctoral School for Microbiology and Environmental Sciences, launched a Master's programme in Microbiome Science, expanded our research infrastructure, and been awarded the Austrian Science Fund Cluster of Excellence "Microbiomes Drive Planetary Health".

These achievements belong to us all. CeMESS succeeds because of our people: researchers at every career stage, students who arrive with questions we had not thought to ask, and the technical and administrative teams whose work makes everything possible.

We thank the institutions who support us: our host institution, the University of Vienna; the Austrian Science Fund; the Vienna Science and Technology Fund; the Christian Doppler Research Association; the European Research Council; the Novo Nordisk Foundation; and every organisation that funds our research. Their commitment provides the scientific freedom and continuity that research requires, as well as the space to pursue complex questions about microbial and environmental systems and how they respond to a changing world.

Andreas Richter, Thilo Hofmann, Matthias Horn,
Michael Wagner, Annina Müller Strassnig



STRUCTURE

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17 CLIBE

19 DOME

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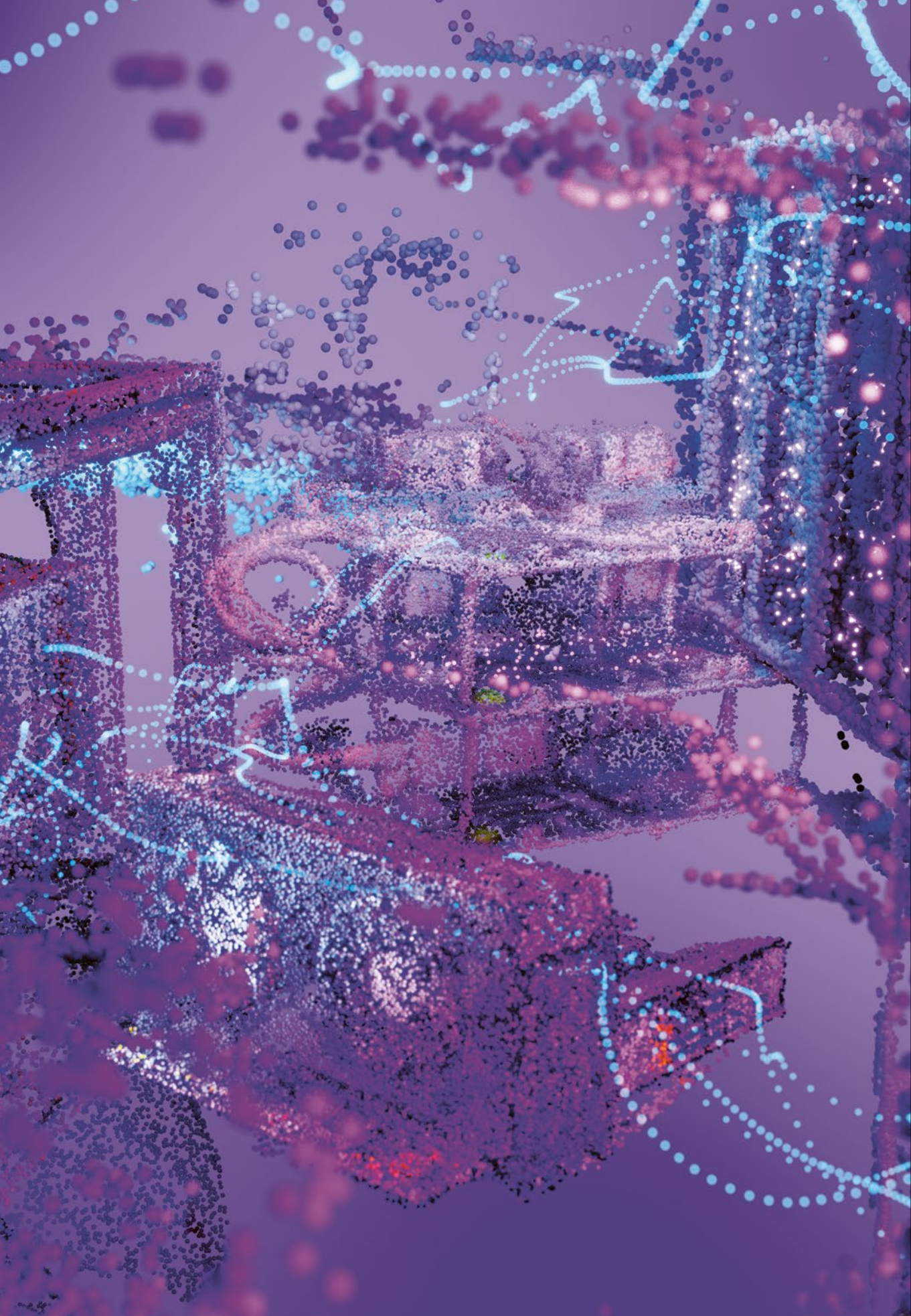
23 TER



CeMESS

The Centre for Microbiology and Environmental Systems Science (CeMESS) at the University of Vienna consists of four Research Divisions, spanning microbiology, ecology, computational biology, terrestrial ecology, and environmental geosciences. This multidisciplinary structure enables us to comprehensively study the critical biotic and abiotic processes that shape humans, the ecosystems in which we live, and our planet as a whole.

What unites the four divisions is the principle of radical sharing. Laboratories, instruments, facilities, technical and administrative personnel, and data are pooled across the Centre rather than assigned to individual groups. The four Research Divisions described below should therefore be understood as entry points into our research rather than as disciplinary boundaries.



CUBE

The Division of Computational Systems Biology comprises bioinformaticians and computational biologists focused on understanding biological systems, ranging from individual species to multi-species systems and ecosystems. CUBE's research is based on data from large-scale bioanalytical methods. Researchers in this Division develop, improve and apply computational methods for the interpretation of molecular information in biology, and establish and analyse quantitative mathematical models.



DOMIE

The Division of Microbial Ecology seeks to understand how microorganisms shape Earth's biogeochemical cycles and influence the health of plants, animals, and humans through their interactions within complex microbiomes. Researchers investigate the biodiversity, ecology, physiology, genomics, and evolution of microbes to uncover the principles governing microbial communities, from the ecophysiology and evolution of key microorganisms in diverse environments to their interactions with one another and with their eukaryotic hosts.



EDGE

The Division of Environmental Geosciences investigates key processes in natural and engineered environments and how these processes control the fate of organic and inorganic environmental pollutants. At EDGE, experimental laboratory work is combined with field observations and quantitative modelling, linking molecular-scale mechanisms with large-scale environmental processes. EDGE researchers aim to address the challenges posed by the release of anthropogenic chemicals and to inform solutions for environmental and human health through fundamental process-level research.



TER

The Division of Terrestrial Ecosystem Research aims to advance our fundamental understanding of how soil microorganisms and plants respond to, and in turn shape, their abiotic and biotic environment, and what consequences these interactions have for the functioning of Earth's terrestrial ecosystems. Researchers at TER combine process-level research with two integrative perspectives: the physical and chemical structure of soil ecosystems, as well as the microbial communities that power biogeochemical processes. Their research addresses pressing environmental issues, such as the impact of climate change on ecosystem functioning and the role of soils in maintaining planetary health.

313 SCIENTISTS & STAFF

It is the individual talent and collective team spirit of our people that makes CeMESS special. Our team includes 18 senior scientists, 54 postdoctoral researchers, 74 PhD students, 80 Master's students, and 62 support staff.

29 RESEARCH LEADERS

Our group leaders, 25 professors and 4 junior group leaders, steer our research towards exciting new frontiers in their respective fields.

15 EARLY CAREER FELLOWS

We are proud to host a large cohort of highly qualified early-stage researchers, including 2 EMBO and 3 Marie Skłodowska-Curie Postdoctoral Fellows, 4 FWF Esprit Fellows, 3 FWF Schrödinger Fellows, and 3 ÖAW Doc Grantees.

8 HIGHLY CITED RESEARCHERS

In 2025, 8 of our scientists were named Highly Cited Researchers by Clarivate, placing them in the top 1% globally in their respective fields. CeMESS researchers account for 15% of Austria's Highly Cited Researchers.

1 WITTGENSTEIN AWARD

We're honoured to have the 2019 FWF Wittgenstein Award winner, Michael Wagner, among our scientists. This is Austria's most prestigious research award.

45 COUNTRIES

We are proud to host an international research community. Our staff and students represent 45 countries across 6 continents.

847 PUBLICATIONS

We consistently achieve a high publication rate, driving forward the frontiers of knowledge. Between 2020 and 2025, our researchers published 847 papers, 83% of which were published in Q1 journals.

>21,000 CITATIONS

The frequent citation of our researchers' work demonstrates its wide-reaching global impact. As of January 2026, the 847 publications written between 2020–2025 had been cited more than 21,000 times.

KEY NUMBERS

1 CHALLENGE PROGRAMME PROJECT

"From Active Microbiomes to Soil Health" is funded by the Novo Nordisk Foundation's Challenge Programme, Harnessing Biology for Climate-Resilient and Healthy Soils, receiving €10 million over 6 years.

1 CLUSTER OF EXCELLENCE

"Microbiomes Drive Planetary Health" is funded with €21 million from the FWF over 5 years. The Cluster is led by 34 researchers from 8 institutions, 21 of whom are from CeMESS.

1 CHRISTIAN DOPPLER LAB

"Biodegradation of Water-Soluble Polymers" has received €3.5 million over 7 years from the Christian Doppler Research Association and BASF.

16 ERC GRANTS

Our faculty has been awarded 16 European Research Council Grants (Starting, Consolidator, Synergy, Proof of Concept, and Advanced Grant). 11 of these were awarded to women. We take great pride in the significant achievements of our many female researchers.

6 AUSTRIAN STARTER GRANTS

This includes 1 FWF START Award, 3 FWF ASTRA Awards, and 2 Vienna Research Groups for Young Investigators from the Vienna Science and Technology Fund (WWTF).

7.5 MILLION EUROS

CeMESS researchers consistently excel in securing third-party funding year after year. In 2025, research expenditure totalled €7.4 million, of which €4.5 million came from the Austrian Science Fund (FWF), €1.1 million from the European Union (e.g., ERC), and €1.8 million from other sources (e.g., WWTF and industry).



SCIENCE FOR PLANETARY HEALTH



RESEARCH AREAS

- 32 MICROBIOMES,
SYMBIOSIS AND
EVOLUTION**
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DRIVE PLANETARY
HEALTH**

MICROBIOMES, SYMBIOSIS AND EVOLUTION

UNDERSTANDING THE VITAL ROLES OF MICROBIAL INTERACTIONS IN PLANETARY HEALTH

We live in a microbial world. Microbes are the dominant form of life – the most abundant and diverse group of organisms. All other life depends on microbes and the functions they perform, including oxygen production, nutrient cycling, the fixation of carbon dioxide or the decomposition of organic carbon. Because microbes are also the most ancient organisms, all other life evolved on a planet already teeming with complex microbial communities. The lives of modern plants and animals, including humans, are therefore intricately intertwined with those of the smallest organisms around them, and microbes are essential for the wellbeing of their hosts.

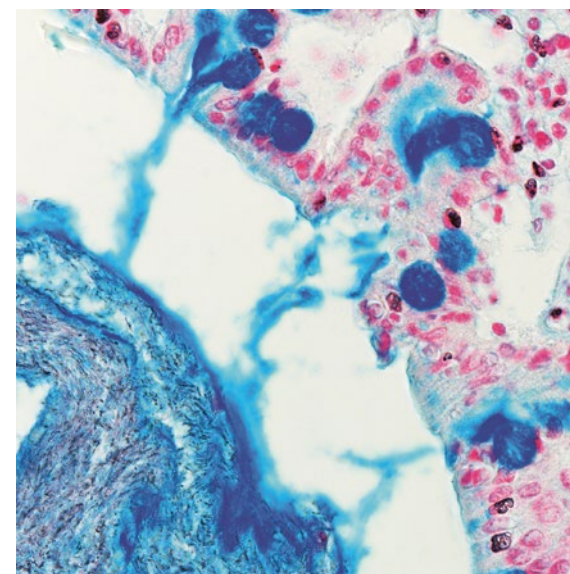
At CeMESS, we study microbes in complex communities across a variety of natural and engineered ecosystems to understand how they perform their functions, how these functions evolved, and how they interact with each other and with their hosts. We explore the evolution of mutualism and parasitism, as well as the ecology and biology of diverse aquatic and terrestrial symbioses, and of humans and their microbiomes.

SELECTED HOST-MICROBE RELATIONSHIPS

Beneficial symbionts in animals
Intracellular microbes and pathogens
Human microbiome, the immune system, and the gut-brain axis
Microbe-plant interactions, such as mycorrhiza
Photosynthetic endosymbiosis
Giant viruses infecting protists
Bacteria-virus (phage) dynamics in the wild

SELECTED MICROBIOMES

Human and animal microbiomes, e.g. gut and skin
Microbiomes in biotechnology and industry, e.g. wastewater treatment
Soil microbiomes, e.g. grasslands and permafrost
Microbiomes of ocean waters and sediments
Freshwater microbiomes



MICROBIOMES, MICROBIAL SYMBIONTS, PATHOGENS, AND THEIR HOSTS

The term ‘microbiome’ describes the community of microbes in a specific environment, such as ocean water, soil, or the human body, together with their genes, activities, and interactions. These microbiomes are often highly diverse, consisting of eukaryotes, bacteria, archaea and viruses. Their interactions with each other, with other (host) organisms, and with their environment determine functions such as large-scale ecosystem processes and global nutrient cycles.

Animal-, plant-, and protist-associated microbiomes are central to their hosts’ biology and well-being and can include microbes that are highly specific to their hosts and either benefit or harm them. Beneficial symbionts may provide essential nutrients to their hosts, in exchange for an optimised environment, or they may modulate their host’s immune system and are essential for host homeostasis. Bacterial pathogens, on the other hand, exploit their hosts, sometimes with fatal consequences. Yet, there is a continuum between these two forms of association. The molecular mechanisms underlying parasitic and beneficial interactions are often similar, and the outcome of these associations depends on environmental conditions, as well as genetics and lifestyle of the host.

At CeMESS, we investigate a broad range of symbiotic systems to uncover both general interaction mechanisms and system-specific processes. Our overarching goal is to deepen our understanding of the principles

governing microbe–microbe and host–microbe interactions and to translate this knowledge into strategies that promote the health of plants, animals, humans, and ecosystems.

MICROBIAL EVOLUTION

The process of evolution underlies the adaptation of organisms to ever-changing environmental conditions. Because many microbes have short generation times, evolutionary change occurs on shorter time scales than in plants and animals, making microbes important model systems for understanding the causes and consequences of evolution.

However, the modes of evolution differ in bacteria and archaea from those in eukaryotes. Horizontal gene transfer between unrelated individuals can introduce entirely novel sets of genes into genomes, and such genes may, for example, turn a harmless bacterium into a pathogen, enable a microbe to use a new nutrient, or introduce antibiotic resistance into entire communities of organisms. Because evolution in microbes is rapid, it can happen on ecologically relevant timescales, thereby influencing how populations and communities of organisms change under different conditions.

We cover diverse topics in microbial evolution, ranging from the reconstruction of the evolutionary history of genes, pathways, and genomes to understanding how species and populations arise and change. This includes investigating how organisms adapt to each other, such as how resistance to viruses evolves in microbes in the wild. Finally, we use evolution experiments to explore the extent to which the outcomes of evolutionary processes are reproducible and predictable.

SELECTED EVOLUTIONARY TOPICS

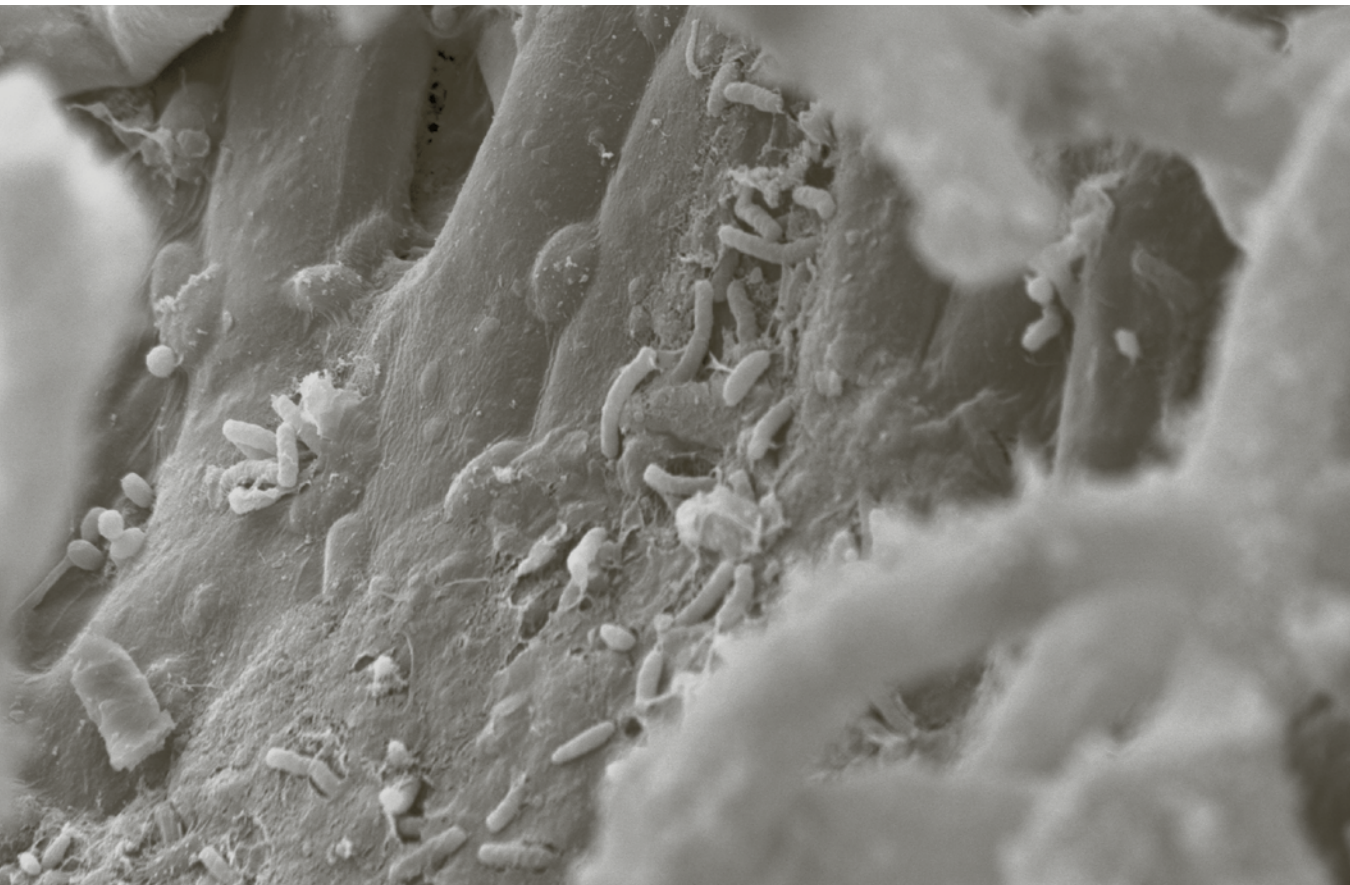
Population genomics
Evolution of resistance in hosts and counter resistance in viruses
Horizontal gene transfer rates and bounds in the wild
Mobile genetic elements

Our aquarium facilities allow us to maintain freshwater and marine organisms with their associated microbial symbionts. Credit: Joseph Krpelan

Mucus secretions (blue) create a physical barrier that shields epithelial tissue (pink) from densely colonised gut microbiota (grey, lower left). Credit: Alessandra Riva

MICROBIAL ECOLOGY AND ECOSYSTEMS

UNDERSTANDING THE BIOGEOCHEMICAL CYCLES THAT ENABLE LIFE



Microorganisms are of critical importance for all global biogeochemical cycles and food webs across terrestrial, aquatic and engineered ecosystems. At CeMESS, we study the structure and function of environmental microbiomes and the resulting flows of nutrient elements such as carbon, nitrogen, phosphorus and sulfur. These topics are investigated across scales, from the level of whole ecosystem processes to the ecophysiology and biochemistry of single microbial cells. We aim to deepen our understanding of how microorganisms contribute to ecosystem functions and how environmental microbiomes can be optimally utilised in engineered ecosystems, such as wastewater treatment.

MICROBIAL C/N/S CYCLING

All living organisms require carbon (C), nitrogen (N), and sulfur (S) for the biosynthesis of nucleic acids, proteins, and other cellular components, and are therefore directly dependent on global C, N, and S cycles. Many steps in these cycles are catalysed exclusively by bacteria and archaea, and the cycles are closely connected. Sulfur-cycling microbes govern how much carbon is mineralised in marine sediments and how much methane escapes from wetlands; denitrifying microbes typically oxidise organic carbon while converting nitrate to nitrous oxide, a potent greenhouse gas. The examples below show how microbial processes in each cycle extend into the others.

