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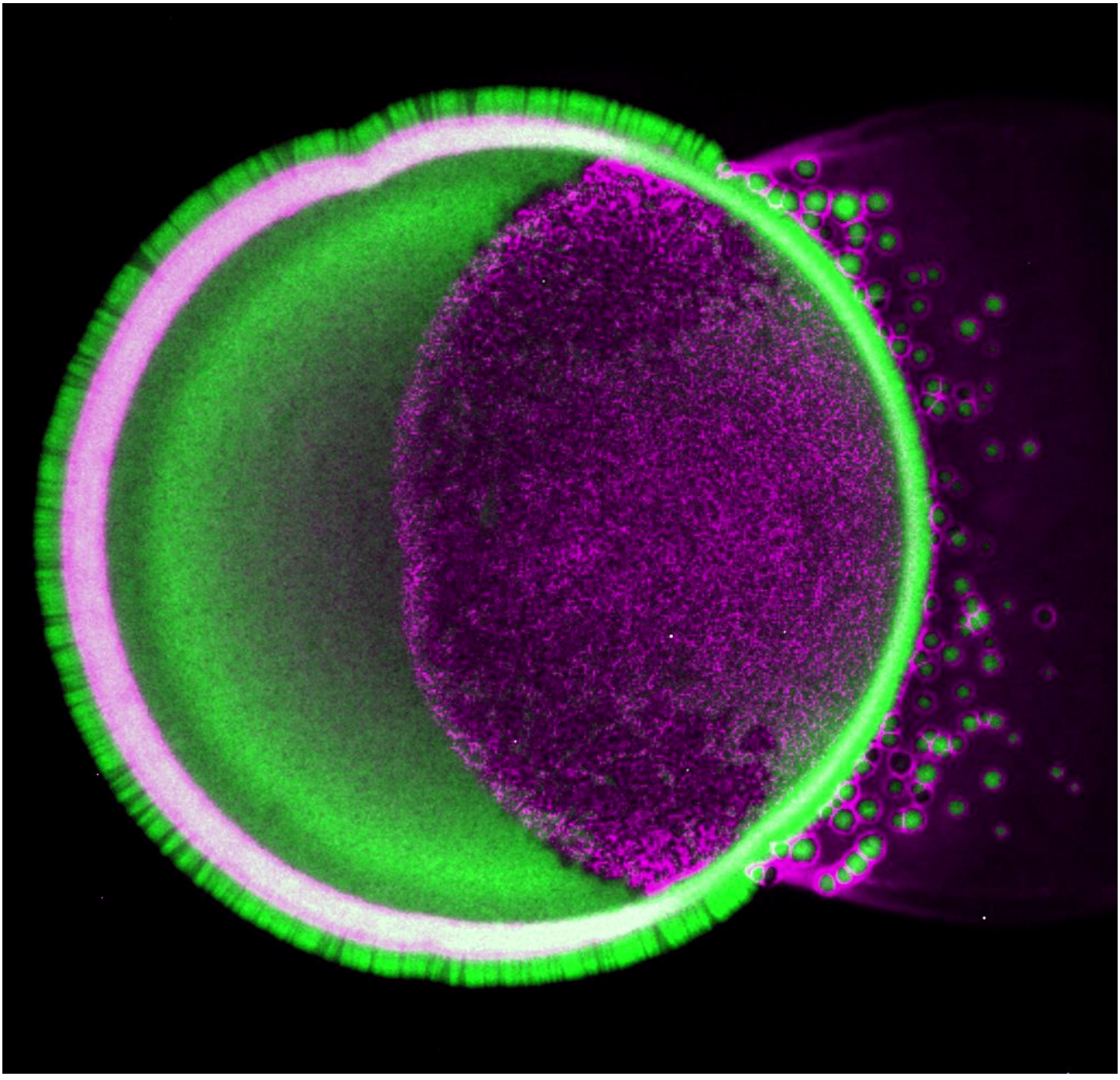
Zurich-Basel Plant Science Center

PlantScience*News*

No 43, Spring 2023



Editorial

Celebrating 25 years of PSC!

The Plant Science Center (PSC) was founded in 1998 as a competence center at ETH Zurich, University of Zurich and University of Basel. PSC members excel with their wide variety of research fields in plant and environmental sciences: from the molecule to the gene to the cell, and from plants and crops in farming systems to whole ecosystems and earth systems. The center has created various research programs and collaboration opportunities, and has funded 165 PhD and Postdoctoral fellowships, so far.
PSC continuously develops the curriculum of its PhD programs, constantly scouting new technological developments and challenges in the fields of plant sciences and science & policy and corresponding to the demands of the plant science community.

To celebrate the success of our center we plan various activities this year. PSC is pleased to present a collection on discoveries in plant sciences, from our members. We hope you enjoy following our *Moments of Discovery* series on Social media and on our website and invite you to submit your landmark discoveries. This year's symposium on 8th of December will bring together world-leading scientists to highlight the "Impact of plant sciences on our lives – food, health, environment and knowledge".

We hope that you enjoy our contributions and we are excited to continue this exceptional journey with our community in the years to come.

Sincerely,
Manuela Dahinden & Melanie Paschke, PSC Managing Directors

Editor's pick
Two years ago, we submitted a list of the 'most important plant sciences research questions' that our PSC members contributed to the New Phytologist Foundation. From over 600 questions collected, a final list of 100 questions was selected and just published.

Armstrong et al., 2023. **One hundred important questions facing plant science: an international perspective.** *New Phytologist* 238 (2), pp470–481. https://nph.onlinelibrary.wiley.com/doi/10.1111/nph.18771

Content

PSC Managing Office: Manuela Dahinden, managing director research and outreach; **Melanie Paschke**, managing director education and science-society dialogue; **Romy Kohlmann**, finances, events and program coordinator; **Luisa Last**, coordinator PSC PhD Program Science and Policy & RESPONSE Doctoral Program; **Yvonne Möller-Steinbac**h coordinator PSC PhD Program Plant Sciences and outreach at schools; **Daniela Gunz**, *fem*inno program coordinator; **Juanita Schläpfer**, outreach manager; **Beatrice Kiser**, NACHTAKTIV project coordinator; **Dubravka Vrdoljak,** Dialog im Quartier project coordinator; **Krisztina Balazs**, Executive Assistant; **Sylvia Martinez**, coordinator Basel & Swiss Plant Science Web.

Awards

For his outstanding achievements in biology **Christian Körner** (University of Basel) was awarded the *Gregor Mendel Honorary Medal* by the Czech Academy of Sciences in 2022.

Nina Buchmann (ETH Zurich) received the *GfÖ Honorary Medal 2022* for her life time achievements and outstanding contributions in the field of plant and ecosystem ecophysiology. The award was handed over during the 2022 Annual Meeting of the Ecological Society of Germany, Austria and Switzerland (GfÖ) in Metz, France.

Johan Six (ETH Zurich) was appointed to the Science Committee of the Global Soil Health Program.

Rodrigo Cámara Leret (University of Zurich) received a Starting Grant from the Swiss National Science Foundation (SNSF) for the project INDIGENOMICS (https://data.snf.ch/grants/grant/211659). Rodrigo will conduct research at the University of Zurich, Institute of Systematic and Evolutionary as assistant professor (Formerly in the Jordi Bascompte group). https://rcamaraleret.com

Gina Garland (SNF PRIMA fellow, ETH Zurich) received the *Division Outstanding Early Career Scientist Award 2023* in the Soil System Sciences at the European Geosciences Union (EGU).

Jolanda Reuss (ETH Zurich) was awarded the *ETH Medal 2022* for her outstanding doctoral thesis entitled "Identifying the chemical nature of soil organic phosphorus with increasing molecular weight" (Emanuel Frossard group).

Congratulations to recipients of the PSC Symposium 2022 Poster Awards

From left to right: **Manuel Waller**, Department of Systematic and Evolutionary Botany, University of Zurich, Poster title: “A tale of the YABBY family of transcription factors: YABBY function in hornwort sporophyte development”; **Magdalena Wey**, Agroscope, FG Extension Ackerbau & Department of Environmental Systems Science, ETH Zurich, Poster title: “Attract-and-infest strategy to biologically control adult and larval stages of *Popillia japonica*”; **Aphrodite Kantsa**, Department of Environmental Systems Science, ETH Zurich, Poster title: “Discriminability of floral colors explains global biogeographical patterns of pollinators”.

Congratulations to highly cited researchers in 2022

Each year the Web of Science publishes a list recognizing the world-class researchers. These scientists are selected for their exceptional research performance, demonstrated by producing multiple highly cited papers that rank in the top 1% by citations for field and year.

Agriculture
Johan Six, ETH Zurich

Cross-Field
Christian Körner, *emeritus* University of Basel;
Klaus Schläppi, University of Basel;
Marcel van der Heijden, University of Zurich & Agroscope

Plant & Animal Science
Cyril Zipfel, University of Zurich

Congratulations to recipients of a PSC-Syngenta fellowship

This funding scheme promotes bottom-up and innovative research in plant sciences focusing on: Climate change – challenges and opportunities in agriculture (or crop production). In the call 2022, the following fellowships were awarded:

Postdoc fellowship: Marta Torres Béjar, Leo Eberl, Klaus Schläppi, Monika Maurhofer. Project title: “Improving biostimulants to cope with future climate for sustainable agriculture”.

PhD Fellowship: Cyril Zipfel, Julia Vorholt, Amedeo Caflisch, Julia Santiago. Project title: “Toward the engineering of plant pattern recognition receptors for durable disease resistance”.

Next deadline for proposal submission: 1 November 2023.

www.plantsciences.ch/research/fellowships/syngenta.html

RESPONSE Doctoral Program

At a glance

The RESPONSE Doctoral Program (DP) is a joint doctoral program of ETH Zurich, University of Zurich and University of Basel. RESPONSE DP is centrally managed by the PSC in collaboration with the ETH competence centers: the World Food System Center (WFSC) and the Energy Science Center (ESC). Since the program`s launch in February 2020, 28 students have started their PhD projects. In this newsletter we introduce four fellows who started in Call 4.

www.plantsciences.uzh.ch/en/research/fellowships/response.html

This program receives funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 847585 – RESPONSE.

Annual Meeting

15–17 March 2023, ETH Zurich

The 3rd Annual Meeting of our H2020-MSCA funded RESPONSE Doctoral Program brought together all 28 participating PhD fellows for a retreat and workshops.

Keynote talk
Prof. Dr. Dieter Gerten
Potsdam Institute for Climate Impact Research (PIK)
A mega-tradeoff: Feeding the world within Planetary Boundaries

Dieter Gerten addressed the question of how much food can be provided globally while respecting multiple Planetary Boundaries. Global environmental limits are defined as a precaution to possible destabilization of planet Earth. Biophysical simulations suggest that half of current food production depends on transgressing one or more boundaries, i.e., world agriculture is highly unsustainable. However, with ambitious transformative action towards more sustainable food production and consumption (e.g., diet change, water and nutrient management), enough food for 10 billion people could be supplied even within these environmental boundaries. On the other hand, ongoing climate change – as well as methods to sequester additional carbon from the atmosphere through biomass plantations – challenges this outlook, as they increase the pressure on Planetary Boundaries on their own.

Upcoming

Future of Land Use

Can we bring it together? Strategies for set-aside areas for biodiversity conservation after Cop15 and Swiss population's increasing demand for land for energy, food and other needs?

In 2022 all countries have agreed that 30% of the land area should be reserved as biodiversity area for species protection within the next 7 years. In Switzerland an additional 18-24% of Switzerland's land area would need to become biodiversity conservation area. Currently, this is only 6-12% area in national parks, nature reserves and other protected areas.

PSC and Reatch, Franxini Hive are hosting a constructive **workshop format in the September 2023**. In the next "Fireside Chat", stakeholders from research, practice, politics, administration and civil society are welcome. Fellows of the RESPONSE DP Program will present and discuss their research with participants.