Methane is a key greenhouse gas that is predominantly produced and consumed by microorganisms. It is mainly produced under anoxic conditions in soils, wetlands, and sediments; nevertheless, many lakes and oceans exhibit elevated methane concentrations in fully oxic surface waters – a phenomenon known as the “methane paradox”. In most systems, aerobic and anaerobic methaneoxidising microbes consume methane before it escapes into the atmosphere. However, methane near the surface of water bodies is prone to rapid exchange with the atmosphere, and as such is a potential atmospheric methane source. Understanding methane sources and sinks is essential for predicting carbon – climate feedback. What controls those sources and sinks, however, often lies outside the carbon cycle itself.

Humans have altered the global nitrogen cycle more profoundly than any other elemental cycle, primarily through industrial fertiliser production, which now rivals natural terrestrial nitrogen fixation. With fertilisation efficiency often below 50%, much of the applied nitrogen is not taken up by plants but lost from agricultural soils. Both microbial nitrification and denitrification release nitrous oxide (N₂O), a greenhouse gas, and heterotrophic denitrification

consumes organic carbon as it reduces nitrate, tying nitrogen losses directly to carbon turnover in soils and sediments. The ecological consequences range from eutrophication and coastal ‘dead zones’ to biodiversity loss. Improving fertiliser efficiency depends on understanding the microbial communities that transform nitrogen, the environments they operate in, and the processes that control their activity. The global sulfur cycle is intimately intertwined with other elemental cycles, mainly through microbial activity. Microbial sulfate respiration is a critical step in the global carbon cycle – fuelling up to 50% of organic carbon mineralisation in marine sediments. In addition, sulfur-cycling bacteria in terrestrial wetlands provide an important control function on methane emissions from these environments.

Research at CeMESS aims to illuminate the biology of these coupled cycles and understand how they will behave under a changing climate – knowledge that is essential for predicting and mitigating the environmental threats arising from human activities and global change.

SELECTED TOPICS IN C/N/S CYCLING

Oxic methane production and consumption in marine and freshwater ecosystems

Nitrogen recycling and loss processes in marine ecosystems

Controls on denitrification and associated N₂O production in soils

Nitrogen fixation by free-living and plant-associated microbes

Ecophysiology, biochemistry, and evolution of nitrifying microorganisms in terrestrial, aquatic, and engineered ecosystems

Interactions of nitrifying microbes with other microorganisms and plants

Utilisation of organic and inorganic nitrogen compounds by plants and microorganisms

Ecophysiology and evolution of organic and inorganic sulfur-compound-utilising microorganisms in marine sediments and terrestrial wetlands

Development of isotope techniques to quantify carbon, nitrogen and sulfur cycle processes



MICROBIOLOGY OF TERRESTRIAL AND MARINE ECOSYSTEMS

Soils play a pivotal role in the functioning of Earth's terrestrial ecosystems and harbour an extraordinary diversity of microorganisms. Our research addresses fundamental questions about the factors shaping this vast microbial diversity, how microbial communities survive and thrive, and the functional roles they play in terrestrial ecosystems.

Soil microorganisms are key players in the terrestrial carbon cycle. They decompose, transform and stabilise soil organic matter, the largest terrestrial reservoir of organic carbon on Earth. To build a deeper understanding of soil organic matter dynamics and nutrient cycling, we investigate how microorganisms interact with each other, as well as with plants, animals, and the soil matrix. Finally, we explore how climate and land-use change affect the functioning of soil ecosystems and the potential consequences for human wellbeing.

SELECTED TOPICS IN TERRESTRIAL AND MARINE MICROBIOLOGY:

Microbial dormancy and resuscitation

Soil organic matter formation and soil carbon storage

Extracellular decomposition and microbial utilisation of soil organic C, N, S, and P

Microbial C and N use efficiency, growth and ecological stoichiometry

Plant-soil-microbe interactions

Mathematical modelling of soil microbial communities

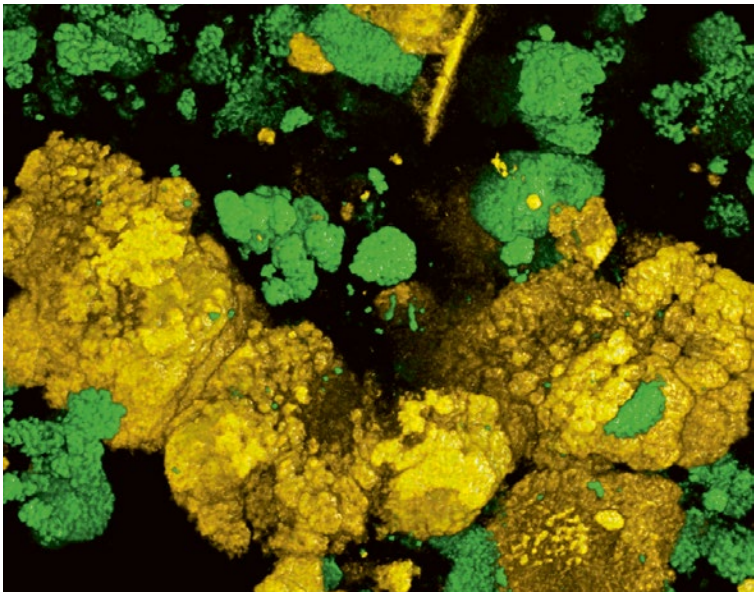
Dark carbon fixation by chemosynthetic microorganisms

Bacteria colonising a mycorrhizal root tip of a beech tree. Credit: Core Facility for Cell Imaging and Ultrastructure Research, University of Vienna

Cross section of a marine tidal sediment showing oxic, suboxic (brown) and sulfidic (black) layers. Credit: Stefan Dykma

Oceans cover the majority of the Earth's surface and play a fundamental role in regulating the global climate. Marine microorganisms are essential for processes such as primary production, nutrient recycling, and the transformation and sequestration of carbon. We study the diversity, distribution, and activity of microorganisms in the ocean, and their roles in shaping marine ecosystems and global biogeochemical cycles.

In sunlit surface waters, photosynthetic microorganisms form the base of marine food webs, while in deeper and often extreme environments – such as hydrothermal vents or oxygen minimum zones – specialised microbial communities sustain life through chemosynthesis and other alternative metabolisms. Our research explores the functional roles microorganisms play in marine ecosystems, and how they respond and adapt to dynamic and often extreme conditions.



Wastewater treatment plant biofilm. Ammonia-oxidizing bacteria in green, nitrite-oxidizing bacteria in yellow. Credit: Holger Daims

GLOBAL CHANGE AND ENVIRONMENTAL POLLUTANTS

UNDERSTANDING ENVIRONMENTAL PROCESSES IN A CHANGING WORLD



Human activities are rapidly transforming environmental systems through pollution, climate change, and shifting land use and management. At CeMESS, we work to understand these changes in terrestrial and aquatic systems, identify their underlying mechanisms, and model them quantitatively by integrating expertise in microbiology, ecology, environmental chemistry, and biogeochemistry. Our research focuses on the fate of environmental pollutants and the climate-relevant feedbacks arising from microbial processes. By integrating these disciplines and approaches, we develop a systems-level understanding of environmental change, providing a scientific basis for informed societal decisions to protect environmental and public health.

MICROBES AND CLIMATE

Microorganisms play a fundamental role in shaping Earth's climate while also being highly responsive

to environmental change. Climate-driven shifts and extremes in temperature, moisture, and resource availability can trigger physiological acclimation and changes in community composition, altering the functional capacity of microbiomes. These shifts can propagate through ecosystems, altering biogeochemical cycling and ultimately ecosystem services. A central challenge in climate change ecology is predicting how microbial functional diversity and metabolic plasticity translate into ecosystem-level responses under future climate scenarios.

At CeMESS, we address this challenge by identifying the microorganisms and functional traits that govern key biogeochemical processes and disentangling their metabolic interactions within complex communities. Our research examines how climate change and climate extremes – including warming, altered precipitation regimes, heatwaves, and drought – modify soil

organic matter turnover and microbial greenhouse gas production. These processes can generate feedbacks to the climate system, including the amplification of atmospheric greenhouse gas concentrations. By integrating molecular, physiological, and ecosystem-level approaches, we connect microbiome dynamics to emergent ecosystem functions.

ENVIRONMENTAL POLLUTANT DYNAMICS
Chemical pollution is recognised as one of the planetary boundaries defining the safe operating space for humanity. Both anthropogenic and naturally occurring pollutants pose risks to ecosystems and human health and undergo complex pathways of formation, transport, and transformation. Environmental interfaces,



where the biosphere, geosphere, and hydrosphere intersect, are particularly important in this context.

At CeMESS, we investigate the physicochemical and biological processes that control the fate of chemicals in the environment, with the aim of understanding and predicting environmental pollution dynamics and informing mitigation and remediation strategies. Our research spans a broad spectrum of anthropogenic and natural chemicals, from small organic molecules used in plastic additives, pharmaceuticals, and pesticides, to polymers used in plastic products and liquid formulations. We further investigate engineered and incidental nanoparticles, brake and tyre wear emissions, wildfire-derived particulate matter, and environmentally relevant species of cadmium, arsenic, uranium,

**SELECTED TOPICS,
MICROBES AND CLIMATE**

Soil warming, microbial acclimations/adaptations and soil-climate feedbacks

Sulfur-cycling microorganisms and controls on wetland methane emission

Interactive effects of elevated CO₂, warming and drought on soil processes

Effects of climate extremes (heatwaves, drought) on soil communities

Nitrogen fertilisation, eutrophication, and nutrient imbalances

**SELECTED TOPICS,
ENVIRONMENTAL
POLLUTANT DYNAMICS**

Environmental fate and effects of plastic and rubber additives

Micro- and nanoplastics in engineered and natural systems

Environmental impacts of engineered and incidental nanoparticles

Interfacial processes controlling pollutant mobility and retention

Mineral surfaces as archives of past biomes

Mobility of PFAS and innovative remediation strategies

Environmental transformation pathways of anthropogenic organic chemicals

Polymer biodegradation in engineered and natural systems



and chromium. Our overarching objective is to elucidate the transport, sorption, and (bio)transformation of anthropogenic and natural chemicals across scales, from the molecular to the ecosystem level. To achieve this, we combine advanced analytical approaches, including high-resolution mass spectrometry, spectroscopy, and isotope-based techniques. Through this

fundamental research, we aim to provide a scientific basis for accurate risk assessment and to inform the development of effective remediation strategies and environmentally benign chemicals.

Tire wear particles undergoing leaching in water to release tire-associated organic chemicals for analysis. Credit: Agricultural Research and Education Centre Raumberg-Gumpenstein.

Deep soil sampling in the tropical rainforest of the DR Congo. Credits: Andreas Richter

MICROBIOMES DRIVE PLANETARY HEALTH



CLUSTER OF EXCELLENCE

The Austrian Clusters of Excellence (CoEs) are the flagship funding instruments of the Austrian Science Fund's (FWF) excellent=austria initiative. These long-term research networks bring together leading scientists from multiple institutions to address fundamental scientific challenges through interdisciplinary collaboration. By pooling expertise and establishing lasting research structures, they strengthen Austria's international competitiveness and position as a leading hub for scientific innovation.

Michael Wagner, Vice-Head of CeMESS, is the scientific coordinator of the Cluster of Excellence "Microbiomes Drive Planetary Health" – one of only nine Clusters of Excellence funded in Austria and the only one coordinated by the University of Vienna. The cluster will receive €35 million of funding during its first funding period (2023–2028), with 60% provided by the FWF and 40% by the participating research institutions. Subject to successful evaluation, funding is expected to continue until 2033.

The cluster unites 34 research groups from eight leading Austrian research institutions, including 21

groups from CeMESS. Its researchers combine internationally recognised expertise in environmental and medical microbiome research with state-of-the-art technologies and quantitative approaches, creating a uniquely interdisciplinary environment in which microbiomes can be studied from molecular mechanisms to planetary-scale processes. Since its launch, more than 50 early-career researchers have joined the consortium, creating a vibrant and highly international research environment with scientists from 28 countries. This unique network has rapidly established itself as one of Europe's largest coordinated microbiome research initiatives and provides a platform for interdisciplinary collaboration, scientific training, and science communication and transfer activities.

Microorganisms are the oldest and most abundant life forms on Earth. Living in complex communities known as microbiomes, they drive biogeochemical cycles, regulate ecosystem functions, and influence global environmental change. At the same time, microbiomes colonise all plants, animals, and humans, where they play fundamental roles in health and disease.

The concept of planetary health recognises that human wellbeing is inseparable from the health of the natural systems on which we depend. Microbiomes are central to this connection: they provide essential ecosystem services, sustain biodiversity, and support the health of all multicellular life. Yet despite their fundamental importance, our understanding of how microbiomes shape planetary health remains surprisingly limited.

One of the major challenges is that environmental and medical microbiome research have traditionally evolved as separate disciplines, despite addressing many of the same biological principles. Moreover, microbiome studies have often relied on correlative observations that generate important hypotheses but rarely reveal the causal mechanisms underlying microbiome function. Consequently, efforts to manipulate microbiomes for environmental or medical applications in a targeted manner have so far achieved only limited success.

The Cluster of Excellence addresses these challenges by uniting environmental and medical microbiome research within a common scientific framework. Research is organised around three closely connected themes: Microbiome Interactions, Microbiome

Perturbations, and Microbiome Monitoring & Interventions. Supported by shared state-of-the-art method facilities, researchers combine complementary expertise to uncover the fundamental principles governing microbiome structure and function across ecosystems and host organisms.

By integrating knowledge across disciplines, the cluster aims to develop a mechanistic understanding of microbiomes that advances both environmental and biomedical research. Ultimately, this knowledge will help unlock the potential of microbiomes to promote ecosystem resilience, improve human health, and contribute to a more sustainable future. More information about the Cluster of Excellence is available at www.microplanet.at.

CoE Members at the second annual meeting 2025
Credit: Alex Bachmayer/CoE



**CURIOSITY,
POOLED**



TEAM

48 PROFESSORS

**73 JUNIOR RESEARCH
GROUP LEADERS**

**76 SENIOR
SCIENTISTS**

**83 EARLY CAREER
RESEARCHERS
& STUDENTS**

**85 TECHNICIANS,
ADMIN & IT STAFF**



Isabella Anderson-Wagner
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MAIN RESEARCH AREAS

- Gut-brain axis
- Gut microbial networks and neurotransmitter production
- Hippocampal plasticity, learning, memory, and spatial navigation
- Alzheimer’s Disease and dementia risk

CURRICULUM VITAE

Since 2021: Assistant Professor (Tenure Track) for Cognitive Neuroscience of Brain Microbiome Interactions, University of Vienna, Austria

2017–2021: Postdoctoral Researcher, University of Vienna, Austria

2017: PhD in Medical Sciences, Radboud University Medical Center, The Netherlands

2016: Postdoctoral Researcher, Radboud University Medical Center, The Netherlands

2011–2016: PhD candidate, Radboud University Medical Center, The Netherlands

SELECTED PUBLICATIONS

Gut microbial diversity and inferred capacity to produce short-chain fatty acids are associated with acute stress reactivity in healthy adults.
Karner T, Forbes PAG, Berry D, Wagner IC. 2026 – Neurobiology of Stress, 42: 100807

Entorhinal grid-like codes for visual space during memory formation.
Graichen LP, Linder MS, Keuter L, Jensen O, Doeller CF, Lamm C, Staudigl T, Wagner IC. 2025 – Nature Communications, 16: 9247.

Entorhinal grid-like codes and time-locked network dynamics track others navigating through space.
Wagner IC, Graichen LP, Todorova B, Lüttig A, Omer DB, Stangl M, Lamm C. 2023 – Nature Communications, 14: 231.

Durable memories and efficient neural coding through mnemonic training using the method of loci.
Wagner IC, Konrad BN, Schuster P, Weisig S, Repantis D, Ohla K, ... Dresler M. 2021 – Science Advances, 7(10): eabc7606.

Mnemonic training reshapes brain networks to support superior memory.
Dresler M, Shirer WR, Konrad BN, Müller NCJ, Wagner IC, Fernández G, Czisch M, Greicius MD. 2017 – Neuron, 93: 1227-35.



Mark Anthony
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MAIN RESEARCH AREAS

- Fungal ecology
- Fungal evolution, with a focus on biotrophic fungi
- Plant-microbe symbioses, with a focus on mycorrhizae and endophytes
- Global change biology, with focus on effects of multiple simultaneous stressors

CURRICULUM VITAE

Since 2026: Associate Professor for Fungal Ecology, University of Vienna

2024–2026: Assistant Professor (Tenure Track), University of Vienna

Since 2022: Ambizione Fellow, Swiss Federal Research Institute WSL

2022–2023: Guest Researcher, Agroscope

2019–2022: Postdoctoral Researcher, ETH Zürich

2015–2019: PhD in Environmental System Sciences, University of New Hampshire

SELECTED PUBLICATIONS

Enumerating soil biodiversity.
Anthony, MA, Bender SF, van der Heijden M. 2023 – PNAS, 120: e2304663120.

Forest tree growth is linked to mycorrhizal fungal composition and function across Europe.
Anthony MA, Crowther TW, van der Linde S, Suz LM, Bidertondo MI, Cox F, ... Averill C. 2022 – ISME J, 16: 1327-36.

Defending Earth’s terrestrial microbiome.
Averill C, Anthony MA, Baldrian P, Finkbeiner F, van der Hoogen J, Kiers T, ... Crowther TW. 2022 – Nature Microbiol, 7: 1717-25.

Fungal community structure and function shifts with atmospheric nitrogen deposition.
Moore JAM, Anthony MA, Pec GJ, Trocha LK, Trzebny A, Geyer KM, van Diepen LTA, Frey SD. 2021 – Glob Chang Biol, 27: 1349-64.

Soil microbial community differences drive variation in Pinus sylvestris physiology, productivity, and responses to elevated CO2.
M.A. Anthony, N. Röckel, A. Traistaru, A. Krishna, H. Meesenburg, ...C. Averill. 2025 – Environmental Microbiome, 21: 3.



Barbara Bayer
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MAIN RESEARCH AREAS

Oxic methane production and consumption in oceans and lakes

Effects of eutrophication/deoxygenation on microbial carbon and nitrogen processing

Dark carbon fixation in aquatic ecosystems

CURRICULUM VITAE

Since 2024: Assistant Professor (Tenure Track) for Microbiology of Aquatic Ecosystems, University of Vienna, Austria

2021–2023: Postdoctoral Researcher, University of Vienna, Austria

2019–2021: Postdoctoral Research Fellow, University of California, Santa Barbara, USA

2019: PhD in Biology, University of Vienna, Austria

Oceans and lakes are home to a plethora of different microorganisms, which drive biogeochemical cycles on our planet. Barbara’s research focuses on the interactions between aquatic microorganisms and their environment and on understanding the environmental regulation of microbial processes that control carbon and nitrogen cycling in the water column.

Barbara and her team combine diverse isotope approaches, cultivation, and multi-omics techniques to quantify biogeochemical processes and identify novel microorganisms and metabolic pathways. Barbara has received an ERC Starting Grant and an Austrian Science Fund (FWF) START Award to investigate microbial methane cycling in aquatic ecosystems.

SELECTED PUBLICATIONS

Minor contribution of ammonia oxidizers to inorganic carbon fixation in the ocean.
Bayer B, Kitzinger K, Paul NL, Albers JB, Saito M, Wagner M, Carlson CA, Santoro AE. 2025 – Nat Geosci, 18: 1144-1151.

Metabolite release by nitrifiers facilitates metabolic interactions in the ocean.
Bayer B, Liu S, Louie K, Northen TR, Wagner M, Daims H, Carlson CA, Santoro AE. 2024 – ISME J, 18: wrae172.

Carbon content, carbon fixation yield and dissolved organic carbon release from diverse marine nitrifying microorganisms.
Bayer B, McBeain K, Carlson CA, Santoro AE. 2023 – Limnol Oceanogr, 68: 84-96.

Prokaryotic Life in the Deep Ocean’s Water Column.
Herndl GJ, Bayer B, Baltar F, Reinthaler T. 2023 – Ann Rev Mar Sci, 15: 461-83.

Metabolic versatility of the nitrite-oxidizing bacterium Nitrospira marina and its proteomic response to oxygen-limited conditions.
Bayer B, Saito MA, McIlvin M, Lucker S, Moran DM, Lankiewicz TS, Dupont CL, Santoro AE. 2021 – ISME J, 15: 1025-39.



David Berry
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Microbial Ecology

Full Professor
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Research in David Berry’s group is focused on understanding the biology of the human microbiota and its role in health and disease. He has pioneered the development of novel experimental and computational tools to reveal the function of microbial communities and has developed single cell isotope labelling techniques to characterise functional guilds in the intestinal ecosystem.

The main research aims of David’s group are to gain a fundamental understanding of the assembly and interactions of the intestinal microbiota and to uncover how the microbiota affects host physiology. David is active in translational and clinical research in several fields, including chronic inflammation, nutrition, metabolic syndrome, cancer, and gut-immune-brain axis development in newborns. He is coordinator of an Austrian Science Fund (FWF) project focused on premature infant health (2023).