Legacy effects of land-use on tropical soils as constraints on the restoration success and service provision of tropical forests in Uganda

Fellow: Matthew Cooper

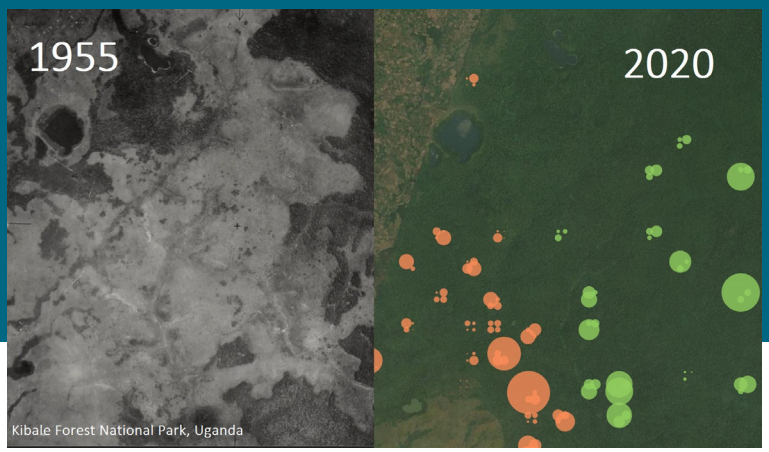
PI: Sebastian Doetterl, Professor of Soil Resources, Institute of Terrestrial Ecosystems, ETH Zurich

Project Partner: Wouter van Goor, Forest Project Manager, Face the Future, Uganda

The main focus of this project is to determine the persistence and longevity of land-use changes on reforestation success by linking historical forest clearing events and encroachment with current soil carbon and nutrient levels. In my PhD project I will address if these patterns translate to forest carbon sequestration rates and structural parameters as well as to arboreal biodiversity levels.

In the last decade, enormous emphasis has been placed on forests as a simple, quick-fix solution to climate change and in reducing the ever-increasing anthropogenic carbon footprint, or at least in counter-balancing it. If we do not understand what the soils have been subjected, how can we accurately and successfully design and implement re- and afforestation efforts? Previous land use can have dramatic impacts on soil properties resulting in long term degradation and loss of fertility. Additionally, tree species selection plays a critical role in long-term survival rates and in turn forest resilience and ecosystem structure. The aim of this study is therefore to determine how persistent historical land-use changes can be on different soil parameters such as bulk density, carbon and nitrogen content, CEC (cation exchange capacity), WHC (water holding capacity) and SOC (soil organic carbon) using a soil spectrometer. We will then investigate if these changes in the soil are reflected both in terms of carbon sequestration and forest structure, but also in terms of forest health and biodiversity. Particular attention will be placed on carbon sequestration rates as in past decades this has been the focus work of Face the Future (our secondment partner).

Uganda intends to plant 40 million trees each year and so our analyses will enable better use of financial resources and improve the results of reforestation efforts. Our partners in Uganda, the Ugandan Wildlife Authority, Face the Future and Makerere University, are also involved in multiple reforestation projects and will therefore be able to directly apply the produced knowledge. This will be presented as guest lectures and presentations at government level as well as through partnerships with local NGO's such as Kyaninga Forest Foundation.



Aerial photograph following colonial clearing of Kibale Forest National Park, Uganda, taken in 1955. Right – Satellite image of the same area taken in 2020 following 25 years of reforestation efforts by Face the Future. Circles represent plots and their size the amount of annually accrued carbon. Red plots have been actively reforested (planted), green plots allowed to naturally recover (protected).

Developing machine learning approaches for improving the rate of genetic gain in crop breeding

Fellow: Carles Quesada Traver

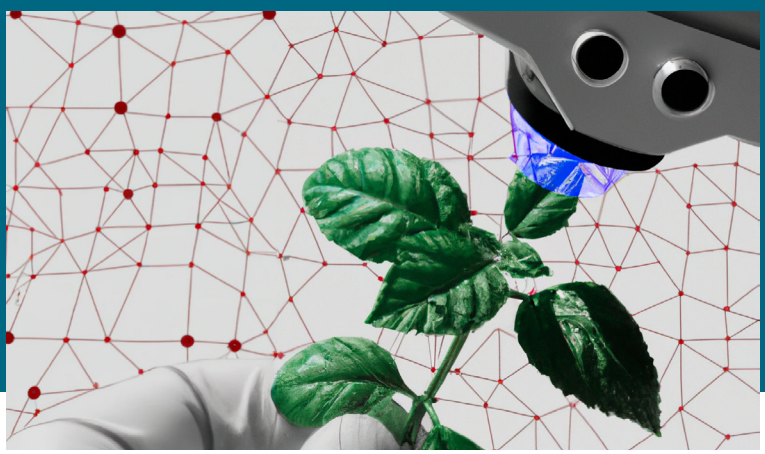
PI: Bruno Studer, Professor of Molecular Plant Breeding, Institute of Agricultural Sciences, ETH Zurich

Project partner: Maximilian Vogt, Head of Plant Breeding, Puregene AG, Switzerland

The properties of current crops, such as appearance, quality, and productivity, have not been stable through history. They are the product of both domestication and the variety development process. Generally, this process takes 8-15 years, for some crops even 25 years. Technological advances in genomics-based breeding offer means to advance plant breeding. The ever-growing generation of genomic data has enabled methods such as marker-assisted or genomic selection (GS) to accelerate the breeding progress. Current GS models, usually based on linear additive models and their variations, use genotypic and phenotypic data to predict agronomic traits of interest for a specific crop. The benefits of using GS models are twofold: increasing selection pressure and reducing breeding cycle length. However, most GS models are ill-equipped to handle the ever-increasing wealth of data.

My doctoral project aims to further advance GS by incorporating additional, differentially structured data, and using novel approaches for GS model development. The performance of classical GS models will be compared to machine learning (ML) algorithms on different sets of input data of *Cannabis sativa* L.. This species, for which the most comprehensive set of genomic and phenomics data is available, will be our primary target for pipeline development. During the secondment at Puregene AG, our project partner, the refinement, preparation, and evaluation of these datasets will be carried out. After comparison of the prediction ability and accuracy from classical and ML-based GS models in *C. sativa,* the pipeline will be expanded to GS programs of other crop species such as apple (*Malus x domestica* Borkh.), common bean (*Phaseolus vulgaris* L.), perennial ryegrass (*Lolium perenne* L.) or wheat (*Triticum aestivum* L.).

Specifically, this project will deliver a GS toolkit for plant breeders to maximise gains in crops. And generally, the generated benefits will improve food security and crop diversity for orphan crops. In addition, the expected benefits of applying ML-based solutions to breeding will be explored and communicated to farmers, stakeholders and the public via communications and conferences.



AI generated image using DALL·E, an AI implementation by OpenAI that generates images from a given prompt. In this case the prompt given was: “A growing plant being inspected by machine learning techniques”.

Fermentation with functional co-cultures: a metabolite driven approach to improve cocoa bean quality, safety, and sustainability

Fellow: Julie Lestang

PI: Laura Nyström, Professor of Food Biochemistry, Institute of Food, Nutrition and Health, Laboratory of Food Biochemistry, ETH Zurich

Project partners: Food Biotechnology Research Group, Institute of Food and Beverage Innovation, ZHAW Zurich University of Applied Sciences, Wädenswil, Switzerland and Halba, Switzerland

This fellowship is hosted by the World Food System Center.

The total world production of cocoa beans, the main ingredient of chocolate, was estimated at 5.2 million tons for the 2020-2021 season (ICCO, 2022). Fermentation is the first transformation step of cocoa beans into chocolate. This chemical process aims to remove the pulp around beans, develop chocolate color and flavor, and avoid seed germination. It involves a well-defined succession of microorganisms of yeasts, lactic acid bacteria, and acetic acid bacteria. Most cocoa fermentations are empirically run by farmers and occur thanks to the spontaneous inoculation of fresh cocoa beans by microorganisms from the environment. Consequently, the fermentation quality may remain inconsistent. Contaminations of the beans by undesirable microorganisms are one of the main causes for low quality. For instance, filamentous fungi producing mycotoxins may contaminate cocoa beans during fermentation, drying, and storage. Accumulation of mycotoxins is a potential risk to human health. Together with our project partner ZHAW Food Biotechnology Research Group we aim to develop an innovative approach. We use rapid mass spectrometric analysis to facilitate the selection of microbial strains for functional fermentation cultures to produce cocoa with desirable characteristics, which typically takes several years. Our aim is to characterize the chemical profiles of cocoa beans fermented with co-cultures using rapid untargeted analyses, as well as targeted analyses of compounds affecting the anti-fungal activity and aroma composition. The correlation between the chemical profiles and beans' quality will be explored to identify markers. The efficacy of the functional co-cultures and the innovative approach will be evaluated under real-life conditions during the secondment in Ecuador at UNOCACE, a cooperative of cocoa producers working in collaboration with Halba (partner). The secondment will also be the opportunity to demonstrate the use of fermentation co-culture in the cooperative.

Cocoa beans fermenting in wooden boxes in Ecuador.

© Julie Lestang

Innovation strategies and policy approaches to support the transition to a clean energy system

© ETH Zurich by A. Kulakovskaya

Fellow: Arnau Aliana

PI: Volker Hoffmann, Professor for Sustainability and Technology, Department of Management, Technology, and Economics, ETH Zurich

Project partners: Peter Scherpereel, Head of Investment & Valuation Onshore and PV Europe and APAC, RWE Renewables GmbH, Germany

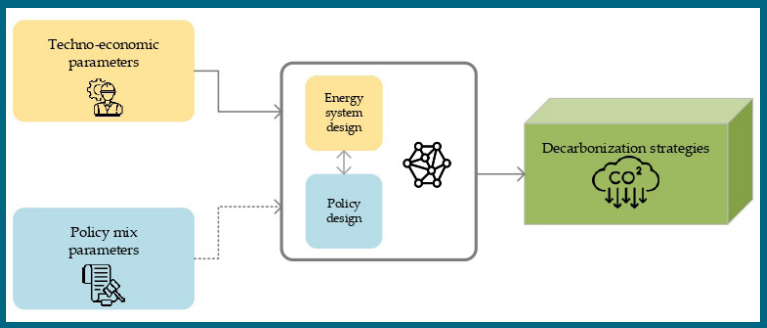
This fellowship is hosted by the Energy Science Center.

A mix of policy instruments that effectively supports energy technology solutions is needed to address the multiple challenges involved in decarbonizing energy systems. The existing literature on policy mixes has mostly focused on qualitative analysis, and quantitative studies using energy models put the focus on techno-economic aspects but disregard the policy domain. Therefore, there is an opportunity to bridge these two fields and address the research gap through interdisciplinary research.

The main goal of our project is to develop a novel modelling framework that introduces endogenous policy decision variables into a techno-economic energy system optimization model. By making policy mix decisions an integral part of the model, the framework combines the perspectives of policymakers and energy system planners in a single environment. As a result, it can deliver integrated optimal energy strategies that cover both the energy policy and the energy system contributions to achieve policy objectives.

The proposed framework will then be applied to two case studies, illustrating the potential of the model-based framework in the decarbonization of the building sector and the Swiss electricity system. To ensure the calibration of our model with real-world data, we will collaborate with RWE Renewables, one of the world's leading energy companies. The company´s experience regarding the role of innovation and policy for a clean energy system, including the integration of renewables and sector coupling, will be very valuable for the project.

The findings of the project will be published in scientific journals as well as in policy briefs, outlining not only which technologies will be key to decarbonize the analysed sectors, but also which concrete policies need to be implemented and when. This innovative approach of designing policies using energy system models will ensure that policymakers have the best tools possible to guide the energy transition.



Conceptual representation of the proposed modelling framework to co-design policy mixes and energy system transformations to develop decarbonization strategies.