MAIN RESEARCH AREAS

Ecology and evolution of the human microbiome

Human microbiota in health and disease

Modelling approaches to study microbial communities

In situ analyses of microbes using single-cell isotope probing

CURRICULUM VITAE

Since 2018: Full Professor for Human Microbiome Research, University of Vienna

Since 2018: Operational Director of the Joint Microbiome Facility (JMF), Medical University of Vienna and University of Vienna

2016–2017: Associate Professor, University of Vienna

2012–2016: Assistant Professor, University of Vienna

2009–2012: Postdoctoral Researcher, University of Vienna

2009: PhD in Environmental Engineering, University of Michigan

SELECTED PUBLICATIONS

Lactulose selectively stimulates members of the gut microbiota, as determined by multi-modal activity-based sorting.
Rasoulimehrabani H, Riva A, Inan D, Hodžić A, Hausmann B, Nikolov G, Khadem S, Hieger N, Wiesenbauer J, Kaiser C, Filz V, Böttcher T, Berry D. 2025 – Gut Microbes, 17(1).

Identification of inulin-responsive bacteria in the gut microbiota via multi-modal activity-based sorting.
Riva A, Rasoulimehrabani H, Cruz-Rubio JM, Schnorr SL, von Baeckmann C, Inan D, ... Berry D. 2023 – Nature Commun, 14: 8210.

Aberrant gut microbiota-immune-brain axis development in premature neonates with brain damage.
Seki D, Mayer M, Hausmann B, Pjevac P, Giordano V, ... Berry D, Wisgrill L. 2021 – Cell Host & Microbe, 29(10): 1558-1572.e6.

Rational design of a microbial consortium of mucosal sugar utilizers reduces Clostridiodes difficile colonization.
Pereira FC, Wasmund K, Cobankovic I, Jehmlich N, Herbold CW, Soo Lee K, ... Berry D. 2020 – Nature Commun, 11: 5104.

A fiber-deprived diet disturbs the fine-scale spatial architecture of the murine colon microbiome.
Riva A, Kuzyk O, Forsberg E, Siuzdak G, Pfann C, Herbold CW, ... Berry D. 2019 – Nature Commun, 10: 4366.



Thomas Böttcher
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Thomas Böttcher's group investigates the chemistry of microbial interactions, as well as chemical strategies for modulating coordinated population behaviours of microbes. Thomas and his team elucidate chemical structures of metabolites that mediate and control interactions between microbes and their human host.

Their research exploits these compounds by synthetic chemistry, in order to develop species-specific antibiotics and anti-virulence compounds. Additionally, the group is interested in chemical probes for active-site directed labelling of virulence-related enzymes and the development of customised inhibitors. Thus, Thomas' research aims not only to build fundamental knowledge of the chemical interactions of microbes, but also to create chemical tools for precision microbiome interventions, with the ultimate vision of chemical microbiome engineering. Thomas has received a European Research Council (ERC) Consolidator grant to investigate the chemistry of prophage induction.

MAIN RESEARCH AREAS

- Discovery of microbial metabolites
- Species-specific antibiotics and anti-virulence strategies
- Chemical strategies for modulating microbial behaviour and signalling
- Development of chemical probes and customised enzyme inhibitors
- Chemistry of microbe-phage interactions

CURRICULUM VITAE

- Since 2020:** Full Professor for Microbial Biochemistry, University of Vienna, Austria
- 2014–2020:** Emmy-Noether Group Leader, Department of Chemistry, University of Konstanz, Germany
- 2011–2014:** Postdoctoral Researcher, Harvard Medical School, USA
- 2010–2011:** Co-Founder and Project Leader of start-up AVIRU GmbH, Germany
- 2010:** Postdoctoral Researcher, Technical University Munich, Germany
- 2009:** PhD in Chemical Proteomics, LMU Munich, Germany

SELECTED PUBLICATIONS

- A phage-selective trigger hints at an SOS-independent mechanism of prophage induction by oxidative stress.** Jancheva M, Nguyen THN, Anderl F, Neubauer J, Joge S, Rominger-Baumann C, Walter A, Storch G, Böttcher T. 2026 – Chem Sci, 17: 1151-1157.
- A quinolone N-oxide selectively targets Neisseria gonorrhoeae via its toxin-anti-toxin system.** Mix AK, Nguyen THN, Schuhmacher T, Szamosvári D, Muenzner P, Haas P, Heeb L, Wami HT, Dobrindt U, Delikkafa YÖ, Mayer TU, Böttcher T, Hauck CR (2025) – Nature Microbiol, 10: 939-957.
- A metabolite of Pseudomonas triggers prophage-selective lysogenic to lytic conversion in Staphylococcus aureus.** Jancheva M, Böttcher T. 2021 – J Am Chem Soc, 143(22): 8344-51.
- Competitive metabolite profiling of natural products reveals subunit specific inhibitors of the 20S proteasome.** Pawar A, Basler M, Goebel H, Alvarez Salinas G, Groettrup M, Böttcher T. 2020 – ACS Cent Sci, 6(2): 241-6.
- Competitive live-cell profiling strategy for discovering inhibitors of the quinolone biosynthesis of Pseudomonas aeruginosa.** Prothiwa M, Englmaier F, Böttcher T. 2018 – J Am Chem Soc, 140(43): 14019-23.



Clarissa Campbell
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The gut microbiota produces a vast array of metabolites that shape host physiology and immune function. Clarissa Campbell's team investigates how dynamic changes in microbial metabolism influence intestinal biology and mucosal immunity. The group focuses on how feeding-dependent shifts in microbial activity generate bioactive molecules, such as metabolites derived from dietary fibers and bile acids, that promote regulatory T cell differentiation and maintain immune tolerance.

To address key questions about how these metabolites act in different nutritional states, Clarissa's team combines candidate-based approaches using curated bacterial molecules with unbiased metabolomics profiling in fed and fasted conditions. They further apply in vitro screening in immune cells and intestinal organoids to identify host targets of microbial signals.

This research provides critical insight into how diet-microbiome interactions regulate immune homeostasis, with implications for understanding and treating inflammatory and metabolic diseases.

MAIN RESEARCH AREAS

- Impact of microbial metabolites on immune cells in health and disease
- Effect of nutrients on gut bacteria and mucosal immunity
- Metabolic adaptation to infections

CURRICULUM VITAE

- Since 2026:** Assistant Professor (Tenure Track) for Immunobiology, University of Vienna, Austria
- 2021–2026:** Principal Investigator at the Research Center for Molecular Medicine of the Austrian Academy of Sciences (CeMM), Austria
- 2019–2021:** Postdoctoral fellow in the Alexander Rudensky lab, Memorial Sloan Kettering Cancer Center, USA
- 2011–2019:** Graduate student, Weill Cornell Medical School of Graduate Sciences, USA
- 2010–2011:** Master's degree in Immunopharmacology, FIOCRUZ, Brazil
- 2006–2010:** Bachelor's degree in biology (minor: Genetics), UFRJ, Brazil

SELECTED PUBLICATIONS

- Altered microbial bile acid metabolism exacerbates T cell-driven inflammation during graft-versus-host disease.** Lindner S, Oriana Miltiadous, ...Campbell C and van den Brink M. 2024 – Nature Microbiology, 9(3): 614-30.
- Bacterial metabolism of bile acids promotes generation of peripheral regulatory T cells.** Campbell C, McKenney PT, ... Rudensky AY. 2020 – Nature, 581(7808): 475-79.
- FXR mediates T cell-intrinsic responses to reduced feeding during infection.** Campbell C, Marchildon F, ... Rudensky AY. 2020 – Proc Natl Acad Sci USA, 117(52): 33446-54.
- Extrathymically generated regulatory T cells establish a niche for intestinal border-dwelling bacteria and affect physiologic metabolite balance.** Campbell C, Dikiy S,... Rudensky AY.. Immunity. 2018 – Immunity, 48(6): 1245-57.
- Metabolites produced by commensal bacteria promote peripheral regulatory T-cell generation.** Arpaia N, Campbell C, ...Rudensky AY. 2013 – Nature, 504(7480): 451-55.



Holger Daims
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MAIN RESEARCH AREAS

Evolution and ecophysiology of nitrite-oxidising bacteria and completely nitrifying organisms (comammox)

Functioning of complex microbiota in engineered systems

Microbial interactions in biofilms

Development of methods to study micro-organisms directly in their environment

Nitrogen-cycling microorganisms perform critical roles in natural ecosystems, agricultural settings, and water treatment facilities. Research in Holger Daims’ group investigates the diversity, ecophysiology, and evolution of these organisms. One of their key research goals is to understand how microorganisms interact and maintain their activities amidst fluctuating environmental conditions. This knowledge helps improve strategies to utilise and control nitrogen-cycling microbes in soils and engineered systems.

Holger and his team have revealed a hidden metabolic versatility of nitrite-oxidising bacteria and made key contributions to the discovery and characterisation of complete ammonia oxidisers (comammox). An additional research area is the development and application of in situ labelling and imaging methods to characterise microorganisms in spatially complex environments, such as environmental and medical biofilms. Software developed by Holger’s group is among the most widely used programs for digital image analysis in microbial ecology, with applications in >500 studies worldwide.

CURRICULUM VITAE

Since 2024: Deputy Head of the Department of Microbiology and Ecosystem Science, University of Vienna, Austria

Since 2017: Full Professor for Ecophysiology of Microorganisms, University of Vienna, Austria

2012–2017: Associate Professor, University of Vienna, Austria

2010–2012: Assistant Professor, University of Vienna, Austria

2003–2010: University Assistant, University of Vienna, Austria

2001: PhD in Microbiology, Technical University Munich, Germany

SELECTED PUBLICATIONS

Unusual plastoquinones in non-phototrophic nitrifying bacteria.
Bale NJ, Fujimura H, Pjevac P, Koenen M, Ikeda H, Itagaki S, ... Daims H. 2025 – Environ Microbiol Rep, 17: e70174.

Growth of complete ammonia oxidizers on guanidine.
Palatinszky M, Herbold CW, Sedlacek CJ, Pühringer D, Kitzinger K, Giguere AT, ... Daims H, Wagner M. 2024 – Nature, 633: 646-653.

Rapid nitrification involving comammox and canonical Nitrospira at extreme pH in saline-alkaline lakes.
Daebeler A, Güell-Bujons Q, Mooshammer M, Zechmeister T, Herbold CW, Richter A, Wagner M, Daims H. 2023 – Environ Microbiol, 25: 1055-1067.

Genomic and kinetic analysis of novel Nitrospinae enriched by cell sorting.
Mueller AJ, Jung MY, Strachan CR, Herbold CW, Kirkegaard RH, Wagner M, Daims H. 2021 – ISME J, 15: 732-45.

Complete nitrification by Nitrospira bacteria.
Daims H, Lebedeva EV, Pjevac P, Han P, Herbold CW, Albertsen M, ... Wagner M. 2015 – Nature, 528: 504-9.



Thilo Hofmann
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MAIN RESEARCH AREAS

Particle-contaminant interactions

Natural, incidental, and engineered nanoparticles

Environmental fate and remediation of emerging contaminants

Plastic pollution and chemical additives, tire-derived compounds

Contaminant processes in soil and freshwater systems, impacts on microbiomes

CURRICULUM VITAE

Since 2019: Vice Head of CeMESS, University of Vienna, Austria

Since 2015: Director interdisciplinary Environment and Climate Research Hub (ECH), University of Vienna, Austria

2012–2016: Dean of the Faculty of Geosciences, Geography and Astronomy, University of Vienna, Austria

Since 2005: Full Professor for Environmental Geosciences, University of Vienna, Austria

1999–2005: Research Associate and Lecturer, University Mainz, Germany

1998: PhD in Aquatic Geochemistry, University of Bremen, Germany

Environmental contamination is a planetary boundary under pressure. Thilo Hofmann’s group investigates the fate and behaviour of emerging contaminants and particle-contaminant interactions in soil and freshwater systems, including nanoscale materials. His research combines experimental, analytical, and modelling approaches to understand contaminant transport, transformation, and effects, informing solutions to environmental challenges. Current work focuses on PFAS, plastic pollution and additives, particularly tire-derived compounds, and impacts on microbiomes.

Thilo is Co-Director of the Environment and Climate Research Hub (ECH) at the University of Vienna, which advances interdisciplinary research and strengthens science-policy-society interfaces through research, dialogue, and outreach. He has received awards from the German Academic Scholarship Foundation, Berlin Technical University, and the German Water Chemical Society. He is Adjunct Professor at Duke University and Guest Professor at Nankai University.

SELECTED PUBLICATIONS

The Invisible Footprint of Climbing Shoes: High Exposure to Rubber Additives in Indoor Facilities.
Sherman, A.; Masset, T.; Wimmer, L.; Maruschka, L. K.; Dailey, L. A.; Hüffer, T.; Breider, F.; Hofmann, T. 2025 – ACS Es&t Air, 2(5): 930-942.

Plastics can be used more sustainably in agriculture.
Hofmann et al. 2023 – Nature Commun Earth Environ, 4: 332.

Uptake, Metabolism, and Accumulation of Tire Wear Particle-Derived Compounds in Lettuce.
Castan, S.; Sherman, A.; Peng, R.; Zumstein, M. T.; Wanek, W.; Hüffer, T.; Hofmann, T. 2023 – Environ. Sci. Technol., 57(1): 168-178

Technology readiness and overcoming barriers to sustainably implement nanotechnology-enabled plant agriculture.
Hofmann T, Lowry GV, Ghoshal S, Tufenkji N, Brambilla D, Dutcher JR, ... Wilkinson KJ. 2020 – Nature Food, 1: 416-25.

A deep learning neural network approach for predicting the sorption of ionizable and polar organic pollutants to a wide range of carbonaceous materials.
Sigmund G, Gharasoo M, Hüffer T, Hofmann T. 2020 – Environ Sci Technol, 54(7): 4583-91.



Matthias Horn
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Microbial Ecology

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Research in Matthias Horn’s group focuses on bacteria and viruses that infect and reside within eukaryotic cells. Using molecular and computational approaches, the group has discovered novel intracellular microbes and uncovered mechanisms and evolutionary processes shaping these associations.

Bacteria living within eukaryotic cells include important pathogens and beneficial symbionts. Yet intracellular microbes have long been underestimated regarding their diversity, distribution, and ecological significance. To address this gap, the group investigates non-model systems, including amoeba-associated symbionts and giant viruses infecting protists. Current research explores co-infections, their role in microbial communities, and the evolutionary trajectories of microbe-host interactions.

Matthias has received an ERC Consolidator Grant and an FWF START Award. He coordinated an FWF-funded PhD program on Microbial Symbiosis and is a member of the European Academy of Microbiology.

MAIN RESEARCH AREAS

- Microbial symbioses
- Evolution, molecular and cellular biology of intracellular bacteria
- Giant viruses infecting protists
- Microbial genome evolution
- Bacteria-host interactions

CURRICULUM VITAE

Since 2026: Vice Head of CeMESS, University of Vienna

2024–2026: Associated member of the CeMESS Management Team, Austria

2019–2024: Head of the Department of Microbiology and Ecosystem Science, University of Vienna, Austria

Since 2007: Full Professor for Microbial Symbioses, University of Vienna, Austria

2005: Associate Professor, University of Vienna, Austria

2003: Assistant Professor, University of Vienna, Austria

2001: PhD in Microbiology, Technical University Munich, Germany

SELECTED PUBLICATIONS

The adaptation of chlamydiae to facultative host multicellularity.
Helmlinger L, Arthofer P, Cyran N, Collingro A, Horn M. 2052 – Current Biol, 35: 3368-3380.e4.

A giant virus infecting the amoeboflagellate Naegleria.
Arthofer P, Panhölzl F, Delafont V, Hay A, Reipert S, Cyran N, Wienkoop S, Willemssen A, Sifaoui I, Arberas-Jiménez I, Schulz F, Lorenzo-Morales J, Horn M. 2024 – Nature Commun, 15: 3307.

Gene gain facilitated endosymbiotic evolution of Chlamydiae.
Dharamshi JE, Köstlbacher S, Schön ME, Collingro A, Ettema TJG, Horn M. 2023 – Nature Microbiol, 1: 40-54.

Defensive symbiosis against giant viruses in amoebae.
Arthofer P, Delafont V, Willemsen A, Panhölzl F, Horn M. 2022 – Proc Natl Acad Sci USA, 119: e2205856119.

Pangenomics reveals alternative environmental lifestyles among chlamydiae.
Köstlbacher S, Collingro A, Halter T, Schulz F, Jungbluth SP, Horn M. 2021 – Nature Commun, 12: 4021.



Christina Kaiser
TER – Division of
Terrestrial Ecosystem Research

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Looking at soil from the perspective of complex systems science, Christina Kaiser’s group explores how small-scale microbial processes ultimately govern the composition and functioning of the community, and in turn, how this affects system processes like soil organic matter turnover. Her work combines soil microbial ecology and theoretical modelling with ecosystem biogeochemistry.

The Kaiser group furthermore investigates carbon and nitrogen exchange in the tripartite symbiosis of plants, mycorrhizal fungi, and soil microbial decomposers. They combine state-of-the-art stable isotope techniques with nanoscale secondary ion mass spectrometry (NanoSIMS) to trace carbon and nitrogen through the plant-soil system, and to visualise elemental exchange at the plant-microbe interface, in situ and at subcellular scales. This allows deeper insights into the controls of this exchange and its consequences for ecosystem carbon and nitrogen cycling. Kaiser has received an ERC Consolidator grant to study self-organisation of microbial soil organic matter turnover.

MAIN RESEARCH AREAS

- Emergent phenomena of complex microbial communities
- The spatial aspect of rhizosphere priming
- Interactions between soil microarchitecture and soil microbial ecology
- Carbon and nitrogen exchange between plants, mycorrhizal fungi and soil bacteria
- Effect of mycorrhizal associations on soil organic matter decomposition

CURRICULUM VITAE

Since 2022: Associate Professor for Terrestrial Ecosystem Research, University of Vienna, Austria

2018–2022: Assistant Professor (Tenure Track), University of Vienna, Austria

2014–2018: Group Leader and Assistant Professor (Univ. Ass.), University of Vienna, Austria

2012–2014: Postdoctoral Fellow, IIASA, Austria

2011: Postdoctoral Fellow, University of Western Australia (UWA), Australia

2010: PhD in Ecology, University of Vienna, Austria

SELECTED PUBLICATIONS

Arbuscular mycorrhizal fungal families and exploration-based guilds exhibit distinct responses to long-term N, P and K deficiencies and imbalances.
Jenab K, Alteio L, Guseva K, Gorka S, Darcy S, Fuchslueger L, Canarini A, Martin V, ... Kaiser C. 2026 – New Phytologist, 250: 1846–1862.

Preferential use of organic acids over sugars by soil microbes in simulated root exudation.
Wiesenbauer J, Gorka S, Jenab K, Schuster R, Kumar N, Rottensteiner C, König A, Krämer S, Inselsbacher E, Kaiser C. 2025 – Soil Biol Biochem, 203: 109738.

Distinct microbial communities are linked to organic matter properties in millimetre-sized soil aggregates.
Simon E, Guseva K, Darcy S, Alteio L, Pjevac P, Schmidt H, Jenab K, Ranits C, Kaiser C. 2024 – ISME Journal, 18: wrae156.

Persistence of soil organic carbon caused by functional complexity.
Lehmann J, Hansel CM, Kaiser C, Kleber M, Maher K, Manzoni S, ... Kögel-Knabner I. 2020 – Nature Geosci, 13: 529-34.

From diversity to complexity: Microbial networks in soils.
Guseva K, Darcy S, Simon E, Alteio LV, Montesinos-Navarro A, Kaiser C. 2022 – Soil Bio Biochem, 169: 10860.



Katharina Kitzinger
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The activity and interactions of individual microbial cells determine ecosystem processes and the fate of nutrients. Katharina investigates nitrogen cycling microorganisms across marine and soil environments to understand controls on their activity, competition for common substrates and feedbacks to climate. Further, she addresses how metabolic versatility enables the coexistence of functionally similar microbes and how environmental factors shape microbial activity.

Katharina and her team integrate field and laboratory approaches. They quantify biogeochemical process rates using stable isotope incubations, combine single cell and molecular techniques that link specific microorganisms in complex communities to their in-situ activity, and use cultivation to examine microbial physiology under controlled conditions.

Together with colleagues from Sweden, Denmark and the US, Katharina was recently awarded an ERC Synergy grant to understand microbial processes in oxygen-depleted marine regions and their climate feedbacks.

MAIN RESEARCH AREAS

Single cell growth and activity

Physiology of nitrogen cycling
microorganisms

Nitrogen recycling and loss processes in
marine oxygen minimum zones

CURRICULUM VITAE

Since 2025: Assistant Professor (Tenure Track) for Single Cell Microbiology, University of Vienna, Austria

2022–2025: Senior Scientist, University of Vienna, Austria

2019–2022: Postdoctoral Researcher, Max Planck Institute for Marine Microbiology, Germany

2015–2019: PhD, Max Planck Institute for Marine Microbiology, Germany & University of Vienna, Austria (cotutelle de these)

SELECTED PUBLICATIONS

Branched-chain amino acid assimilation promotes mixotrophy of ammonia-oxidizing archaeal sponge symbionts. Glasl B*, Kitzinger K*, Luter HM, Legin A, Salas E, Heldwein N, et al. 2025 – bioRxiv, 2025–09.

Urea use drives niche separation between dominant marine ammonia oxidizing archaea. Stuehrenberg J*, Kitzinger K*, von Arx JN, Graf JS, Lavik G, Littmann S, et al. 2025 – Nature Communications.