© Arnau Aliana

Traditional medicine in transition

PSC is project partner in a new SOR4D project funded by SNF/ DEZA. The project chaired by PD Dr. Caroline Weckerle at University of Zurich will explore the role of museums as agents of change for effective, safe, culturally embedded, and sustainable knowledge transfer in Uganda.

In many countries in Africa, more than 80 % of the population rely directly on plants for basic health care (WHO, 2002). During the Covid 19-pandemic, the inadequacy of public medical care in Uganda worsened, with serious consequences especially for women and children. This led to an increased interest in traditional, mainly herbal medicine, both, among the public and politics. However, Traditional Medicine (TM) in Uganda is confronted with a loss of its natural, cultural and intellectual resources. This must be addressed if TM is to be ensured as part of future primary health care, source of innovation, and socially and environmentally stabilizing cultural heritage.

The project aims to make a significant contribution to the validation and valorization of TM plant knowledge in Uganda and enhance promotion of sustainable use, cultivation and protection of medicinal plants and biodiversity. It is reported that in many parts of Uganda, herbal preparations often contain species of the plant families Fabaceae, Asteraceae, Euphorbiaceae, Lamiaceae, and Solanaceae, and their widespread use may be due to their broad spectrum of bioactive compounds (Tugume et al., 2016). The project will combine epidemiology, ethnobotany and socio-cultural research to analyze underlying dynamics and interrelations of contemporary knowledge transmission in the field of TM. Particular attention will be given to the exploration of museums as communication and participative research tool in remote areas.

The collaboration partner PROMETRA – an international organization dedicated to the preservation and restoration of African traditional medicine and indigenous science – educates and trains those who wish to become natural healers to increase their knowledge of the use and conservation of native medicinal plants and organic farming methods. In the longer term, PROMETRA plans to earn money by selling seeds and seedlings of medicinal plants, vegetables and cereals. They also plan to professionally process, package and market pharmaceuticals and health products.

https://data.snf.ch/grants/grant/215892

Botanical Garden of Entebbe, Uganda.
© Jacqueline Grigo

Project partners in SWITZERLAND

Department of Systematic and Evolutionary Botany and Botanical Garden, University of Zurich

Department of Social Anthropology and Cultural Studies, University of Zurich

Zurich-Basel Plant Science Center

Project partners in UGANDA

Ministry of Health, Kampala

Uganda National Museum, Kampala

Igongo Cultural Institute, Mbarara

PROMETRA, Mpigi

Institute for Plant Science, Microbiology & Biotechnology, Makerere University, Kampala

Ethnomedicine and Ethnopharmacology, Bishop Stuart University, Mbarara

Tooro Botanical Gardens, Tooro

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Mental Health Global Action program. Geneva, Switzerland: World Health Organisation; 2002.

Tugume, P., Kakudidi, E.K., Buyinza, M. et al. (2016). Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda. *J Ethnobiology Ethnomedicine* 12, 5. https://doi.org/10.1186/s13002-015-0077-4

Nature Reviews Microbiology (2022)
https://doi.org/10.1038/s41579-022-00779-w

Soil microbiomes and one health

Banerjee S and van der Heijden MGA

The concept of one health highlights that human health is not isolated but connected to the health of animals, plants and environments. In this Review, we demonstrate that soils are a cornerstone of one health and serve as a source and reservoir of pathogens, beneficial microorganisms and the overall microbial diversity in a wide range of organisms and ecosystems. We list more than 40 soil microbiome functions that either directly or indirectly contribute to soil, plant, animal and human health. We identify microorganisms that are shared between different one health compartments and show that soil, plant and human microbiomes are perhaps more interconnected than previously thought. Our Review further evaluates soil microbial contributions to one health in the light of dysbiosis and global change and demonstrates that microbial diversity is generally positively associated with one health. Finally, we present future challenges in one health research and formulate recommendations for practice and evaluation.

One health links human, animal and environmental health, and microorganisms have a central role in this connection. In this Review, Banerjee and van der Heijden outline the central role of the soil microbiome for one health and its detrimental or beneficial effects.

Science (2022)
https://doi.org/ 10.1126/science.abn6697

From white to green: Snow cover loss and increased vegetation productivity in the European Alps

Rumpf SB, Gravey M, ..., Guisan A

Mountains are hotspots of biodiversity and ecosystem services, but they are warming about twice as fast as the global average. Climate change may reduce alpine snow cover and increase vegetation productivity, as in the Arctic. Here, we demonstrate that 77% of the European Alps above the tree line experienced greening (productivity gain) and <1% browning (productivity loss) over the past four decades. Snow cover declined significantly during this time, but in <10% of the area. These trends were only weakly correlated: Greening predominated in warmer areas, driven by climatic changes during summer, while snow cover recession peaked at colder temperatures, driven by precipitation changes. Greening could increase carbon sequestration, but this is unlikely to outweigh negative implications, including reduced albedo and water availability, thawing permafrost, and habitat loss.

Nature Earth & Environment (2022)
https://doi.org/10.1038/s43017-022-00366-w

Strategy games to improve environmental policymaking

Hartmann M and Six J

Soil microbiomes drive key functions in agroecosystems, determining soil fertility, crop productivity and stress tolerance. The microbiome is intricately linked with soil structure, such as aggregation and pore connectivity, because this structure regulates the flow of water, oxygen and nutrients through the system. In this Review, we summarize the key functions of soil microbiomes in agroecosystems, highlight the dependence of these functions on the structural integrity of the soil, and discuss how agricultural practices influence the link between soil structure and microbiome functioning. System-level agricultural management practices can induce structural alterations to the soil, thereby changing the microbial processes occurring at the microscale. These changes have large-scale consequences, such as soil erosion, reduced soil fertility and increased greenhouse gas emissions. Sustainable approaches such as integrated soil fertility management and integrated pest management seek to improve soil structure and enhance microbial biodiversity, but we lack a mechanistic understanding of how multifaceted decisions at the farm level shape these context-dependent small-scale processes in the long term. Future research needs to bridge the microscale and field scale to inform agricultural management decisions for building climate-smart, resource-efficient and stress-resilient agroecosystems, and to harness the soil microbiome as a nature-based solution for sustainable agriculture.