Single-cell imaging reveals efficient nutrient uptake and growth of microalgae darkening the Greenland Ice Sheet. Halbach L, Kitzinger K, Hansen M, Littmann S, Benning LG, Bradley JA, et al. 2025 – Nature Communications, 16(1): 1521.

Growth of complete ammonia oxidizers on guanidine. Palatinszky M, Herbold CW, Sedlacek CJ, Pühringer D, Kitzinger K, Giguere AT, et al. 2024 – Nature, 633(8030): 646-653.

Single cell analyses reveal contrasting life strategies of the two main nitrifiers in the ocean. Kitzinger K, Marchant HK, Bristow LA, Herbold CW, Padilla CC, Kidane AT, et al. 2020 – Nature Communications, 11(1): 767.

*equal contribution



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Stephan Krämer’s group studies the interactions of the biosphere with earth materials on the molecular scale. Surface chemistry processes at the interface of biotic and abiotic materials play a critical role in driving environmental processes like pollutant transport, nutrient availability, mineral weathering, and global element cycling.

Stephan and his group study the mechanisms underlying surface biogeochemical processes in various contexts, from the transformation and mobilisation of pollutants and nutrients to the enzymatic degradation of organic polymers in the context of soil carbon cycling. His group uses modern methods such as non-traditional stable isotope geochemistry and synchrotron X-ray adsorption spectroscopy to study these processes. Notably, they also explore how interactions between mineral surfaces and nucleic acids (DNA, RNA) leads to the preservation or degradation of environmental DNA.

MAIN RESEARCH AREAS

Mineral surface chemistry

Mobilisation and immobilisation of inorganic
contaminants in soils and sediments

Mechanisms and rates of enzymatic
degradation of polymers at mineral surfaces

aDNA and eDNA preservation at mineral
surfaces

Biological trace nutrient acquisition

CURRICULUM VITAE

Since 2012: Head of the Department of Environmental Geosciences, University of Vienna, Austria

Since 2006: Full Professor for Environmental Geosciences, University of Vienna, Austria

2005: Habilitation in Environmental Geochemistry, ETH Zürich, Switzerland

2000–2006: ETH-Oberassistent, Department of Environmental Sciences, Swiss Federal Institute of Technology Zürich, Switzerland

1998–1999: Guest Scientist, Department of Environmental Science, Policy and Management, University of California, Berkeley, USA

1997: PhD in Geosciences, TH Darmstadt, Germany

SELECTED PUBLICATIONS

Chromium mobilisation by ligand complexation in oxic and anoxic environments and the isotopic fingerprint. Wang W, Chrastny V, Hettler J, Kistler A, Yadav AK, Sebek O, Kumar N, Kraemer SM. 2026 – Comm Earth Env. 7(1): 90.

Polymer Length Governs DNA Adsorption Dynamics on Mineral Surfaces. Singh VV, Kumar N, Kimber RL, Weiser A, Pinhasi R, Kraemer SM. 2025 – Env Sci Technol, 59(38): 20462-73.

Redox Cycling of Tetrahedral Iron Drives the Fenton Reactivity of Chrysotile Asbestos. Walter M, Schenkeveld WDC, Geroldinger G, Gille L, Kraemer S M. 2024 – ACS Earth Space Chem, 8(1): 1–13.

Solid phase speciation controls copper mobilisation from marine sediments by methanobactin. Rushworth DD, Schenkeveld WDC, Kumar N, Noël V, Dewulf J, van Helmond NAGM, Slomp CP, Lehmann MF, Kraemer SM. 2024 – Science of The Total Environment, 934: 173046.

Rates and mechanism of vivianite dissolution under anoxic conditions. Metz R, Kumar N, Schenkeveld WDC, Kraemer SM. 2023 – Env Sci Technol, 57(45): 17266–77.



Alexander Loy
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Microbial Ecology

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Alexander Loy’s research covers a broad spectrum in microbial ecology and symbiosis, ranging from the role of intestinal microbiota in health and disease to the ecology and evolution of sulfur-compound-utilizing microorganisms. He has extensive expertise in developing and applying stable isotope-labeling and molecular biology methods for the in situ analysis of complex host-associated and environmental microbiota.

Alexander’s group investigates how interactions among microbiome members affect their environment or host. This includes how environmental microbes connect sulfur, iron, and carbon cycling, influence organic matter mineralization and greenhouse gas production, and how symbionts and pathogens impact host health and nutrition. Their current projects focus on microbial sulfur metabolism in wetlands, marine sediments, and the intestinal tract, the impact of emerging pollutants on microbiomes, and the discovery of new secondary metabolites, including antibiotics, produced by complex microbiome members.

MAIN RESEARCH AREAS

The complex symbiotic microbiota of animals and humans in health and disease

Evolution and ecology of sulfur microorganisms

Development of novel methods to study microorganisms in their natural environments

CURRICULUM VITAE

Since 2017: Full Professor for Microbial Communities, University of Vienna, Austria

Since 2016: Co-founder and executive committee member, Austrian Microbiome Initiative (AMICI)

Since 2013: Faculty member, Austrian Polar Research Institute (APRI)

2009–2017: Assistant/Associate Professor, University of Vienna, Austria

2003–2009: Postdoctoral Researcher/Group Leader, University of Vienna, Austria

2003: PhD in Microbiology, Technical University Munich, Germany

SELECTED PUBLICATIONS

Sulfoquinovose degradation by cow rumen microbiota.

Krasenbrink J, Chen SC, Tanabe TS, Sarikece H, Meurs P, ... Loy A. 2026 – ISME Journal, wrag069.

Microbial iron oxide respiration coupled to sulfide oxidation.

Chen SC, Li XM, Battisti N, Guan G, Montoya MA, ..., Mussmann M, Loy A. 2025 – Nature, 646: 925-933.

Sulfoquinovose is exclusively metabolized by the gut microbiota and degraded differently in mice and humans.

Krasenbrink J, Hanson BT, Weiss AS, Borusak S, Tanabe TS, ...Loy A. 2025 – Microbiome, 13: 184.

Ecophysiology and interactions of a taurine-respiring bacterium in the mouse gut.

Ye H, Borusak S, Eberl C, Krasenbrink J, Weiss AS, ... Loy A. 2023 – Nature Commun, 1: 5533.

Genomic insights into diverse bacterial taxa that degrade extracellular DNA in marine sediments.

Wasmund K, Pelikan C, Schintlmeister A, Wagner M, Watzka M, ... Loy A. 2021 – Nature Microbiol, 6: 885-98.



Sarah Pati
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Assessing and managing anthropogenic contamination of natural resources and ecosystems is a major challenge for sustainable development. Sarah’s group investigates the occurrence and fate of organic contaminants in aquatic systems to improve assessment of their environmental impacts. A key research focus is elucidating reaction mechanisms of photochemical and enzymatic transformations to identify dominant pathways and how fast they occur under environmentally relevant conditions, which transformation products form, and how these transformations influence persistence and mobility of aquatic contaminants. The group’s approach integrates field-scale studies with laboratory experiments and combines high-resolution mass spectrometry with compound-specific stable isotope analysis. By linking reaction mechanisms to environmental behaviour for emerging and legacy contaminants and their transformation products, the group’s research informs evidence-based exposure assessment, remediation, and policies that protect water quality and ecosystem health.

MAIN RESEARCH AREAS

Occurrence and fate of organic contaminants in aquatic environments

Reaction mechanisms of photochemical and enzymatic contaminant transformations

Role of dissolved oxygen and reactive oxygen species in contaminant transformations

Stable isotope analysis of organic contaminants and dissolved oxygen

CURRICULUM VITAE

Since 2024: Assistant Professor (Tenure Track) for Environmental Contaminants, University of Vienna, Austria

2019–2023: Research Associate, University of Basel, Switzerland

2016–2019: Postdoctoral Researcher, University of Minnesota, USA

2011–2015: Doctoral Researcher, ETH Zurich and Eawag, Switzerland

SELECTED PUBLICATIONS

Oxygen isotopic fractionation of O2 consumption by methane and ammonia monooxygenases.

de Carvalho CFM, van Kessel MA, Pol A, Zopfi J, Lehmann MF, Pati SG. 2026 – ACS Environ Au, 6: 93-104.

Oxygen isotope fractionation of O2 consumption through abiotic photochemical singlet oxygen formation pathways.

Pati SG, Brunner LM, Ley M, Hofstetter TB. 2025 – ACS Environ Au, 5: 220-9.

Substrate-specific coupling of O2 activation to hydroxylations of aromatic compounds by Rieske non-heme iron dioxxygenases.

Pati SG, Bopp CE, Kohler HPE, Hofstetter TB. 2022 – ACS Catal, 12: 6444-56.

Increased use of quaternary ammonium compounds during the SARS-CoV-2 pandemic and beyond: Consideration of environmental implications.

Hora PI, Pati SG, McNamara PJ, Arnold WA. 2020 – Environ Sci Technol Lett, 7: 622-31.

Comprehensive screening of quaternary ammonium surfactants and ionic liquids in wastewater effluents and lake sediments.

Pati SG, Arnold WA. 2020 – Environ Sci Processes Impacts, 22: 430-41.



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MAIN RESEARCH AREAS

- Beneficial host-microbe interactions
- Biodiversity, ecology, and evolution of marine and terrestrial symbioses
- Microbial metabolism
- In situ imaging of microbial identity and function
- Meta-omics analyses of host-associated microbes

CURRICULUM VITAE

Since 2025: Full Professor for Ecology and Evolution of Marine Chemosynthetic Symbioses, University of Vienna, Austria

2020–2025: Associate Professor, University of Vienna, Austria

2015–2023: WWTF Vienna Research Group Leader, University of Vienna, Austria

2016–2020: Assistant Professor, University of Vienna, Austria

2009–2015: Postdoctoral Researcher and Senior Scientist, Max Planck Institute for Marine Microbiology, Germany

2009: PhD in Marine Microbiology, University of Bremen, Germany

Animals and plants evolved in a ‘sea’ of microbes. It is therefore not surprising that most have evolved to rely on beneficial microbes for many aspects of their health, development, nutrition, and productivity. Jillian Petersen’s group contributes to this rapidly expanding research field. Their work focuses on interactions between marine plants and animals and their sulfur-oxidising bacterial symbionts, as well as terrestrial plant-microbe interactions. The goal is to understand how the symbiotic partners establish and maintain their intimate relationship from generation to generation, how these associations evolved in such diverse and widespread habitats, from deep-sea hydrothermal vents to shallow water seagrass beds, and how host-microbe associations are shaped by environmental forces (and vice versa).

Jillian and her group use a range of molecular and biogeochemical methods for understanding diversity and function of uncultured microbes in natural habitats. She received an ERC Starting Grant, an ERC Consolidator Grant, is a Board Member for the FWF, and Editor-in-Chief of The ISME Journal.

SELECTED PUBLICATIONS

Sulfur-oxidizing symbionts colonize the digestive tract of their lucinid hosts. Alcaraz CM, Séneca J, Kunert M, Pree C, Sudo M, Petersen JM 2024 – ISME J, 18(1): wræ200.

Gene loss and symbiont switching during adaptation to the deep sea in a globally distributed symbiosis. Osvatic JT, Yuen B, Kunert M, Wilkins L, Hausmann B, Girguis P, ... Petersen JM. 2023 – ISME J, 17(3): 453-66.

Global biogeography of chemosynthetic symbionts reveals both localized and globally distributed symbiont groups. Osvatic JT, Wilkins LG, Leibrecht L, Leray M, Zauner S, Polzin J, ... Petersen J. 2021 – PNAS, 118(29): e2104378118.

Diversity matters: Deep-sea mussels harbor multiple symbiont strains. Ansorge R, Romano S, Sayavedra L, Kupczok A, Tegetmeyer HE, Dubilier N, Petersen JM. 2019 – Nature Microbiol, 4: 2487-97.

Chemosynthetic symbionts of marine invertebrate animals are capable of nitrogen fixation. Petersen JM, Kemper A, Gruber-Vodicka H, Cardini U, van der Geest M, Mussmann M, ... Weber M. 2016 – Nature Microbiol, 2: 16195.



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MAIN RESEARCH AREAS

- Bacterial genetics
- Carbon cycling by microbiomes
- Evolutionary and ecological genomics
- Plant-Microbe interactions
- Machine learning and bioinformatics

CURRICULUM VITAE

Since 2024: Assistant Professor (Tenure Track) for Complex Systems Science in Microbiome Research, University of Vienna, Austria

2023–2024: Junior Research Group Leader, University of Vienna, Austria

2022–2023: Postdoc, Massachusetts Institute of Technology, USA

2018–2022: Postdoc, Massachusetts Institute of Technology, USA

2014–2018: PhD in Evolutionary Systems Biology, Tel Aviv University, Israel

SELECTED PUBLICATIONS

Public good exploitation in natural bacterioplankton communities. Pollak S, Gralka M, Sato Y, Schwartzman J, Lu L, Cordero OX. 2021 – Sci Adv, 7(31): eabi4717.

Facultative cheating supports the coexistence of diverse quorum-sensing alleles. Pollak S, Omer-Bendori S, Even-Tov E, Lipsman V, Bareia T, Ben-Zion I, et al. 2016 – Proc Natl Acad Sci, 113(8): 2152-7.

A division of labor controls the degradation of fucoidans in the ocean. Sichert A, Pollak S, Goyal A, Cordero OX, Sauer U. 2025 – bioRxiv, 2025-08

Genome content predicts the carbon catabolic preferences of heterotrophic bacteria. Gralka M, Pollak S, Cordero OX.. 2023 – Nat Microbiol, 8(10): 1799-808.

Bacterial activity has shaped our world for billions of years, and the function of virtually all ecosystems on Earth depends on this activity. Shaul Pollak is interested in how bacterial interactions mediate functions like protecting plants from pathogens or carbon cycling in soils and oceans.

Shaul loves questions that span levels of organization, such as how an interaction between specific genes on a chromosome translates to planetary-scale changes in carbon fluxes. To answer these questions, Shaul’s group integrates genomics, high-throughput experiments and genetics with ecological and evolutionary theory and machine learning. Current projects include using genomic dark matter to predict carbon fluxes in soils, as well as investigating the effects of environmental change on plant-bacteria genetic interactions.



Martin Polz
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MAIN RESEARCH AREAS

- Microbial population genomics
- Bacteria-virus interactions
- Single cell bacterial growth
- Evolutionary and ecological microbiome dynamics

CURRICULUM VITAE

Since 2020: Full Professor for Microbial Population Biology and Genetics, University of Vienna, Austria

2009–2019: Full Professor, Massachusetts Institute of Technology, USA

2004–2009: Associate Professor, Massachusetts Institute of Technology, USA

1998–2004: Assistant Professor, Massachusetts Institute of Technology, USA

1998: Postdoctoral Fellow, Harvard University, USA

1997: PhD in Organismic and Evolutionary Biology, Harvard University, USA

Martin is a microbial ecologist and evolutionary biologist whose work is focused on the elucidation of structure-function relationships in natural microbial communities. Using primarily marine vibrios as a model, he investigates microbial population biology and genomics, including how bacterial viruses interact with their hosts, and most recently, how fast single cells grow in their natural habitat. Other interests include microbe-microbe and host-microbe interactions, and the evolution of ecological differentiation within complex microbiomes. His lab uses a wide array of techniques, from environmental sampling, genomics and metagenomics to molecular genetics.

SELECTED PUBLICATIONS

Genome-wide sweeps create ecological units in the human gut microbiome.
Yu, A., Strachan, C., Herbold, C.W., Lang, M. Gasche, C., Makristathis, A., Segata, N., Pollak, S., Tett, A., Polz, M.F. 2026 – Nature, 1-8

Recent speciation among epithelial bacteria creates a sink for a key nutritional substrate in the cow rumen.
Strachan CR, Yu X, Naubauer V, Mueller A, Wagner M, Zebeli Q, Selberherr E, Polz MF. 2023 – Nature Microbiol, 8(2): 309-20.

Rapid evolutionary turnover of mobile genetic elements drives microbial resistance to phage.
Hussain FA, Dubert J, Esherbini J, Murphy M, VanInsberghe D, Arevalo P, ... Polz MF. 2021 – Science, 374(6566): 488-92.

A reverse ecology approach based on a biological definition of microbial populations.
Arevalo P, VanInsberghe D, Elsherbini J, Gore J, Polz MF. 2019 – Cell, 178(4): 820-834.e14.

A major lineage of non-tailed dsDNA viruses as unrecognized killers of marine bacteria.
Kauffman KM, Hussain FA, Yang J, Arevalo P, Brown JM, Chang WK, ... Polz MF. 2018 – Nature, 554(7690): 118-22.



Thomas Rattei
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MAIN RESEARCH AREAS

- Computational and systems biology
- Genome and metagenome analysis
- Functional genomics Host-pathogen interactions
- Databases and infrastructure for bioinformatics

CURRICULUM VITAE

Since 2020: Head of the Doctoral School Microbiology and Environmental Science, University of Vienna, Austria

Since 2019: Vice Head of the Department of Microbiology and Ecosystem Science, University of Vienna, Austria

Since 2010: Full Professor for In Silico Genomics, University of Vienna, Austria

2001–2010: Group Leader and Assistant Professor, Department of Genome Oriented Bioinformatics, Technical University Munich, Germany

1999: PhD in Chemistry, Technical University Dresden, Germany

SELECTED PUBLICATIONS

DeepNOG: Fast and accurate protein orthologous group assignment.
Feldbauer R, Gosch L, Lüftinger L, Hyden P, Flexer A, Rattei T. 2020 – Bioinformatics, 36(22-23): 5304-12.

Conserved Secondary Structures in Viral mRNAs.
Kiening M, Ochsenreiter R, Hellinger HJ, Rattei T, Hofacker I, Frishman D. 2019 – Viruses, 11(5): 401.

eggNOG 5.0: a hierarchical, functionally and phylogenetically annotated orthology resource based on 5090 organisms and 2502 viruses.
Huerta-Cepas J, Szklarczyk D, Heller D, Hernández-Plaza A, Forslund SK, ... Rattei T, ... Bork P. 2019 – Nucleic Acids Res, 47(D1): D309-14.

Critical Assessment of Metagenome Interpretation-a benchmark of metagenomics software.
Sczyrba A, Hofmann P, Belmann P, Koslicki D, Janssen S, ... Rattei T, McHardy AC. 2017 – Nat Methods, 14(11): 1063-71.

The 5300-year-old Helicobacter pylori genome of the Iceman.
Maixner F, Krause-Kyora B, Turaev D, Herbig A, Hoopmann MR, ... Rattei T, Zink A. 2016 – Science, 351(6269): 162-5.

Thomas Rattei's work covers a wide spectrum of topics from bioinformatics, genome and metagenome analysis, and systems biology. He has long-standing expertise in developing and applying computational methods for the interpretation of large-scale sequence information. The international reputation of his research group has triggered their involvement in numerous international (meta)genome sequencing and analysis consortia.

Thomas's research activities not only cover individual, project-specific questions but also general problems in bioinformatics, computational infrastructure, and large-scale biological databases. Furthermore, his group develops novel, genome-based computational approaches for studying molecular inter-species interactions, such as between hosts and pathogens, between symbionts, and within microbial ecosystems.

Thomas and his team maintain and develop internationally relevant resources in computational biology, such as the web portals phendb.org, vogdb.org, and effectivedb.org for microbial trait prediction, virus orthologous groups and protein families, and bacterial secreted proteins and secretion systems.



Andreas Richter
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MAIN RESEARCH AREAS

Microbial growth, turnover, and carbon use efficiency

Effect of climate change and elevated CO₂ on soil processes

Ecological stoichiometry and carbon, nitrogen and phosphorus cycling

Arctic soil carbon storage and the permafrost-climate feedback

CURRICULUM VITAE

Since 2020: Head of CeMESS, University of Vienna, Austria

Since 2011: Full Professor for Soil Ecology and Global Change, University of Vienna, Austria

Since 2016: Guest Research Scholar at the International Institute for Applied Systems Analysis (IIASA), Austria

2013–2016: Director of the Austrian Polar Research Institute (APRI), Austria

2000–2010: Associate Professor, Institute of Ecology and Conservation Biology, University of Vienna, Austria

1989: PhD in Botany and Geology, University of Vienna, Austria

Microbial communities are key components of global biogeochemical cycles and play a central, yet poorly understood, role in climate-change biology. Andreas Richter’s soil ecology group investigates how the growth and turnover of microbial communities control the decomposition, mineralization, and buildup of organic matter in soils under current and future climates. Andreas’s group has redefined and expanded the concepts of microbial growth and microbial carbon and nitrogen use efficiency. Andreas also pioneered methods to estimate microbial growth using stable oxygen and hydrogen isotopes.

A particular focus of Andreas’s research is the interactive effects of future climate conditions and climate extremes on microbial processes, soil microbial and faunal community composition, and plant-microbe interactions. His group studies soils and peatlands across biomes from the tropics to the Arctic, with particular emphasis on Arctic ecosystems, where it has made substantial contributions to understanding microbial contributions to permafrost-climate feedbacks.

SELECTED PUBLICATIONS

Soil fungi remain active and invest in storage compounds during drought independent of future climate conditions.
Canarini, A., Fuchslueger, L., Schnecker, J., ... Richter, A. 2024 – Nature Commun, 15: 10410.