Nature Microbiology (2022)
https://doi.org/10.1038/s41564-022-01209-6

***Pseudomonas putida* mediates bacterial killing, biofilm invasion and biocontrol with a type IVB secretion system**

Purtschert-Montenegro G, Carcamo-Oyarce G, Pinto-Carbo M, Agnoli K, Bailly A, Eberl L

Many bacteria utilize contact-dependent killing machineries to eliminate rivals in their environmental niches. Here we show that the plant root colonizer *Pseudomonas putida* strain IsoF is able to kill a wide range of soil and plant-associated Gram-negative bacteria with the aid of a type IVB secretion system (T4BSS) that delivers a toxic effector into bacterial competitors in a contact-dependent manner. This extends the range of targets of T4BSSs-so far thought to transfer effectors only into eukaryotic cells-to prokaryotes. Bioinformatic and genetic analyses show that this killing machine is entirely encoded by the kib gene cluster located within a rare genomic island, which was recently acquired by horizontal gene transfer. *P. putida* IsoF utilizes this secretion system not only as a defensive weapon to kill bacterial competitors but also as an offensive weapon to invade existing biofilms, allowing the strain to persist in its natural environment. Furthermore, we show that strain IsoF can protect *Ralstonia solanacearum* in a T4BSS-

dependent manner, suggesting that IsoF can be exploited for pest control and sustainable agriculture.

Nature Communications (2022)
https://doi.org/10.1038/s41467-022-35194-5

Growth of alpine grassland will start and stop earlier under climate warming

Möhl P, von Büren RS, Hiltbrunner E

Alpine plants have evolved a tight seasonal cycle of growth and senescence to cope with a short growing season. The potential growing season length (GSL) is increasing because of climate warming, possibly prolonging plant growth above- and belowground. We tested whether growth dynamics in typical alpine grassland are altered when the natural GSL (2–3 months) is experimentally advanced and thus, prolonged by 2–4 months. Additional summer months did not extend the growing period, as canopy browning started 34–41 days after the start of the season, even when GSL was more than doubled. Less than 10% of roots were produced during the added months, suggesting that root growth was as conservative as leaf growth. Few species showed a weak second greening under prolonged GSL, but not the dominant sedge. A longer growing season under future climate may therefore not extend growth in this widespread alpine community, but will foster species that follow a less strict phenology.

Nature Communications (2022)
https://doi.org/10.1038/s41467-022-33213-z

Leakage does not fully offset soy supply-chain efforts to reduce deforestation in Brazil

Villoria N, Garrett R, Gollnow F, Carlson K.

Zero-deforestation supply chain policies that leverage the market power of commodity buyers to change agricultural producer behavior can reduce forest clearing in regions with rapid commodity expansion and weak forest governance. Yet leakage—when deforestation is pushed to other regions—may dilute the global effectiveness of regionally successful policies. Here we show that domestic leakage offsets 43–50% of the avoided deforestation induced by existing and proposed zero-deforestation supply chain policies in Brazil's soy sector. However, cross-border leakage is insignificant (<3%) because soybean production is displaced to existing U.S. farmland. Eliminating deforestation from the supply chains of all firms exporting Brazilian soy to the EU or China from 2011–2016 could have reduced net global deforestation by 2% and Brazilian deforestation by 9%. Thus, if major tropical commodity importers (e.g., the EU) require traders to eliminate deforestation from their supply chains, it could help bend the curve on global forest loss.

Nature Communications (2022)
https://doi.org/10.1038/s41467-022-32744-9

Generation of an *Escherichia coli* strain growing on methanol via the ribulose monophosphate cycle

Keller P, Reiter MA, Kiefer P, Gassler T, Hemmerle L, Christen P, Noor E, Vorholt J

Methanol is a liquid with high energy storage capacity that holds promise as an alternative substrate to replace sugars in the biotechnology industry. It can be produced from CO_2 or methane and its use does not compete with food and animal feed production. However, there are currently only limited biotechnological options for the valorization of methanol, which hinders its widespread adoption. Here, we report the conversion of the industrial platform organism *Escherichia coli* into a synthetic methylotroph that assimilates methanol via the energy efficient ribulose monophosphate cycle. Methylotrophy is achieved after evolution of a methanol-dependent *E. coli* strain over 250 generations in continuous chemostat culture. We demonstrate growth on methanol and biomass formation exclusively from the one-carbon source by C-13 isotopic tracer analysis. In line with computational modeling, the methylotrophic *E. coli* strain optimizes methanol oxidation by upregulation of an improved methanol dehydrogenase, increasing ribulose monophosphate cycle activity, channeling carbon flux through the Entner-Doudoroff pathway and downregulating tricarboxylic acid cycle enzymes. En route towards sustainable bioproduction processes, our work lays the foundation for the efficient utilization of methanol as the dominant carbon and energy resource.

Nature Communications (2022)
https://doi.org/10.1038/s41467-022-31975-0

Global genomic analyses of wheat powdery mildew reveal association of pathogen spread with historical human migration and trade

Sotiropoulos AG, Arango-Isaza E, Ban T, Barbieri C, Bourras S, Cowger C, Ben-David R, Dinoor A, Ellwood SR, …, Hatta K, …, Sanchez-Martin J, McDonald BA, Shamanin V, Shimizu KK, Yoshihira T, Keller B, Wicker T

The fungus *Blumeria graminis* f. sp. *tritici* causes wheat powdery mildew disease. Here, we study its spread and evolution by analyzing a global sample of 172 mildew genomes. Our analyses show that *B.g. tritici* emerged in the Fertile Crescent during wheat domestication. After it spread throughout Eurasia, colonization brought it to America, where it hybridized with unknown grass mildew species. Recent trade brought USA strains to Japan, and European strains to China. In both places, they hybridized with local ancestral strains. Thus, although mildew spreads by wind regionally, our results indicate that humans drove its global spread throughout history and that mildew rapidly evolved through hybridization.