Soil warming increases the number of growing bacterial taxa, but not their growth rates.
Metze, D., Schnecker, J., ... Hausmann, B., Kaiser, C., Richter, A. 2024 – Sci Adv, 10: eadk6295.

Microbial growth under drought is confined to distinct taxa and modified by potential future climate conditions.
Metze D, Schnecker J, Canarini A, Fuchslueger L, Koch BJ, ... Kaiser C, Richter A. 2023 – Nature Commun, 14: 5895.

Ecological memory of recurrent drought modifies soil processes via changes in soil microbial community.
Canarini A, Schmidt H, Fuchslueger L, Martin V, Herbold CW, Zezula D, ... Richter A. 2021 – Nature Commun, 12: 5308.

Microbial carbon limitation – the need for integrating microorganisms into our understanding of ecosystem carbon cycling.
Soong JL, Fuchslueger L, Marañon-Jimenez S, Torn MS, Janssens IA, Penuelas J, Richter A. 2020 – Glob Chang Biol, 26: 1953-61.



Megan Sørensen
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MAIN RESEARCH AREAS

Evolution of endosymbioses

Plastid evolution

Photosynthetic microbial eukaryotes

CURRICULUM VITAE

Since 2026: Assistant Professor (Tenure Track) for Microbial Eukaryotes, University of Vienna, Austria

2025–2026: College of Life Science Fellow, Wissenschaftskolleg zu Berlin, Germany

2022–2025: EMBO & MSCA Postdoctoral fellow, Heinrich-Heine University, Germany

2020–2022: Postdoctoral researcher, University of Stockholm & University of Uppsala, Sweden

2015–2020: PhD in Mechanistic Biology, University of Sheffield, UK

The evolution of photosynthetic endosymbioses have driven critical evolutionary transitions, and continue to play crucial roles in modern ecosystems. Research in Megan Sørensen’s group leverages microbial eukaryote systems to study the evolution and ecology of these important associations. Megan and her group use a diverse range of experimental and analytical techniques to probe how these partnerships are integrated at every level of their cellular biology, and how this enables coordination, and potential manipulation, between the partners.

The overall research aim is to advance our fundamental understanding of the molecular mechanisms that underpin the emergence and maintenance of endosymbioses, as well as the processes by which endosymbioses can, on occasion, evolve into organelles. Current key questions include: How are potential partners selected? How are the partners metabolically integrated? How do these endosymbioses carve out their ecological niche? Megan was recently awarded an ERC Starting grant to investigate these questions.

SELECTED PUBLICATIONS

Protein Import into Bacterial Endosymbionts and Evolving Organelles.
Sørensen MES, Stiller ML, Kröninger L, Nowack ECM. 2024 – FEBS J, 292: 2992-3013.

A novel kleptoplastidic symbiosis revealed in the marine centrohelid Meringosphaera with evidence of genetic integration.
Sørensen MES, Zlatogursky VV, Onuț-Brännström I, Walraven A, Foster RA, Burki F. 2023 – Curr Biol, 33: 3571-84.

Rapid compensatory evolution can rescue low fitness symbioses following partner switching.
Sørensen MES, Wood AJ, Cameron DD, Brockhurst MA. 2021 – Curr Biol, 31: 3721-8.

Comparison of independent evolutionary origins reveals both convergence and divergence in the metabolic mechanisms of symbiosis.
Sørensen MES, Wood AJ, Minter EJA, Lowe CD, Cameron DD, Brockhurst MA. 2020 – Curr Biol, 30: 328-34.

The role of exploitation in the establishment of mutualistic microbial symbioses.
Sørensen MES, Lowe CD, Minter EJA, Wood AJ, Cameron DD, Brockhurst MA. 2019 – FEMS Microbiol Lett, 366: fnz148



Michael Wagner
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Microbial Ecology

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MAIN RESEARCH AREAS

- Nitrification with a focus on ammonia-oxidation and complete nitrification (comammox)
- Functional analyses of microbes using single-cell isotope probing
- Wastewater microbiology
- Sponge microbiology
- Microbial physiology

CURRICULUM VITAE

- Since 2025:** Speaker of the Vienna Center for Advanced Studies, Austria
- Since 2022 & 2009–2019:** Member of the Senate, University of Vienna, Austria
- Since 2019:** Distinguished Professor (20%), Aalborg University, Denmark
- 2019–2020:** Founding Head of CeMESS (2019-2020), since 2020 Vice Head of CeMESS, University of Vienna, Austria
- Since 2003:** Full Professor for Microbial Ecology, University of Vienna, Austria
- 1996–2003:** Assistant and Associate Professor, Technical University Munich, Germany
- 1995–1996:** Postdoctoral Fellow, Northwestern University, USA
- 1995:** PhD in Microbiology, Technical University Munich, Germany (summa cum laude)

Humans profoundly alter the global nitrogen cycle through extensive fertilizer use. Nitrification contributes to fertilizer losses, eutrophication, and greenhouse gas emissions, yet it is also essential for efficient wastewater treatment. Research in Michael Wagner's group focuses on the ecology, physiology, and evolution of nitrifying microorganisms. The group has discovered, cultivated, and characterized important new nitrifiers, including the long-sought complete nitrifiers (comammox organisms), revealing unexpected physiological traits and ecological functions. Wagner's research also addresses wastewater treatment microbiomes, symbionts of marine sponges, and interactions between prescribed drugs and the human gut microbiome. His group develops innovative single-cell methods for linking microbial identity and function directly in environmental and host-associated communities. Wagner is a member of EMBO and recipient of an ERC Advanced Grant, the Wittgenstein Prize of the FWF (the highest Austrian science award), the ISME Jim Tiedje Award, and the Schrödinger Prize of the Austrian Academy of Sciences. He directs the FWF Cluster of Excellence "Microbiomes Drive Planetary Health."

SELECTED PUBLICATIONS

- The Microflora Danica atlas of Danish environmental microbiomes.** Singleton CM, Jensen TBN, Delogu F, Knudsen KS, Sørensen EA, ... , Wagner M, Dueholm MKD, Nielson PH, Albertsen M. 2026 – Nature, 649: 971-981
- Growth of complete ammonia oxidizers on guanidine.** Palatinszky M, Herbold CW, Sedlacek CJ, Pühringer D, Kitzinger K, Giguere AT, ... Hofmann T, Zumstein M, Djinoić-Carugo K, Daims H, Wagner M. 2024 – Nature, 633: 646-653.
- The Parkinson's disease drug entacapone disrupts gut microbiome homeostasis via iron sequestration.** Pereira FC, Ge X, Kristensen JM, ... Hausmann B, Berry D, Wasmund K, Schintlmeister A, Böttcher T, Cheng JX, Wagner M. 2024 – Nat Microbiol, 9: 3165-3183.
- Kinetic analysis of a complete nitrifier reveals an oligotrophic lifestyle.** Kits KD, Sedlacek CJ, Lebedeva EV, Han P, Bulaev A, ... Daims H, Wagner M. 2017 – Nature, 549: 269-272.
- Complete nitrification by Nitrospira bacteria.** Daims H, Lebedeva EV, Pjevac P, Han P, Herbold C, Albertsen M, ... Wagner M. 2015 – Nature, 528: 504-509.



Wolfgang Wanek
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MAIN RESEARCH AREAS

- Soil-plant-microbe interactions controlling carbon and nutrient cycling under global change
- Stable isotope tracing of ecosystem processes and element fluxes
- Microbial metabolism and resource use (metabolomics, fluxomics, CUE/NUE frameworks)
- Mechanistic controls of soil organic matter formation and stabilization
- Development of isotope-based and biomarker approaches in ecosystem research

CURRICULUM VITAE

- Since 2019:** Full Professor of Physiological Ecology and Ecosystem Research, University of Vienna, Austria
- 2006–2019:** Associate Professor, University of Vienna, Austria
- 2006:** Habilitation in Physiological Ecology and Ecosystem Research, University of Vienna, Austria
- 2001–2006:** Assistant Professor, University of Vienna, Austria
- 1996–2001:** Research Assistant, University of Vienna, Austria
- 1996:** PhD in Plant Sciences, University of Vienna, Austria

Understanding how terrestrial ecosystems regulate carbon and nutrient cycling is central to predicting and mitigating global change. Wolfgang Wanek investigates the interactions between plants, soil microorganisms, and their physicochemical environment that govern ecosystem functioning across grasslands, forests, and croplands. His team integrates stable isotope techniques (¹³C, ¹⁵N, 18O, 34S), metabolomics, and ecophysiological approaches to quantify element fluxes and trace the fate of carbon and nutrients through soil-plant-microbe systems. A key focus lies on disentangling biological and abiotic controls of carbon, nitrogen, phosphorus, and sulfur cycling, and on resolving how these processes respond to climate change and land management. By developing and applying advanced isotope-based and biomarker methods, his group provides mechanistic insights into ecosystem functioning from local to global scales, contributing to improved predictions of biogeochemical feedbacks and the development of sustainable land-use strategies.

SELECTED PUBLICATIONS

- Advancing predictive understanding of tree organic and inorganic nitrogen uptake across forest biomes.** Liu M, Xu X, Jin P, Bruehlheide H, ... Bardgett RD, Wanek W. 2026 – Soil Biol Biochem, 213: 110027.
- Increased belowground carbon allocation reduces soil carbon losses under long-term warming.** Schindlbacher A, Kwatocho-Kengdo S, Heinze J, Tian Y, ...Wanek W, Borken W. 2026 – Glob Change Biol, 31: e70561.
- Fungal necromass carbon dominates global soil organic carbon storage.** Fu H, Chen H, Ma Z, ...Wanek W, Wu L, Ma Q. 2025 – Glob Change Biol, 31: e70413.
- High-resolution lipidomics for decoding soil biome: improved lipid annotation, quantitation, and response to climate stress.** Samrat R, Salas E, Fuchslueger L, Schmidt H, ...Eichorst SA, Wanek W. 2025 – Soil Biol Biochem, 209: 109892.
- Soil microbiomes show consistent and predictable responses to extreme events across climates.** Knight CG, Nicolitch O, Griffiths RI, Goodall T, ...Wanek W, de Vries FT. 2024 – Nature, 636: 690-96.



Anouk Willemsen
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Viruses are major but often overlooked players in ecological interactions. They are ubiquitous in nature, infecting organisms across all domains of life. Viruses have evolved many different shapes, sizes and types of genome organisation, which allows them to thrive in different environments. Research in Anouk Willemsen’s group focuses on the evolutionary genetics and genomics of microbes, especially the ability of viruses to adapt (or not) to changes in their environments.

Anouk’s group employs a range of molecular and microbiology techniques, experimental evolution, sequencing, genomics, phylogenetics and bioinformatics. Anouk has received two Marie Skłodowska-Curie grants and an ERC Starting Grant (2021) to investigate the role of mobile genetic elements in the ecology and evolution of giant viruses. She is the co-lead of an FWF project focused on studying giant viruses in the wild.

MAIN RESEARCH AREAS

- Virus genome architecture and stability
- Virus-host co-evolution
- Virus-host-microbe interactions
- Experimental evolution of viruses
- Bioinformatics and genomics of viruses

CURRICULUM VITAE

Since 2023: Assistant Professor (Tenure Track) for Virus Evolution, University of Vienna, Austria

2020–2023: Postdoctoral Researcher, University of Vienna, Austria

2016–2020: Postdoctoral Researcher, French National Centre for Scientific Research, France

2012–2016: PhD in Biotechnology, University of Valencia, Spain

SELECTED PUBLICATIONS

A giant virus forms a specialized subcellular environment within its amoeba host for efficient translation.
Ruixuan Z, Mayer L, Hikida H, Shichino Y, Mito M, Willemsen A, Iwasaki S, Ogata H. 2026 – Nature Microbiology, 11(2): 584-596

Giant virus transcription and translation occur at well-defined locations within amoeba host cells.
Mayer L, Nikolov G, Kunert M, Horn M, Willemsen A. Giant virus transcription and translation occur at well-defined locations within amoeba host cells. 2025 – Journal of Virology, 99(7): e00554-25.

Novel high-quality amoeba genomes reveal widespread codon usage mismatch between giant viruses and their hosts.
Willemsen A, Manzano-Marín A, Horn M. 2025 – Genome Biology and Evolution, 17(1): evae271.

Transcriptomic, proteomic, and functional consequences of codon usage bias in human cells during heterologous gene expression.
Picard MA, Leblay F, Cassan C, Willemsen A, Bauffe F, Decourcelle M, Demange A, Bravo IG. 2023 – Protein Science, 32(3): e4576.

On the stability of sequences inserted into viral genomes.
Willemsen A, Zwart MP. 2019 – Virus Evolution, 5(2): vez045.



Dagmar Wöbken
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Microbial Ecology

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Soils harbour the diversity of microorganisms on Earth, but we are yet to fully understand their functional roles and how this diversity is maintained. Dagmar’s research aims to elucidate active microbial participants in key soil processes, alongside the genomic and physiological features that allow their success in challenging soil habitats.

Dagmar’s team investigate survival strategies and resuscitation in soil microbes, with a particular focus on arid soils. Another area of interest is plant-microbe associations, especially how plant microbiomes are assembled and their potential beneficial effects, such as nitrogen fixation or salt-stress mitigation. Dagmar’s group aims to gain a holistic view of soil microbiome functions, combining process-level measurements, meta-omics analyses, and stable isotope probing coupled to single-cell investigations such as NanoSIMS. She has received an ERC Starting Grant (2014) to study survival mechanisms in desert soil microorganisms, and an ERC Advanced Grant (2025) to investigate different water sources allowing microbial reactivation in deserts and their influence on ecosystem processes.

MAIN RESEARCH AREAS

- Survival mechanisms and ecophysiology of soil microorganisms
- Plant-microbe interactions
- Microbial communities and processes in biological soil crusts and microbial mats
- Microorganisms involved in atmospheric N2 fixation
- Application of single cell methods in terrestrial and plant-associated systems

CURRICULUM VITAE

Since 2024: Head of DOME & Head of the Department of Microbiology and Ecosystem Science, University of Vienna, Austria

Since 2022: Associate Professor for Microbial Ecology University of Vienna, Austria

2017–2022: Assistant Professor (Tenure Track), University of Vienna, Austria

2012–2017: Group Leader, University of Vienna, Austria

2008–2011: Postdoctoral Researcher, Stanford University/NASA Ames Research Center/Lawrence Livermore National Laboratory, USA

2007: PhD in Marine Microbiology, University of Bremen (Max Planck Institute for Marine Microbiology, Bremen), Germany

SELECTED PUBLICATIONS

Survival and rapid resuscitation permit limited productivity in desert microbial communities.
Imminger S, Meier DV, Schintlmeister A, Legin A, Schnecker J, Richter A, Gillor O, Eichorst SA, Woebken D. 2024 — Nat Commun, 15: 3056.

Both abundant and rare fungi colonizing Fagus sylvatica ectomycorrhizal root-tips shape associated bacterial communities.
Dietrich M, Montesinos-Navarro A, Gabriel R, Strassner F ... Richter A, Kaiser C, Woebken D. 2022 – Commun Biol, 5: 1261.

Nitrogen fixation by diverse diazotrophic communities can support population growth in arboreal ants.
Nepel M, Pfeifer J, Oberhauser FB, Richter A, Woebken D, Mayer VE. 2022 – BMC Biol, 20: 135.

Distribution of mixotrophy and desiccation survival mechanisms across microbial genomes in an arid biological soil crust community.
Meier DV, Imminger S, Gillnor O, Woebken D. 2021 – mSystems, 6: e00786-20.

Acidobacteria are active and abundant members of diverse atmospheric H2-oxidizing communities detected in temperate soils.
Giguere AT, Eichorst SA, Meier DV, Herbold CW Richter A, Greening C, Woebken D. 2021 – ISME J, 15: 363-76.



Michael Zumstein
EDGE – Division of
Environmental Geosciences

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MAIN RESEARCH AREAS

Polymer biodegradation in aquatic environments

Biotransformation pathways of pharmaceuticals and pesticides

Environmental benign by design

Environmental analytical chemistry

Extracellular enzymes in natural and engineered systems

CURRICULUM VITAE

Since 2025: Associate Professor for Environmental Biotransformation, University of Vienna, Austria

2022–2025: Assistant Professor (Tenure Track), University of Vienna, Austria

2021–2022: Junior Group Leader, University of Vienna, Austria

2019–2020: Postdoctoral Researcher and SNSF Ambizione Fellow, Eawag, Switzerland

2018–2019: Postdoctoral Researcher, Cornell University, USA

2013–2017: PhD candidate in Environmental Chemistry, ETH Zurich, Switzerland

Michael and his group investigate the biodegradation of anthropogenic organic chemicals in natural and engineered environments. To obtain a fundamental understanding of the activity, specificity, and identity of microorganisms and enzymes involved, the group combines techniques from environmental analytical chemistry and molecular biology. The obtained molecular-level insights provide actionable guidance for the development and selection of biodegradable chemicals.

A current research focus lies on the biodegradation of water-soluble polymers, which provide key functions in home and personal care products, in wastewater and freshwater environments. Other chemical classes of interest include pharmaceuticals and agricultural pesticides. Across these classes, the group investigates how chemical structure and environmental factors affect biodegradation pathways and kinetics. Since 2025, Michael has been heading the Christian Doppler Laboratory for Biodegradation of Water-Soluble Polymers – an interdisciplinary and intersectoral collaboration between academic and industrial researchers.

SELECTED PUBLICATIONS

Conserved specificity of extracellular wastewater peptidases revealed by multiplex substrate profiling by mass spectrometry.
Wichmann N, Meibom J, Kohn T, Zumstein M. 2025 – Environ Chem Lett, 23: 953-959.

Flavonoid Stability and Biotransformation in Agricultural Soils: Effects of Hydroxylation, Methoxylation, and Glycosylation.
Gruseck R, Hofmann T, Zumstein M. 2025 – J Agric Food Chem, 73: 14245-14252.

Biodegradation of Water-Soluble Polymers by Wastewater Microorganisms: Challenging Laboratory Testing Protocols.
Kintzi A, Daturpalli S, Battagliarin G, Zumstein M. 2024 – Environ Sci Technol, 58: 15246-15256.

Hydrolysis of Antimicrobial Peptides by Extracellular Peptidases in Wastewater.
Wichmann N, Gruseck R, Zumstein M. 2024 – Environ Sci Technol, 58: 717-726.

Environmental biodegradation of water-soluble polymers: Key considerations and ways forward.
Zumstein M, Battagliarin G, Kuenkel A, Sander M. 2022 – Acc Chem Res, 55(16): 2163-7.

JUNIOR
RESEARCH
GROUP
LEADERS



Carlos Arellano-Caicedo
TER

Microbes are essential for all ecosystems, hence preserving them and their diversity is crucial for keeping ecosystems functional. Yet there is no consensus on fundamental rules that shape microbial communities, for example the rules that govern their diversity, composition, or their responses to environmental changes. This is because microbes and their habitats are tiny, making it difficult to assess their activity at the relevant scale. To address this, the Carlos Arellano-Caicedo group employs a diverse toolbox of techniques, from classical culture experiments to microscopy, microfluidics, and mathematical modeling, to unravel the rules that shape microbiomes. The group is especially interested in how microbial interactions occur in spatially structured microenvironments and how the self-organization of microbial cells at the microscale dictates the macroscale behavior of the entire community.

CURRICULUM VITAE

- Since 2023:** Junior Research Group Leader, University of Vienna, Austria
- 2022–2023:** Postdoctoral Fellow, Lund University, Sweden
- 2021–2022:** Lecturer, Escuela Politécnica Nacional, Ecuador
- 2016:** PhD in Biology, Lund University, Sweden



Lucia Fuchslueger
TER

Lucia Fuchslueger’s group investigates the ecology and biogeochemistry of soil microorganisms and the processes they mediate in interaction with plant roots and the soil matrix. In particular, Lucia investigates the sensitivity, responses, and resilience of soil microbial communities to changing nutrient and environmental conditions. Her group combines field and laboratory experiments using microbial biomarkers, analytical methods, and stable isotopes as tools to trace carbon, nitrogen, and phosphorus through the plant-soil-microbe continuum and to investigate soil microbial resilience to global change, such as elevated CO₂, drought, and warming. Current projects explore the impact of plant root exudates on agricultural soils and describe nitrification-inhibiting compounds. Another focus is understanding climate-change feedbacks and microbial organic matter turnover in mineral-nutrient-constrained ecosystems, such as tropical rainforests.

CURRICULUM VITAE

- Since 2023:** Junior Research Group Leader, University of Vienna, Austria
- Since 2025:** Postdoc, Cluster of Excellence, University of Vienna, Austria
- 2020–2025:** REWIRE Fellow & Co-PI Young Investigator Research Group, University of Vienna, Austria
- 2017–2020:** Postdoc, University of Antwerp, Belgium
- 2015–2017:** Postdoc, National Institute for Amazon Research, Brazil
- 2015:** PhD in Biology, University of Vienna, Austria



Valentin Göldner
EDGE

Modern societies rely on hundreds of thousands of specialized synthetic chemicals. Over their lifetimes, these chemicals may enter the environment where the resulting mixtures can threaten ecosystems and human health. Valentin develops and applies advanced analytical workflows to identify pollutants and their transformation products and to evaluate their environmental behavior. He combines chromatography with high-resolution mass spectrometry to unravel complex environmental samples and develops chemical and computational tools for compound identification. These tools prioritize underexplored areas of the chemical space, such as transformation products of organic contaminants and help to prioritize relevant targets for monitoring and mitigation.