Nature Communications (2022)
https://doi.org/10.1038/s41467-022-35189-2

Biodiversity-stability relationships strengthen over time in a long-term grassland experiment

Wagg C, Roscher C, Weigelt A, Vogel A, Ebeling A, De Luca E, Roeder A, Kleinspehn C, Temperton V, Meyer ST, Scherer-Lorenzen M, Buchmann N, Fischer M, Weisser WW, Eisenhauer N, Schmid B

Numerous studies have demonstrated that biodiversity drives ecosystem functioning, yet how biodiversity loss alters ecosystems functioning and stability in the long-term lacks experimental evidence. We report temporal effects of species richness on community productivity, stability, species asynchrony, and complementarity, and how the relationships among them change over 17 years in a grassland biodiversity experiment. Productivity declined more rapidly in less diverse communities resulting in temporally strengthening positive effects of richness on productivity, complementarity, and stability. In later years asynchrony played a more important role in increasing community stability as the negative effect of richness on population stability diminished. Only during later years did species complementarity relate to species asynchrony. These results show that species complementarity and asynchrony can take more than a decade to develop strong stabilizing effects on ecosystem functioning in diverse plant communities. Thus, the mechanisms stabilizing ecosystem functioning change with community age.

Nature Ecol Evol (2023)
https://doi.org/10.1038/s41559-022-01979-6

Rapid upwards spread of non-native plants in mountains across continents

Iseli E, Chisholm C, Lenoir J, Haider S, Seipel T, Barros A, Hargreaves AL, Kardol P, Lembrechts JJ, McDougall K, Rashid I, Rumpf SB, Ramón Arévalo J, Cavieres L, Daehler C, Dar PA, Endress B, Jakobs G, Jiménez A, Küffer C, Mihoc M, Milbau A, Morgan JW, Naylor BJ , …, Alexander JM

High-elevation ecosystems are among the few ecosystems worldwide that are not yet heavily invaded by non-native plants. This is expected to change as species expand their range limits upwards to fill their climatic niches and respond to ongoing anthropogenic disturbances. Yet, whether and how quickly these changes are happening has only been assessed in a few isolated cases. Starting in 2007, we conducted repeated surveys of non-native plant distributions along mountain roads in 11 regions from 5 continents. We show that over a 5- to 10-year period, the number of non-native species increased on average by approximately 16% per decade across regions. The direction and magnitude of upper range limit shifts depended on elevation across all regions. Supported by a null-model approach accounting for range changes expected by chance alone, we found greater than expected upward shifts at lower/mid elevations in at least seven regions. After accounting for elevation dependence, significant average upward shifts were detected in a further three regions (revealing evidence for upward shifts in 10 of 11 regions). Together, our results show that mountain environments are becoming increasingly exposed to biological invasions, emphasizing the need to monitor and prevent potential biosecurity issues emerging in high-elevation ecosystems.

Remote Sensing of Env. (2023)
https://doi.org/10.1016/j.rse.2022.113338

Genetic constraints on temporal variation of airborne reflectance spectra and their uncertainties over a temperate forest

Czyz EA, Schmid B, Hueni A, Eppinga MB, Schuman MC, Schneider FD, Guillen-Escriba C, Schaepman ME

Remote sensing enhances large-scale biodiversity monitoring by overcoming temporal and spatial limitations of ground-based measurements and allows assessment of multiple plant traits simultaneously. The total set of traits and their variation over time is specific for each individual and can reveal information about the genetic composition of forest communities. Measuring trait variation among individuals of one species continuously across space and time is a key component in monitoring genetic diversity but difficult to achieve with ground-based methods. Remote sensing approaches using imaging spectroscopy can provide high spectral, spatial, and temporal coverage to advance the monitoring of genetic diversity, if sufficient relation between spectral and genetic information can be established. We assessed reflectance spectra from individual *Fagus sylvatica* L. (European beech) trees acquired across eleven years from 69 flights of the Airborne Prism Experiment (APEX) above the same temperate forest in Switzerland. We derived reflectance spectra of 68 canopy trees and correlated differences in these spectra with genetic differences derived from microsatellite markers among the 68 individuals. We calculated these correlations for different points in time, wavelength regions and relative differences between wavelength regions. High correlations indicate high spectral-genetic similarities. We then tested the influence of environmental variables obtained at temporal scales from days to years on spectral-genetic similarities. We performed an uncertainty propagation of radiance measurements to provide a quality indicator for these correlations.

We observed that genetically similar individuals had more similar reflectance spectra, but this varied between wavelength regions and across environmental variables. The short-wave infrared regions of the spectrum, influenced by water absorption, seemed to provide information on the population genetic structure at high temperatures,

whereas the visible part of the spectrum, and the near-infrared region affected by scattering properties of tree canopies, showed more consistent patterns with genetic structure across longer time scales. Correlations of genetic similarity with reflectance spectra similarity were easier to detect when investigating relative differences between spectral bands (maximum correlation: 0.40) than reflectance data (maximum correlation: 0.33). Incorporating uncertainties of spectral measurements yielded improvements of spectral-genetic similarities of 36% and 20% for analyses based on single spectral bands, and relative differences between spectral bands, respectively. This study highlights the potential of dense multi-temporal airborne imaging spectroscopy data to detect the genetic structure of forest communities. We suggest that the observed temporal trajectories of reflectance spectra indicate physiological and possibly genetic constraints on plant responses to environmental change.