CURRICULUM VITAE

- Since 2024:** Junior Research Group Leader, University of Vienna, Austria
- 2023:** PhD in Analytical Chemistry, University of Münster, Germany



Elizabeth (Liz) Hambleton
DOME

Liz Hambleton’s group studies the evolution and molecular mechanisms of diverse, ecologically important photosynthetic symbioses (‘photosymbioses’) between symbiotic dinoflagellate algae and marine invertebrates. Her main research questions include: how do different host organisms interact on the cellular level with the same intracellular algal symbiont? What are the molecular mechanisms underlying these symbioses, particularly metabolic exchange? Liz’s group combines functional experimentation in model systems, single-cell transcriptomics, metabolomics, and mass spectrometry-based metabolic imaging. Throughout her career, Liz has been an expert in studying molecular mechanisms of coral-algal symbiosis, including the exchange of essential sterol nutrients. In addition, her group is establishing a new model system with the photosymbiotic marine acoel flatworm Waminoa. The group’s ultimate aim is to understand globally widespread and evolutionarily important photosymbioses and their responses to environmental change.

CURRICULUM VITAE

- Since 2020:** Junior Research Group Leader, University of Vienna, Austria
- 2014–2020:** Postdoc, University of Heidelberg, Germany
- 2013–2014:** Early Career Fellow, Center for Ocean Solutions, Stanford University, USA
- 2013:** PhD in Biology, Stanford University, USA

SENIOR SCIENTISTS



Astrid Collingro
DOME

microbial symbioses

chlamydial genome evolution, diversity
and ecology

Fascinated by the interactions between intracellular bacteria and their eukaryotic host cells, Astrid studies bacteria-protist symbioses since her diploma thesis. Currently she works mainly with chlamydial symbionts of diverse host organisms. By using infection experiments, comparative 'omics and phylogenetic methods, she explores how bacteria evolved from symbionts of protists to pathogens of animals and humans. Her work often focuses on yet unexplored chlamydial lineages using 'omics methods, together with different cultivation approaches. Recently, the impact of symbionts of protists on ecosystem processes and microbial community composition – so far overlooked members of ecosystems – have gathered her interest.



Stephanie A. Eichorst
DOME

microbial physiology

soil microorganisms

Acidobacteriota

One gram of soil contains over a million microorganisms, yet much of their function remains unknown. Stephanie started studying soil microbes during her PhD at Michigan State University, and continued as a postdoc at Los Alamos National Lab, coordinator of the Microbial Diversity Course at the Marine Biological Laboratory, and scientist at the Joint Bio-Energy Institute (USA). Since joining the University of Vienna in 2012, she has been investigating soil microorganisms (Acidobacteriota) via cultivation, 'omics methods and metabolic process measurements. She is currently exploring atmospheric gas oxidation as a means of survival during periods of energy limitation, as well as factors governing the use of different terminal oxidases in soil microbes, which may underpin their physiological flexibility.



Bettina Glasl
DOME

marine symbiosis

coral reef microbial ecology

sponge-microbe interactions

Coral reefs are biodiversity hot-spots of our oceans. Understanding how microbes contribute to the health and functioning of these ecosystems has been a central focus of Bettina's joint PhD research at James Cook University and the Australian Institute of Marine Science in Australia. In 2020, Bettina joined the University of Vienna, where she deepened her expertise in the mechanistic interactions between marine sponges and their microbial symbionts. Her research combines field- and aquarium-based experiments with meta-omics approaches, chemical imaging, and advanced fluorescence microscopy, enabling a multifaceted approach to tackling key questions at the forefront of animal-microbe interactions.



Ksenia Guseva
TER

theoretical microbial ecology
interactions shaping ecological dynamics, stability, and function
complex-systems ecology

Microbial communities are highly diverse and complex systems, often composed of many coexisting species that interact in dynamic ways. These interactions can give rise to collective behaviors that are difficult to infer from the properties of individual organisms alone. Ksenia Guseva’s research focuses on developing theoretical frameworks to describe how such communities self-organize. Her work seeks to understand how features of the community shape ecological dynamics and to identify general, reproducible statistical “fingerprints” that characterize these systems. To address these questions, she employs approaches from statistical physics, dynamical systems theory, and individual-based modeling. These methods enable the exploration of relationships between interaction structure, diversity, and ecological dynamics, with the ultimate goal of linking microbial community organization to ecological function.



Thorsten Hüffer
EDGE

fate and transport of particulates
leaching of additives and xenobiotics
environmental exposure pathways and uptake

Thorsten investigates how chemical pollution from plastics and other anthropogenic materials affects ecosystems across aquatic and terrestrial ecosystems. He focuses on the mass transfer processes that govern the release, transport and transformation of additives and plastic-associated chemicals at environmental interfaces. Combining laboratory experiments, field observations, and modelling, he examines how environmental factors such as weathering, turbulence, and biological activity control long-term contaminant emissions from microplastics and tire materials. He also studies the uptake of these chemicals into organisms and food webs, including agricultural crops. His research advances understanding of persistent pollution sources and supports more effective risk assessment and mitigation strategies.



Hanna Koch
DOME

nitrogen cycling
microbial physiology
nitrification

Human activities, such as the overuse of nitrogen-based fertilizers, result in imbalances within the microbial-driven nitrogen cycle posing significant risks to both human and planetary health. Since her PhD at the University of Vienna, Hanna’s primary research interest has been the metabolic and phylogenetic diversity of nitrifying microorganisms, key nitrogen transformers in numerous natural and engineered systems. She deepened her knowledge in microbial genomics and physiology during her postdoctoral positions at the University of Oldenburg (Germany) and Radboud University (Netherlands). Since joining the University of Vienna in 2025, Hanna has applied her expertise in ‘omics’ and other molecular tools to explore the ecology, metabolic capabilities, and environmental interactions of nitrifiers.



Anton Legin
DOME

high-resolution elemental imaging
correlative microscopy workflows
imaging-driven microbiological research

Starting from Institute of Inorganic Chemistry at the University of Vienna, Anton’s main research focus was on investigating the subcellular localisation of metal-based chemotherapeutics in cancer systems. Since joining DOME in 2022, Anton develops and applies correlative imaging approaches that combine electron microscopy, confocal microscopy, and NanoSIMS to map elemental distributions in biological samples. Beyond imaging, his focus is on sample preparation and experimental design as well as workflows for automated data analyses and data interpretation.

His team supports interdisciplinary projects, particularly in the field of microbiology, by integrating imaging workflows and advising on study design. This work enables high-resolution insights into cellular metabolic processes and element dynamics in complex biological systems.



Alejandro Manzano Marín
DOME

animal-microbe symbiosis
host-microbe interactions
genome evolution

Animals are thriving with microbial life, often establishing intimate symbiotic relationships with their tiny companions. When these persist over evolutionary time, they bring about deep changes to both the hosts and their symbionts. Alejandro’s group explores the impact of symbiotic interactions on the biology and evolution of hosts and symbionts at the genomic, metabolic, and morphological levels; working at the interface of molecular evolution, organismal biology, symbiosis, and genomics, their research focuses on two animal systems with nutrient-restricted diets: aphids and blood-feeding leeches; applying genomic, microscopic, and evolutionary methods.



Philipp Martin
EDGE

biochar sorbents for organics remediation
reactive nanoparticles (modified ZVI) for contaminants
mechanistic evaluation using trace analysis and CSIA

The environmental behaviour of organic contaminants – how they sorb, transform and move – determines remediation success and long-term risk. Philipp leads lab-based research on sustainable remediation materials and processes to mitigate legacy and emerging organic contaminants, such as PFAS. He focuses on activated biochars, biochar composites and modified zero-valent iron nanoparticles, evaluating removal mechanisms, longevity and environmental compatibility. Analytical method development (GC-MS, LC-MS, GC-IRMS, LC-IRMS) supports mechanistic insight and source/pathway tracing, allowing to translate mechanistic understanding into low-impact, scalable remediation solutions to reduce ecosystem and human exposure to persistent pollutants.



Marc Mußmann
DOME

aquatic sediments and gastrointestinal tract
element cycling
meta-omics

Marc investigates the valuable ecosystem services provided by aquatic sediments as biocatalytic filters. In particular, he studies the role of microbes in the degradation of organic matter and the oxidation of potentially toxic compounds such as hydrogen sulfide. Here, he currently focuses on mineral-microbe interactions in these environments, applying a range of molecular techniques to elucidate underlying processes. Recently, his research has expanded to gut microbiomes, where he examines microbial community structure and function in relation to host health and metabolic processes. To support research at the UBB, he provides training and technical expertise in flow cytometry.



Petra Pjevac
DOME

microbial ecology of soils and sediments
chemolithoautotrophic microorganisms
multiomic microbiome analysis

Understanding how microbial communities shape Earth's biogeochemical cycles is central to Petra's research. Petra investigates the diversity, function, and ecological roles of microorganisms in complex environments such as soils and sediments, with a particular focus on chemolithoautotrophic taxa. Her work addresses how environmental factors drive community assembly, metabolic interactions, and niche differentiation amongst microorganisms. Combining sequencing-based analyses with physiological experiments and biogeochemical measurements, Petra integrates multi-level data to obtain a deeper mechanistic understanding of microbial processes relevant to ecosystem functioning and global element cycling. In parallel, in her role as director of the Joint Microbiome Facility, Petra and her team support researchers in study design, sequencing data generation, and analysis.



Arno Schintlmeister
DOME

NanoSIMS
SRS
stable isotope probing

Topochemical analysis deals with the structural and chemical characterization of materials. Since its establishment at the University of Vienna in 2010, Arno has worked with nanometer-scale secondary ion mass spectrometry (NanoSIMS), a cutting-edge imaging technique dedicated to (ultra) trace element and high-sensitivity isotope analysis with utmost spatial resolution. Recently, he has extended chemical imaging capacity at CeMESS with the establishment of vibrational spectroscopy-based techniques (Stimulated Raman Scattering Spectroscopy and Mid-Infrared Photothermal Spectroscopy), coupled to fluorescence in situ hybridisation (FISH). After graduation at Innsbruck University, he spent seven years in industry (Plansee SE) before returning to academia (Technical University Vienna). Today, he enjoys collaboration across disciplines, from microbiology and biomedical sciences to geology and materials science.



Markus Christian Schmid
DOME

Raman spectroscopy
microscopy

In the early stages of his career at the Technical University Munich and later at the University of Nijmegen, Markus worked mostly on the detection of microorganisms involved in different parts of the nitrogen cycle. This included ammonia oxidizing bacteria, anaerobic ammonium oxidizers (ANAM-MOX) and denitrifying eukaryotes in many different environments, including wastewater, soil, freshwater and marine systems. Since joining the University of Vienna in 2008, he has continued to work with microscopic techniques and is now responsible for several aspects of microscopy at CeMESS, including epifluorescence and confocal laser scanning microscopy, as well as laser microdissection and Raman spectroscopy.



Hannes Schmidt
TER

soil microbiomes
microenvironments
in situ imaging

Soil microbiomes are fundamental to ecosystem functioning. Since his PhD at the University of Bremen (Germany), Hannes has been studying root-associated archaea and bacteria via multi-scale imaging, sequencing, and stable isotope techniques. Currently, he investigates how soil pore space shapes microbial activity by combining non-invasive imaging of soil structure with microbial ecology. As a co-supervisor of MSc and PhD students, he explores microbial communities and their processes in soils, ranging from the tropics to the polar regions. Hannes is an active member of the university's sustainability initiative and serves as a designated Person of Trust, which keeps him engaged in advancing sustainable practices in both the lab and the office.



Daan Speth
DOME

bioinformatics
nitrogen cycle genomics
protein evolution

Recent advances in sequencing technologies have yielded millions of microbial genomes and dramatically altered our view of microbial diversity. During his PhD at Radboud University (Netherlands), Daan used the lens of (meta) genomics to study microbial communities, transforming nitrogen and carbon in wastewater and marine environments. He continued this work at Caltech (USA) and the Max Plank Institute of Marine Microbiology (Germany), and additionally studied protein families essential for anaerobic microorganisms. At the University of Vienna, he has built databases and tools, such as the GlobDB and AASTK, that leverage the wealth of newly available genome data, and applied these to analyses of nitrogen cycle organisms, as well as protein families of broad environmental relevance.



Martin Stockhausen
EDGE

biodegradable plastics, micro- and nano-
scopic particles

advanced characterization of environmental
matrices

contaminant transport using nanominerals
and anthropogenic tracers

To support a sustainable economy and healthy environment, Martin investigates the environmental fate of contaminants. His work includes tracking the degradation of biodegradable plastics and their transition into micro- and nano-
scopic fragments. By employing advanced analytical techniques like hyphenated mass spectrometry, he explores nanomineral-driven contaminant transport and the application of tracers. This research is crucial for modeling groundwater dynamics and provides the empirical basis for protecting vital environmental systems.



Anton Strunov
DOME

advanced fluorescence microscopy

super-resolution imaging

imaging-based spatial transcriptomics

Understanding the intricate machinery of life requires tools capable of visualizing its smallest components with exceptional precision. Anton brings extensive expertise in fluorescence and electron microscopy to tackle fundamental cell biology questions across diverse biological systems – from bacteria and yeasts to complex tissues such as fly brains and minipig eyes. At the University of Vienna, his work focuses on developing and adapting cutting-edge fluorescence imaging approaches, with particular emphasis on fluorescence lifetime imaging, super-resolution microscopy, and spatial transcriptomics. As a member of the microscopy team at CeMESS, Anton works to optimize imaging workflows and instrument performance, empowering researchers across the Centre to pursue high-impact biological discoveries.



Frank von der Kammer
EDGE

manufactured nanoparticles, micro-
and nanoplastics

environmental colloid chemistry and
analytics

nanotechnology risk assessment

Colloids and nanoparticles constitute a large part of the total reactive surface area of the planet. Their role in environmental processes is only partially understood. Frank develops specific experimental and analytical methods to elucidate the transformation, interaction and general behaviour of colloidal/nanoscale particles in the environment. His group uses the acquired knowledge and sophisticated analytical techniques to better understand environmental nanoscale processes. He supports the risk assessment of nanomaterials by improving our understanding of incidental and manufactured nanoparticles in the environment. This includes development of methods for identification and quantification of nanomaterials in food, cosmetics and the environment, as well as the development of regulatory tools on OECD and ISO levels.

EARLY CAREER RESEARCHERS & STUDENTS

Jaber Abbaszadeh
Sarah Salim Abdulmunem Al-Ajeel
Cristina Alcaraz
Wajdi Allagui
Carlos Arellano
Daniella Oghenenyerhovwo Ayeni
Aline Ballot
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Edo Danilyan
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Nir Shmuel Even
Manuela Pia Felsberger
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Marie-Therese Fischer
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 Daniela Schwarz
 Filip David Seki
 Joana Séneca Cardoso Da Silva
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 David Szamosvari
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 Elena Tiis
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 Bram Vekeman
 Dean Velikov
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 Valerie Wilkeit
 Jan-Philipp Wittlinger
 Jiahui Wu
 Meng Zhang

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 Margarete Watzka
 Chiara Maria Angela Weiß
 Erika Wimmer
 Nora Wittmann
 Michael Wolfram
 Frederic Würth
 Daniela Zetner



EXPANDING KNOWLEDGE



EDUCATION

92 TEACHING

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VDS MES**

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TEACHING

EMPOWERING SCIENTIFIC TALENT FOR THE NEXT GENERATION OF RESEARCHERS AND PROFESSIONALS

CeMESS aims to equip a new generation of researchers across academia, industry, policy, and society with the skills required to address the planetary challenges ahead. To this end, we are engaged at all levels of teaching, from Bachelor's and Master's programmes to doctoral training, across a broad range of disciplines. We teach courses and contribute to curricula spanning microbiology, bioinformatics, ecology, and environmental sciences. Across all teaching activities, we foster a student-centred, research-oriented, and interdisciplinary learning environment.

UNIVERSITY DEGREE PROGRAMMES

At the undergraduate level, we support students in acquiring foundational disciplinary knowledge while developing their ability to critically engage with complex real-world problems. Within the University of Vienna, CeMESS contributes to teaching in the following degree programmes:

BACHELOR'S PROGRAMMES

Biology

Earth Sciences

CeMESS is particularly engaged in teaching at the master's level, where we provide research-led training, that prepares students for careers in academia, industry and the public sector and ensures high employability across diverse professional sectors. Within the University of Vienna, CeMESS contributes to the following master's programmes:

MASTER'S PROGRAMMES

Computational Science

Bioinformatics

Molecular Microbiology, Microbial Ecology, and Immunobiology

Ecology and Ecosystems

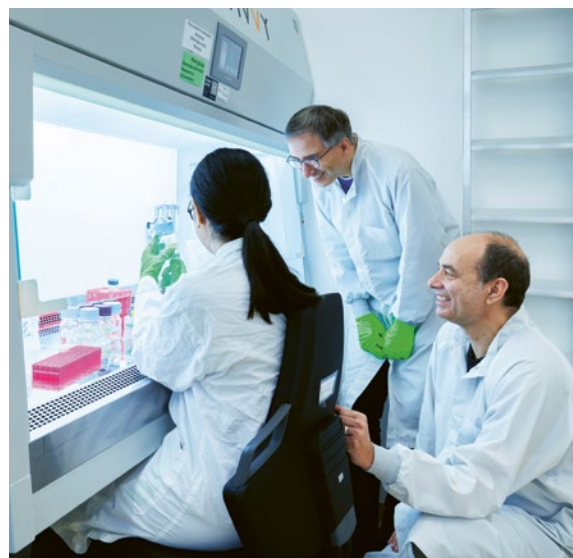
Environmental Systems: Processes, Pollution, Solutions

Earth Sciences

In addition, CeMESS contributes to the development of new interdisciplinary teaching initiatives. The interdisciplinary Massive Open Online Course (MOOC) Environmental Emergencies is one of the University of Vienna's largest sustainability-oriented online courses and is supported strongly by the Centre. With contributions from several CeMESS researchers, the course addresses climate change, biodiversity loss, and pollution from interdisciplinary scientific perspectives and is integrated into multiple curricula as an open educational resource.

INTERNATIONAL FISH COURSE

CeMESS offers an annual summer school for researchers at all career stages interested in fluorescence in situ hybridisation (FISH), an advanced molecular method for studying the structure and function of microbial communities. For over a decade, this course has fostered transnational scientific exchange and collaboration.



DOCTORAL SCHOOL VDS MES

VIENNA DOCTORAL SCHOOL IN MICROBIOLOGY AND ENVIRONMENTAL SCIENCE



The Vienna Doctoral School in Microbiology and Environmental Science (VDS MES), established in July 2020, offers interdisciplinary training at the interfaces of microbiology, ecology, and environmental science. Our PhD students benefit from the collaboration between two internationally recognised research institutions: CeMESS and the Max Perutz Labs.

Since its launch in October 2020, the doctoral school has provided an inspiring environment in which students are empowered to address the major environmental and medical challenges of the 21st century. In an international setting with members from over 25 different countries, our students conduct cutting-edge research using state-of-the-art scientific infrastructure.

Training through research is a core principle of the school, and all PhD students are fully integrated into the faculty's research groups. We complement this research-based training with workshops and seminars on advanced methods, research stays in partner laboratories, one-to-one coaching, annual retreats,

regular team meetings, and individual meetings with supervisors. Additional seminars provide opportunities for students to interact with high-profile international speakers and leading scientists in their fields.

We place great value on fostering an active feedback culture, encouraging students to contribute to the continued development of the programme. Student representatives are in regular exchange with the two heads and the coordinator of the doctoral school, and their ideas have helped shape past and ongoing events, courses, and workshops.

WHAT WE OFFER

We pride ourselves on nurturing a dynamic feedback culture and maintaining regular dialogue with student representatives. The support and opportunities we offer our doctoral students is constantly evolving, and currently includes:

SUPPORT AND OPPORTUNITIES FOR DOCTORAL STUDENTS

Structured onboarding to the doctoral program
Coursework in quantitative methods, bioinformatics, or environmental science
Individual career coaching
Intensive paper writing courses
1-on-1 support for research data management
Visa and residence title support for international PhD students
Financial support (finishing grants, funding for conference attendance)
Annual anonymous supervision surveys
Alumni network
Annual retreats for 1 st , 2 nd , and 3 rd + year cohorts
Community-building events for students and supervisors
Broad soft skills training in cooperation with the University's central services



FACTS AND FIGURES

A SNAPSHOT FROM WINTER SEMESTER 2025/2026

STUDENT NATIONALITIES

VDS MES students hail from diverse corners of the world.
26.32% Austria
14.74% Germany
22.11% other EU countries
36.84% outside the EU

FEMALE REPRESENTATION

VDS MES takes pride in our community with 59% female students and 39% female faculty, championing inclusivity and representation in science.

19+10+14 GRADUATES

Annually, in our last three years of operation (2023 to 2025).

92 STUDENTS IN 2025

92.4% FULLY FUNDED

Either through Third-Party Funding or the University of Vienna (72%), external institutions (14%), or self-funded through grants or stipends (6,4%).

3 FIELDS OF STUDY

Our Doctoral School comprises diverse fields of research, hosting 69 Students in Biology, 19 in Environmental Sciences and 4 in Molecular Biology.

1:2.8 FACULTY: STUDENT RATIO

With 33 faculty members and 92 students, we're proud to offer an exceptional faculty-to-student ratio that ensures detailed supervision and access to research opportunities for each of our students.

ENGAGEMENT BEYOND ACADEMIA



Research at CeMESS touches on questions of direct public relevance: climate change, environmental pollution, human health, soil health, and planetary health. This chapter describes how our work reaches beyond the Centre, through public communication, scientific service, and the building of research communities.

SCIENCE COMMUNICATION AND PUBLIC ENGAGEMENT

CeMESS researchers regularly communicate their research findings through newspapers, television and radio, documentaries, and podcasts across Austria, Germany, Switzerland, and beyond. They also participate in public lectures and dialogue formats both nationally and internationally. Ongoing engagement

formats include *Umwelt im Gespräch*, the *Lange Nacht der Forschung*, and *KinderUni*, alongside school outreach, teacher training, exhibitions, and digital media activities. In 2025, these activities reached around 1,000 participants.

The Centre also contributes to science communication initiatives of the Austrian Science Fund (FWF). In 2025, CeMESS was represented at the University of Vienna delegation to EXPO 2025 in Osaka.

SCIENTIFIC SERVICE AND POLICY ADVICE

Centre researchers advise governmental institutions, international organisations, and public stakeholders on environmental pollution, ecosystem health, microbiome science, and sustainability. In 2025, CeMESS researchers provided scientific briefings to the Austrian and European Parliament on the role of microbiomes in human health.

CeMESS researchers also serve on expert bodies where scientific findings are translated into standards, guidelines, and recommendations. Members of the Centre contribute to standardisation work at ISO and CEN (e.g. methods for measuring microplastics in soils), as well as to expert groups at the OECD level. Although taking place behind the scenes, this work determines how substances are measured, assessed, and regulated across Europe.

BUILDING SCIENTIFIC COMMUNITIES

Several Centre members lead initiatives that connect researchers across institutional boundaries. The Environment and Climate Research Hub (ECH), directed by Thilo Hofmann, links environmental research across the University of Vienna and supports exchange between science, policy, and society. The Vienna Center for Advanced Studies (ViCAS), for which Michael Wagner serves as spokesperson, promotes interdisciplinary exchange and international visibility. CeMESS researchers also play active roles in national networks, including the Austrian Microbiome Initiative (AMICI) and the Austrian Polar Institute (APRI).



CeMESS participation @ Lange Nacht der Forschung 2026
Credit (pp 96-97): Zsolt Marton



**BUILT TO BE
SHARED**

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COMPARATIVE GENOMICS

Life on Earth has been evolving for billions of years. Living organisms inhabit virtually every environment, surviving and thriving under extremes of temperature, radiation, pressure, salinity, acidity, and darkness. Many of these environments are exclusively colonised by “simple” microorganisms, where energy is derived from chemical compounds that only microbes can exploit. Their extraordinary genetic and metabolic diversity, together with their range of environmental adaptations, indicates that microbes long ago “solved” many problems for which scientists and engineers are still seeking solutions, from carbon capture to nitrogen fixation.

The secrets to microbial adaptations are encoded in their genomes, which contain the genetic instructions to build functioning organisms. Since the first complete bacterial genome was sequenced in 1995, the number of available genomes has grown exponentially. These vast datasets require advanced computational methods to unlock the potential of genomic data for studying microbial evolution, adaptation, and gene function, and ultimately for developing new medical and environmental applications.

Most microorganisms and viruses cannot be cultivated in the laboratory. We therefore use culture-independent approaches, including amplicon sequencing and metagenomics, to analyse nucleic acids directly from environmental samples and investigate the diversity, structure, and functional potential of microbial communities. State-of-the-art sequencing technologies, combined with computational methods, enable us to reconstruct complete genomes from metagenomic data, study microbial population structure, and predict phenotypic traits from genome sequences.

CeMESS is involved in a broad range of genome sequencing and metagenomics projects and has established advanced tools and workflows for interpreting genomic and metagenomic data. We run the Joint Microbiome Facility (JMF), a joint initiative with the Medical University of Vienna, manage the Life Science Compute Cluster LiSC, contribute to the maintenance and improvement of genomic data in public databases, and develop new software to push the limits of accuracy and throughput in computational genomics.

OUR METHODS, AT A GLANCE

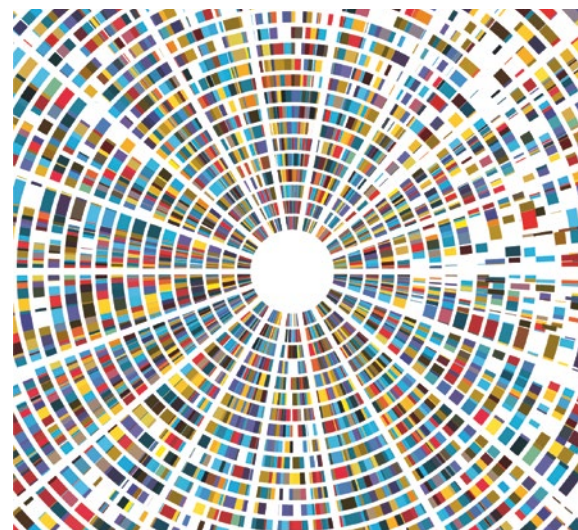
High-throughput community profiling using short- and long-read amplicon sequencing

Genome annotation: EffectiveDB, SIMAP, pCOMP, GenSkew, ConsPred

Functional genomics: NVT

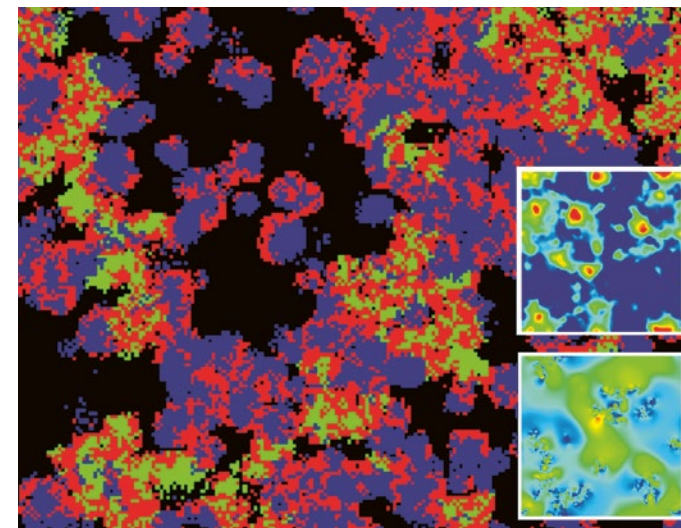
Comparative Genomics: Gepard, PICA, PhenDB, DeepNOG, VOGDB, GlobDB

Metagenomics: probeBase, HoloVir



Genome sequence map, artist impression.
Credit: Tetiana Lazunova

MICROBIAL COMMUNITY MODELLING



OUR METHODS, AT A GLANCE

Individual-based microbial community modelling

Population dynamics of microbial consortia (by Lotka-Volterra and Consumer-resource models)

Joint species distribution modelling

Co-occurrence networks in environmental samples

Computational models for molecular inter-species interactions

Computational prediction of phenotypic roles of bacterial species

Steady-state modelling of the metabolism of species and microbial communities

Microbial communities in natural environments comprise a diverse array of functionally distinct individuals. These communities are intricate networks in which microbes interact through competition, predation, and subtle interactions like metabolite exchange. These interactions are pivotal in driving community metabolism and ecosystem behaviour across ecological and evolutionary timescales, influencing how ecosystems respond and adapt to environmental change. Yet understanding how these interactions and their outcomes give rise to emergent collective phenomena beyond properties of individual organisms remains a major challenge.

At CeMESS, we use mathematical modelling to uncover the underlying mechanisms that govern the dynamics and functioning of these complex microbial communities. Our approach involves various types of mathematical models, each designed to shed light on different aspects of microbial life. Individual-based modelling simulates competitive and synergistic

interactions among microbial decomposers within structured micro-environments, helping us to understand how system properties emerging from these interactions influence overall community behaviour.

We develop complex consumer-resource models to explore microbial population dynamics during the decomposition of organic matter. In addition, we use individual-based modelling to simulate competitive and synergistic interactions among microbial decomposers within structured micro-environments, helping us understand how system properties emerging from these interactions influence overall community behaviour. We also develop new tools to infer microbial interaction networks. Using network models based on Lotka-Volterra dynamics and approaches like time series analysis, we evaluate how diverse interactions affect community properties, such as stability and resilience. By integrating meta-omic data, we are able to predict the structure of metabolic pathways, phenotypic roles, and growth rates of microbial species. Our steady-state metabolic modelling extends this understanding, predicting how these communities respond to changes in nutrient availability and other key factors, including host influences. This comprehensive modelling approach is integral to advancing our understanding of microbial community dynamics and their environmental (and medical) implications.

Snapshot of an individual-based model simulation of microbes belonging to three different functional groups decomposing leaf litter. Each coloured dot represents a microbe, inserts show distribution of soluble metabolic products. Credit: Christina Kaiser

MICROSCOPY FOR MICROBIAL IMAGING



Microorganisms and viruses inhabit every ecosystem on our planet, yet this microbial world remains invisible to the naked eye. Indeed, its existence remained unknown until the invention of the microscope over three centuries ago, which revealed the extraordinary richness of microbes in the environment and the human body. Today, microscopy remains a key technique in modern microbiology and microbiome research, providing the foundation for advanced fluorescence and chemical imaging methods.

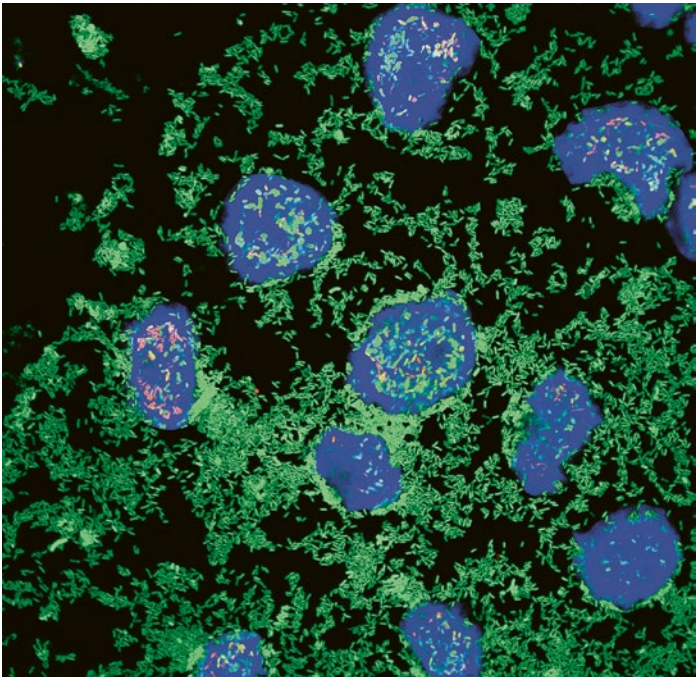
State-of-the-art light microscopes are highly complex devices that have little in common with their seventeenth-century predecessors. Of particular importance for microbiome research at CeMESS is

fluorescence light microscopy combined with methods like fluorescence in situ hybridisation (FISH) and immunofluorescence, which enable specific microorganisms or their molecular components to be labelled with fluorescent dyes. Modern confocal laser scanning microscopes (CLSMs) record sharp, three-dimensional images of labelled microbial communities, allowing us to study the composition and spatial structure of complex microbiomes in detail.

CeMESS is well equipped for confocal and epifluorescence microscopy, and these techniques underpin a wide range of research projects. Yet even our most advanced conventional light microscopes are constrained by the diffraction limit, with a spatial

resolution of approximately 200 nm, leaving finer details beyond reach. With its high-end multicolour stimulated emission depletion (STED) microscope, CeMESS extends its imaging capabilities well into the super-resolution range. This instrument enables the visualisation of microbes and viruses at resolutions below 50 nm, providing unprecedented insight into their molecular architectures and interactions. By making previously inaccessible structural features observable, STED microscopy is a powerful tool for advancing research at the Centre at the highest level. Building upon these imaging capabilities, digital image analysis is essential for quantifying complex microbial

community features, such as spatial localisation patterns of populations, that are only accessible through microscopy. To achieve this, we develop image analysis software tailored to the specific needs of microbiome research, which is utilised in our own studies and widely adopted by the scientific community.



Acanthamoeba spp. (blue) hosting varied intracellular bacterial symbionts (yellow, red), amidst a bacterial matrix (green) serving as nourishment. FISH image captured via CLSM. Credit: Nadja Holzleitner

OUR METHODS, AT A GLANCE

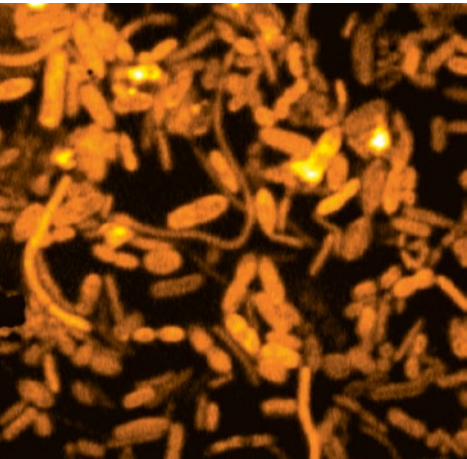
Detecting and visualising specific microorganisms and molecular components by fluorescence labeling techniques and fluorescence microscopy

Confocal laser scanning microscopy for visualising complex microbiomes in all three spatial dimensions

Super-resolution, multicolor confocal stimulated emission depletion (CLSM-STED) imaging for resolving fine structural details of microbial cells and viruses

3D visualisation and image analysis software “daime” (developed in-house)

SINGLE CELL ANALYSIS



OUR METHODS, AT A GLANCE

- Single-cell chemical imaging using NanoSIMS, spontaneous Raman microspectroscopy, stimulated Raman scattering (SRS) and mid-infrared photothermal (MIP) microscopy
- Visualising and quantifying uncultured microbial cells by fluorescence in situ hybridisation (FISH) and confocal laser scanning microscopy (CLSM), including stimulated emission depletion (STED) microscopy
- Single cell manipulation and sorting by laser microdissection
- Flow cytometry and fluorescence activated cell sorting, and Raman-activated microfluidic cell sorting
- Visualizing transcriptional profiles of single cells using mRNA FISH
- Single cell mass determination using a suspended microchannel resonator device (LifeScale)

Visualizing deuterium incorporation of defined human gut microbiome members using SRS and FISH. Credit: Xiaowei Ge, Fatima Pereira, and Jannie Munk Kristensen.

Virtually all microbial communities on our planet are dominated by a great diversity of uncultured microorganisms that cannot be studied using traditional approaches in microbiology. In their natural habitats, microbes often coexist in spatially complex assemblies, colonising sediments, soils, roots, teeth, the gut, and many other environments with intricate three-dimensional structures. Within these consortia, microbes are influenced by numerous abiotic factors (e.g., fluctuations in nutrient concentrations) and engage in a wide range of biotic interactions.

To understand this complex microbial life, we must look directly at single cells and the microscopically small niches in which they thrive and interact with other organisms. Only by doing so can we decipher the in situ metabolic activities and symbiotic relationships of uncultured microbes. However, single-cell microbiology presents enormous methodological challenges, given the tiny size of microbial cells and the extremely low quantities of substrates that are taken up, utilised, and exchanged by individual cells.

CeMESS plays a leading role in developing and applying single-cell techniques to study uncultured microorganisms in situ. Our toolbox includes cutting-edge methods for labelling cells with isotope tracers, detecting metabolic activities at the single-cell level, monitoring the flow of substrates through microbial communities, resolving three-dimensional localisation patterns of microbial cells, and activity-based cell sorting for downstream analyses and single-cell genomics. These powerful approaches underpin our research projects across the Centre. We continually optimise and adapt our single-cell tools to address new research questions and extend their sensitivity, accuracy, and spatial resolution.

GNOTOBIOTIC MICE

Conventional laboratory mice naturally harbour complex microbial communities. As a result, it is often difficult to determine whether a particular microbe directly causes a physiological effect or is merely associated with it. Gnotobiotic systems overcome this obstacle by allowing scientists to manipulate microbial exposure under tightly controlled conditions and directly test causal relationships between microbes and host phenotypes.

The term “gnotobiotic” means “known life,” referring to animals whose microbial status is completely defined. These mice are typically raised in sterile isolators and may be germ-free, containing no microorganisms at all, or colonised with specific microbes selected by researchers.

At CeMESS, we use gnotobiotic mice to understand how interkingdom interactions shape intestinal microbial ecology and affect the health of the host. We employ minimal defined microbial consortia – microbial communities with precisely known compositions – including the Altered Schaedler Flora, the Oligo-Mouse-Microbiota, together with genetically engineered bacterial strains that gain or lose key metabolic functions. This enables us to uncover the principles governing microbe-microbe and microbe-host exchanges in the gut.

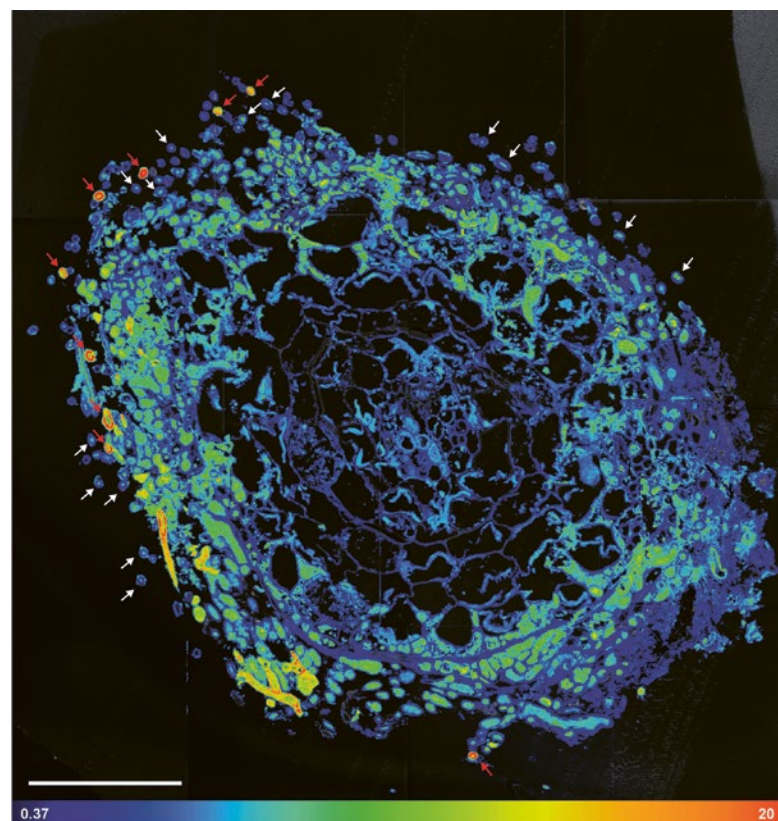
OUR METHODS, AT A GLANCE

- A colony of germ-free C57Bl/6 mice
- Individually ventilated cages, providing maximal flexibility for experimental setups
- Expertise in colonising animals with defined microbial consortia
- Capacity for infection with viral or bacterial pathogens, as well as metabolic challenges (for example, diets)
- Deep immune phenotyping using spectral flow cytometry

ISOTOPE BIOGEOCHEMISTRY

Isotope approaches provide powerful and often unique insights across ecology, ecosystem science, and environmental research, and are essential for biogeochemistry. They are central to linking microorganisms to their ecological functions, studying uncultivable taxa, and resolving host-microbe interactions. Beyond microbial systems, isotope techniques enable the quantification of ecosystem-scale processes and are instrumental in tracing carbon and nutrient fluxes from the plot to the global scale, resolving source-sink relationships, estimating the fate of chemicals and contaminants in the environment, and elucidating changes in biogeochemical cycling under changing environmental conditions.

At CeMESS, we employ a comprehensive suite of isotope-based methods spanning light and heavy elements, including stable, radiogenic, and radioactive isotope systems. Our core expertise centres on elements fundamental to the biosphere (hydrogen, carbon, nitrogen, oxygen, sulfur, and phosphorus), while extending to heavier elements that serve as environmental contaminants (e.g., mercury) or tracers of geological origin and provenance (e.g., strontium). These approaches are underpinned by a dedicated analytical infrastructure, including the Stable Isotope Facility SILVER, Environmental Mass Spectrometry (EMS), and high-resolution imaging platforms such as NanoSIMS.



NanoSIMS visualisation showing ^{15}N enrichment within an ectomycorrhizal root tip of beech (*Fagus sylvatica*) associated with fungi from the genus *Thelephora*. Credit: Christina Kaiser

Our work encompasses three complementary isotope-based approaches. Firstly, we employ stable and radioisotope tracing to quantify biogeochemical processes. This includes tracer applications to resolve carbon, nitrogen, phosphorus, and sulfur transformations, nitrogen fixation, organosulfur decomposition, and microbial metabolism of organic substrates across environments ranging from soils to aquatic and host-associated systems. Isotope pool dilution approaches are routinely applied to quantify gross rates of microbial nitrogen and carbon transformations, such as N mineralization and nitrification, and depolymerization of naturally occurring organic matter, providing process-level resolution of production and consumption fluxes.

Secondly, we use isotope-enabled approaches to directly link microbial identity and function. Stable isotope probing (SIP) allows the identification of active microorganisms based on ^{18}O - or ^2H -labelled water incorporation into biomarkers such as nucleic acids or membrane lipids. Complementary, radioisotope-based techniques, including microautoradiography combined with fluorescence in situ hybridization (FISH), enable highly sensitive quantification of substrate uptake while assigning activity to specific taxa. At the microscale, NanoSIMS and Raman spectromicroscopy provide quantitative chemical and isotopic imaging at subcellular resolution, resolving metabolic heterogeneity within microbial populations.

Thirdly, we apply natural abundance isotope approaches and non-traditional isotope systems to trace matter fluxes and constrain source-sink relationships in a non-invasive manner. These approaches are complemented by isotope hydrology techniques to elucidate water and solute movement, and by emerging heavy element isotope systems that provide additional resolution of complex environmental processes across spatial and temporal scales, such as strontium isotope geochemistry to resolve mobility and landscape use.

Overall, these methodological advances are enabled by the tightly integrated isotope facilities at CeMESS, which continue to expand our ability to resolve the mechanistic basis of microbial ecology, biogeochemical cycling, and pollutant dynamics, from single cells and molecular processes to ecosystems and global-scale systems.

OUR METHODS, AT A GLANCE

Isotope pool dilution measurements and the use of natural stable isotope abundances for studying microbial cycling and tracing matter flow in ecosystems

Isotope hydrology and non-traditional isotope geochemistry for complex environments

Stable and radioisotope probing techniques, including isotope microarrays and FISH-microautoradiography

NanoSIMS and Raman spectroscopy for stable-isotope imaging

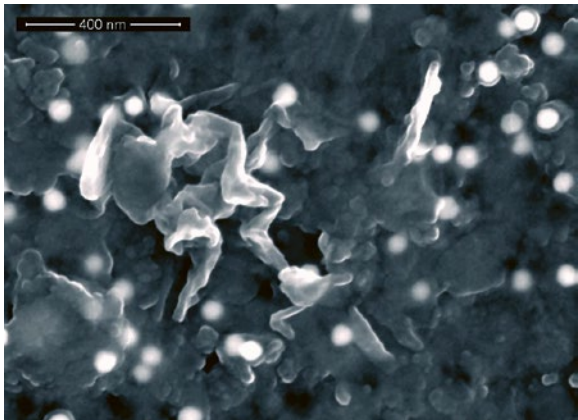
MICRO- AND NANOPARTICLES IN THE ENVIRONMENT

Natural nanoparticles play a pivotal role in many environmental processes, representing the largest fraction of the reactive surface area in soils and sediments and bridging the gap between solutes and solids. Over the past two decades, engineered nanomaterials (ENMs), advanced materials (AMs) and micro-/nanoplastics (MNPs) have brought renewed attention to the behaviour of particulate pollutants in the aquatic and terrestrial environment and the risks they may pose.

Since 2005, CeMESS researchers have been at the forefront of developing analytical and mechanistic approaches for the detection and characterisation of particulate contaminants in complex environmental matrices, food systems, and consumer products. This work includes the identification of ENMs against high natural background concentrations, tracing the fragmentation and transformation pathways of biodegradable MNPs in soils and composting systems, and attributing sources of automotive catalyst and brake-wear particles in urban environments through elemental and isotopic fingerprints. This work has resulted in internationally recognised, validated methodologies and contributed to the development of two OECD Test Guidelines for environmental risk assessment of ENMs.

Investigating the critical role of these micro- and nanoparticles in environmental processes requires specialised instruments and methodologies beyond those typically available in environmental chemistry. At CeMESS, we combine advanced analytical chemistry, particle physics, environmental process research, and high-resolution imaging to quantify, characterise, and mechanistically understand particulate materials across environmental compartments. Our integrated workflows span environmental sampling, contamination control, sample preparation, single-particle analysis, spectroscopic identification, and quantitative process characterisation.

We apply laser-based particle sizing techniques, including beam shading and static and dynamic light scattering, to determine particle size distributions ranging from 0.6 nm to 600 µm. We further use Raman



microspectroscopy and complementary high-resolution analytical approaches to investigate fragmentation, ageing, and transformation processes of MNPs in compost, soils, sediments, and urban environmental matrices.

In our internationally leading laboratory for field flow fractionation (FFF) analysis, we operate three instruments coupled to multi-detection systems, including ICP-MS/MS. For multi-element single particle analysis in the attogram range, we operate two of the few inductively coupled plasma time-of-flight mass spectrometers (ICP-TOFMS) in Europe, jointly with the Faculty of Chemistry. Together, these analytical platforms and methodological developments enable the characterisation of micro- and nanoparticles in complex environmental matrices with unprecedented sensitivity and resolution, providing insights into the “world of neglected dimensions”.

OUR METHODS, AT A GLANCE

- Laser-based particle sizing techniques
- Dynamic light scattering/laser doppler anemometry
- Field flow fractionation analysis (FFF) and size exclusion chromatography
- Inductively coupled plasma-time of flight mass spectrometry (ICP-TOFMS)

Gold nanoparticles (30 nm) among natural soil-derived nanoparticles in a scanning electron microscope.

ENVIRONMENTAL TRACE ANALYSIS OF POLLUTANTS

The release of contaminants into the environment – including synthetic organic compounds, transformation products, heavy metals, and radioactive materials – poses major risks to environmental and human health. At CeMESS, our goal is to develop fundamental insights into these pressing environmental challenges and inform lasting solutions. To this end, we investigate the processes that govern the fate, transformation, and mobility of contaminants in aquatic and terrestrial systems. We develop and apply quantitative and molecular-scale analytical approaches to study organic and inorganic trace compounds and elucidate the key processes that determine their behaviour in the environment. Our methodologies span the full analytical workflow, from field sampling and sample preparation to controlled laboratory experiments, advanced chemical analysis, and data analysis. This infrastructure is coordinated through the Environmental Mass Spectrometry Facility.

These approaches enable us to investigate the transformation of organic contaminants under controlled conditions, including complete biodegradation assessed by respirometry and isotope-specific spectrometry. Transformation products are identified and characterised using liquid chromatography coupled to

high-resolution mass spectrometry. Complementary laboratory-scale experiments provide mechanistic insights into sorption processes relevant to contaminant mobility and remediation. These findings are then translated to the environmental scale through field studies based on the quantification of organic contaminants using liquid chromatography coupled to tandem mass spectrometry. For elemental analysis, we use inductively coupled plasma optical emission spectrometry (ICP-OES) for high-throughput analysis of major and trace elements across diverse matrices. In addition, inductively coupled plasma mass spectrometry (ICP-MS and ICP-MS/MS) enables ultra-trace analysis of metals, metalloids, sulphur, and phosphorus. These capabilities are applied, for example, to investigate metal transformation and leaching from brake wear particles in lung lining fluids and, in combination with liquid chromatography, chromium(III)/chromium(VI) speciation in redox-variable systems.



Preparation for analysis of trace contaminants in an environmental sample. Credit: Thomas Suchanek

OUR METHODS, AT A GLANCE

- Chromatographic separation with mass spectrometry for organic pollutant analysis
- High-resolution mass spectrometry for identifying organic chemicals and transformation products
- ICP-OES for high-throughput elemental analysis
- ICP-MS and ICP-MS/MS for ultra-trace elemental analysis



FACILITIES

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118 SILVER

119 NANOSIMS

120 EMS

LiSC

LIFE SCIENCE COMPUTE CLUSTER

CeMESS operates the Life Science Compute Cluster (LiSC), a medium-sized high-performance computing facility specialised in bioinformatics and computational life science. Unlike large, generic computing facilities such as the Vienna Scientific Cluster (VSC), LiSC is optimised for biological data analysis. It provides a rich, flexible, and up-to-date bioinformatics software repository, local copies of major biological databases, and high-speed storage for the processing of large datasets. Most users are able to analyse their data simply by using pre-installed tools and databases, without the need for additional software installation.

The cluster is based on common PC architecture and contains several login nodes for job testing and submission, compute nodes, and data storage infrastructure. It contains more than 4000 CPU cores and up to 4 TB RAM per node. Copies of relevant biological databases (such as NCBI nt and nr) are available. Local

high-speed disks in all compute nodes accelerate I/O intensive tasks. Software is managed through a modular environment that allows different applications and software versions to be activated and deactivated as needed. The storage system has 8 petabytes of total capacity, based on redundant, parallel filesystems. In addition, a redundant virtualisation cluster hosts specific working environments. Virtual machines are used to operate our publicly available resources, such as web portals, databases and user-friendly visualisation tools.

The Life Science Compute Cluster is operated by CeMESS together with the Faculties of Chemistry and Life Science, the Max Perutz Laboratories, and collaborators within and beyond the University of Vienna. As many users are non-specialists in high-performance computing, CeMESS provides comprehensive user support, including a dedicated help-desk and software installation support.



Login nodes, compute nodes, server nodes and storage nodes, all mounted in 19" racks and housed at the University of Vienna Biology Building (UBB). Credit: Joseph Krpelan

JMF

JOINT MICROBIOME FACILITY



AVAILABLE SERVICES INCLUDE

Illumina MiSeq-based highly multiplexed gene amplicon sequencing (e.g. 16S rRNA genes, 18S rRNA genes, ITS region)

Amplicon sequences variant (ASV) inference and classification; biostatistical data analyses

Illumina HiSeq-/NovaSeq-based (meta-)genome and (meta-)transcriptome sequencing Oxford Nanopore MinION and PromethION technologies for long-read sequencing

Taxonomic and functional profiling of omic datasets; metagenome assembly binning, and metagenome assembled genome (MAG) annotation and classification; transcriptional profiling and differential transcriptome analysis

The Joint Microbiome Facility (JMF) provides advanced 'omics sequencing workflows and analytical pipelines to investigate and characterise complex microbial communities. In recent years, scientists have increasingly recognised the critical role of microbiomes in both human and environmental health. Microbiome research is rapidly expanding, with new programs and institutions being established worldwide. Equipped with state-of-the-art technology and world-class expertise, the JMF supports both local and international research groups in conducting high-quality sequencing-based microbiome research.

Our facility offers individualised consulting services at all stages of the research process, from experimental design to sample processing, sequencing, bioinformatic analysis, and data interpretation. We provide a range of cost-effective, high-throughput services that enable researchers to comprehensively assess microbial composition and activity in their systems. These services include DNA/RNA extraction from diverse sample types, gene amplicon sequencing, full-length primer-free rRNA profiling, and metage-

nomic and meta-transcriptomic shotgun sequencing. Specifically, we offer Illumina MiSeq-based highly multiplexed gene amplicon sequencing (e.g. 16S rRNA, 18S rRNA, ITS), Illumina NovaSeq-based metagenome and metatranscriptome sequencing, as well as long read (Oxford Nanopore Technologies based) microbial isolate genome and metagenome sequencing. For all sequencing datasets generated by the JMF, we also offer bioinformatics support, including data QC, as well as standardised processing and analyses using in-house developed or maintained workflows.

Established in 2018, the JMF is a collaborative venture between the Medical University of Vienna and the University of Vienna. We have extensive expertise in characterising microbial communities from a wide range of habitats, including human, animal, and plant microbiomes, as well as soils, sediments, aquatic environments, and hot springs. Beyond providing sequencing services, the JMF is actively advancing the field of microbiome research by benchmarking existing approaches and developing new technological and analytical strategies.

The Oxford Nanopore PromethION System enables high throughput long read sequencing for generating high quality (meta) genomic datasets. Credit: Joseph Krpelan

SILVER

STABLE ISOTOPE FACILITY OF THE UNIVERSITY OF VIENNA FOR ENVIRONMENTAL RESEARCH

The Stable Isotope Facility of the University of Vienna for Environmental Research (SILVER) specialises in the analysis of stable isotopes of light elements in environmental samples. It is the largest facility of its kind in Austria and among the leading laboratories for ecological stable isotope research in Europe. At SILVER, we analyse isotopes of key biosphere elements, including hydrogen, carbon, nitrogen, oxygen, and sulfur, which occur naturally in multiple stable (non-radioactive) forms. The ratios of heavy to light isotopes (e.g., $^{13}\text{C}/^{12}\text{C}$ or $^{15}\text{N}/^{14}\text{N}$) provide quantitative insights into physical, chemical, and biological processes, as well as the sources and sinks of matter in environmental systems. In addition, experimental enrichment with heavy stable isotopes enables precise tracing of compounds through complex biogeochemical pathways, providing process-level resolution that is not achievable through other approaches.

SILVER is part of the Large-Instrument Facility for Advanced Isotope Research at the University of Vienna. The facility operates five continuous-flow isotope ratio mass spectrometers (IRMS), each tailored to specific analytical applications. These include an elemental analyser (EA-IRMS) for determining ^{13}C and ^{15}N in solid samples, a high-temperature pyrolysis system

for ^2H and ^{18}O analyses in solids and liquids (TEC/EA-IRMS), and a headspace analyser (Gasbench-IRMS) for measuring stable isotopes in trace gases. In addition, compound-specific isotope analyses are performed by coupling IRMS to liquid chromatography (LC-IRMS) and gas chromatography (GC-IRMS), enabling the determination of ^{13}C , ^{15}N , and ^2H in individual organic compounds.

INSTRUMENTATION OF THE SILVER FACILITY

EA – IRMS: Elemental analyser for ^{13}C and ^{15}N in solid environmental samples

Pyrolysis-IRMS: High-temperature pyrolysis system for ^2H and ^{18}O in solid samples and water

Gasbench-IRMS: Trace gas pre-concentrator for ^{15}N analysis of N_2O , and for ^{13}C analysis of CO_2 and CH_4 , and ^{18}O and ^2H analysis of water

LC-IRMS: HPLC-Isolink for ^{13}C analysis of organic solutes

GC-IRMS: GC-Isolink for ^{13}C , ^{15}N and ^2H analysis in organic analytes



A suite of isotope ratio mass spectrometers (IRMS) for bulk and compound-specific analysis of hydrogen, carbon, nitrogen and oxygen in environmental samples.
Credit: Reinhold Leitner

NANOSIMS

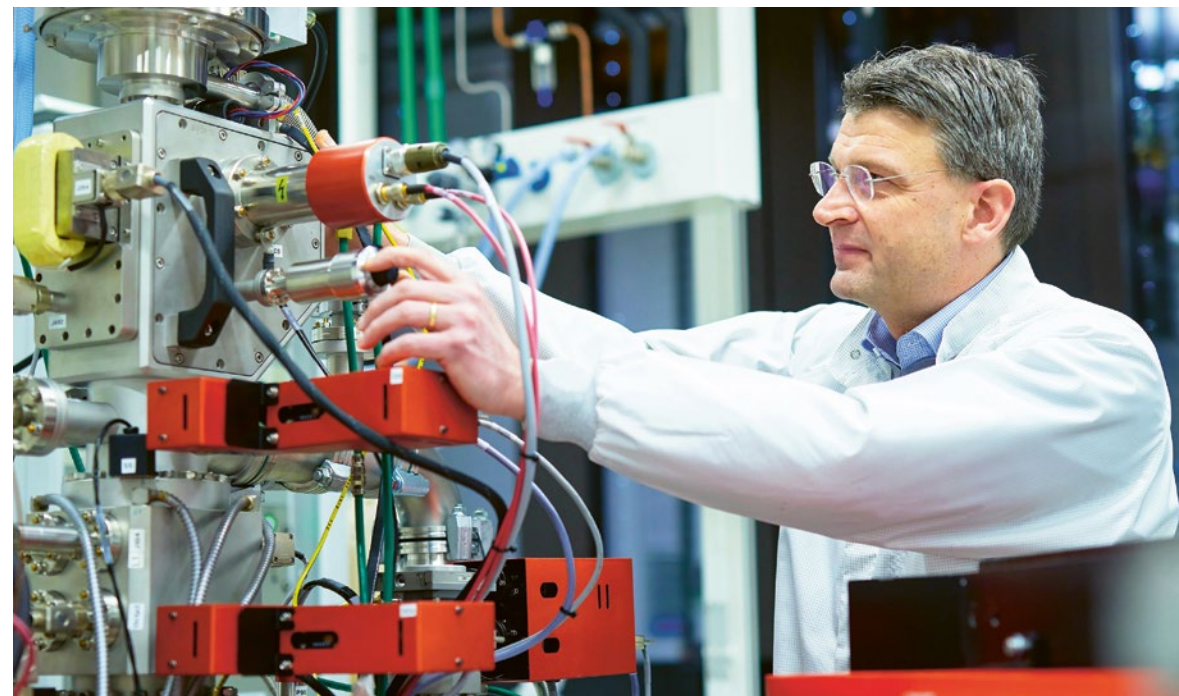
NANOSCALE SECONDARY ION MASS SPECTROMETRY

Acquired in 2010 as part of the Large-Instrument Facility for Advanced Isotope Research, CeMESS operates a CAMECA NanoSIMS 50L. NanoSIMS is an advanced type of secondary ion mass spectrometer (SIMS) that allows us to determine the content of trace elements and isotopes with utmost sensitivity, down to sub-micrometer scales – smaller than a single microbial cell. It does this by bombarding a sample with a focused ion beam, which causes atoms and molecules from the sample to be ejected. The fraction of ionized particles is then detected based on the mass-to-charge ratio. NanoSIMS can detect up to seven distinct secondary ion species simultaneously, at single-ion-counting sensitivity. This method is perfectly suited for visualising where different elements and isotopes are located in a variety of materials, ranging from sub-micrometer sized grains of minerals and alloys to tissues and microbial cells even down to the sub-cellular level.

At CeMESS, the NanoSIMS is primarily used for research in microbial ecology. It is often combined

with other techniques like stable isotope probing and bulk analysis with isotope ratio mass spectrometry (EA-IRMS), as well as optical microscopy techniques like fluorescence in situ hybridisation (FISH). With this approach, we can learn about the phylogenetic identity, physiological function and interactions of microbes in various environments, such as soils, microbial mats, activated sludge, deep groundwater and even within symbiotic host organisms. In recent years, the NanoSIMS has been upgraded with a new oxygen ion source, enhancing its capabilities in ultra-trace metal analysis. This allows for new types of studies, like investigating the role of metals in microbial cells.

This instrument is the only one of its kind in Austria. As such, the NanoSIMS facility at CeMESS collaborates with a wide range of research groups, both locally and internationally. Beyond conducting measurements, we also provide extensive support in designing studies, preparing and pre-characterising samples, and evaluating and interpreting data.



Refining settings on the CAMECA NanoSIMS 50L
Credit: Ludwig Schedl

EMS

ENVIRONMENTAL MASS SPECTROMETRY



The Environmental Mass Spectrometry Facility (EMS) provides state-of-the-art mass spectrometry for studying environmental processes at the nanometre and molecular scale. Since 2005, our facility has pioneered novel methods in environmental analytical chemistry designed to address relevant questions in terrestrial and aquatic systems research. Our research focuses on natural and anthropogenic contaminants, encompassing a wide range of organic and inorganic chemicals, including substances of unknown structure, substances of emerging concern, and transformation products. At the EMS, we detect substances down to ultra-trace levels, investigate stable isotope fractionations, and conduct non-target analysis. Our studies include the identification of unknown contaminants, source tracing, and the investigation of processes controlling the biogeochemical cycling of metals.

In addressing research questions related to organic chemicals, we analyse environmental and laboratory-derived samples using separation techniques coupled to mass spectrometry. For example, liquid chromatography coupled to high-resolution mass spectrometry (LC-HRMS) enables the detection and identification of unknown organic chemicals and transformation products of known chemicals. Complementarily, we use gas and liquid chromatography paired with triple

quadrupole mass spectrometry for the precise quantification of a wide range of relevant organic substances at trace levels, ranging from conventional non-polar substances leaching from plastics to chemicals of emerging concern such as tyre additives, pharmaceuticals, pesticides, and PFAS.

Our suite of analytical infrastructure addressing inorganic contaminants includes time-resolved inductively coupled plasma time-of-flight mass spectrometry (ICP-ToF-MS), which records elemental mass spectra down to attogram levels in single nanoparticles. Triple quadrupole ICP-MS (ICP-MS/MS) offers flexibility in method development and unrivalled control of interferences, delivering greater accuracy and more consistent results. Coupled with size exclusion chromatography or field-flow fractionation, these approaches enable high-resolution analysis of elemental composition as a function of molecular weight or particle size in the nanometre size range. The EMS conducts research in cooperation with researchers from CeMESS, the Faculties of Chemistry, Earth Sciences, and Life Sciences, and with other national and international partners.

Assembling a high-resolution mass spectrometer of the EMS for environmental chemical analyses.
Credit: Thomas Suchanek

LOCATIONS



VIENNA BIOCENTER

The University of Vienna Biology Building (UBB) is part of the Vienna BioCenter Campus, one of Europe's leading centres for life science research. Located in Vienna's third district, the campus is home to 6 research institutions (including CeMESS), almost 40 biotech companies, several research facilities, and more than 2,800 researchers from over 80 countries.



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