Global Change Biology (2022)

https://doi.org/10.1111/gcb.16351

Links across ecological scales: Plant biomass responses to elevated CO_2

Maschler J, Bialic-Murphy L, Wan J, …, Crowther TW

The degree to which elevated CO_2 concentrations (e[CO_2]) increase the amount of carbon (C) assimilated by vegetation plays a key role in climate change. However, due to the short-term nature of CO_2 enrichment experiments and the lack of reconciliation between different ecological scales, the effect of e[CO_2] on plant biomass stocks remains a major uncertainty in future climate projections. Here, we review the effect of e[CO_2] on plant biomass across multiple levels of ecological organization, scaling from physiological responses to changes in population-, community-, ecosystem-, and global-scale dynamics. We find that evidence for a sustained biomass response to e[CO_2] varies across ecological scales, leading to diverging conclusions about the responses of individuals, populations, communities, and ecosystems. While the distinct focus of every scale reveals new mechanisms driving biomass accumulation under e[CO_2], none of them provides a full picture of all relevant processes. For example, while physiological evidence suggests a possible long-term basis for increased biomass accumulation under e[CO_2] through sustained photosynthetic stimulation, population-scale evidence indicates that a possible e[CO_2]-induced increase in mortality rates might potentially outweigh the effect of increases in plant growth rates on biomass levels. Evidence at the global scale may indicate that e[CO_2] has contributed to increased biomass cover over recent decades, but due to the difficulty to disentangle the effect of e[CO_2] from a variety of climatic and land-use-related drivers of plant biomass stocks, it remains unclear whether nutrient limitations or other ecological mechanisms operating at finer scales will dampen the e[CO_2] effect over time. By exploring these discrepancies, we identify key research gaps in our understanding of the effect of e[CO_2] on plant biomass and highlight the need to integrate knowledge across scales of ecological organization so that large-scale modeling can represent the finer-scale mechanisms needed to constrain our understanding of future terrestrial C storage.

PNAS (2022)

https://doi.org/10.1073/pnas.2108808119

Ancient variation of the AvrPm17 gene in powdery mildew limits the effectiveness of the introgressed rye Pm17 resistance gene in wheat

Muller MC, Kunz L, Schudel S, Lawson AW, Kammerecker S, Isaksson J, Wyler M, Graf J, Sotiropoulos AG, Praz CR, Manser B, Wicker T, Bourras S, Keller B

Introgressions of chromosomal segments from related species into wheat are important sources of resistance against fungal diseases. The durability and effectiveness of introgressed resistance genes upon agricultural deployment is highly variable-a phenomenon that remains poorly understood, as the corresponding fungal avirulence genes are largely unknown. Until its breakdown, the Pm17resistance gene introgressed from rye to wheat provided broad resistance against powdery mildew (*Blumeria graminis*). Here, we used quantitative trait locus (QTL) mapping to identify the corresponding wheat mildew avirulence effector AvrPm17. It is encoded by two paralogous genes that exhibit signatures of reoccurring gene conversion events and are members of a mildew sublineage specific effector cluster. Extensive haplovariant mining in wheat mildew and related sublineages identified several ancient virulent AvrPm17 variants that were present as standing genetic variation in wheat powdery mildew prior to the Pm17 introgression, thereby paving the way for the rapid breakdown of the Pml7resistance. QTL mapping in mildew identified a second genetic component likely corresponding to an additional resistance gene present on the 1AL.1RS translocation carrying Pm17. This gene remained previously undetected due to suppressed recombination within the introgressed rye chromosomal segment. We conclude that the initial effectiveness of 1AL.1RS was based on simultaneous introgression of two genetically linked resistance genes. Our results demonstrate the relevance of pathogen-based genetic approaches to disentangling complex resistance loci in wheat. We propose that identification and monitoring of avirulence gene diversity in pathogen populations become an integral part of introgression breeding to ensure effective and durable resistance in wheat.

Professor Thomas W. Crowther, ETH Zurich

Doctoral student Julia Maschler and Dr. Constantin Zohner discuss their CO_2 mineralization experiment.
© Crowther Lab

Thomas (Tom) Crowther started his professorship in Global Ecosystem Ecology at ETH Zurich in 2017, when he founded Crowther Lab at the Institute of Integrative Biology at the Department of Environmental Systems Science. Tom completed his PhD in 2014 at Cardiff University under Dr. Hefin Jones. Prior to ETH Zurich, he received a postdoctoral fellowship from the Yale Climate and Energy Institute and studied the impact of carbon cycle feedbacks on climate change at the Netherlands Institute of Ecology at Wageningen University as a Marie Curie fellow.

Tom's initial research focused on how soil microbial communities and global carbon cycles interact with climate change. His research suggests that warming might stimulate the activity of soil organisms in high-latitude arctic and sub-arctic soils: the resulting carbon loss could accelerate climate change by 12–17%. In 2015, his landmark study showed for the first time that Earth is home to around three trillion trees – about half of the number of trees prior to the agricultural revolution 12'000 years ago. Tom and his team gained wide-spread attention with their 2019 study on the global tree restoration potential, estimating that there are 0.9 billion hectares on Earth where trees would naturally be able to grow outside of urban and agricultural land. If this land could be protected, there would be room for one trillion more trees, which could capture up to a third of the excess atmospheric carbon to date.

The wide range of his research topics reflects the interdisciplinarity at the core of Tom's lab. Set up to study the interlinked causes and effects of climate change and biodiversity loss, and to build the scientific foundation for global ecosystem restoration, the lab consists of scientists from ecology, biology, chemistry, physics, mathematics, and data science. Using geospatial modelling, field experiments, and lab analyses, the lab has published maps and papers on phenology, mycorrhizal networks, carbon cycling, plant biogeography, biodiversity patterns, animal seed dispersal, ecosystem resilience and restoration, and more. Recently, they released a paper calling for more protection of soil biodiversity and the inclusion of soil communities in ecosystem restoration. The science communication team is responsible for sharing the work to peers and the general public.

Bridging the theoretical and the applied is of key interest to Tom. The large-scale mapping efforts and ecological research of the lab led him to found the non-profit *Restor*, an open data platform for ecosystem conservation and restoration, offering ecological insights, transparency and connectivity for scientists, practitioners and funders alike. *Restor* now connects and supports over 100'000 project sites worldwide. Tom is currently co-chair of the Advisory Board to the United Nations Decade on Ecosystem Restoration and aims to soon launch SEED, an initiative to make biocomplexity transparently measurable.

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Professor Johanna Jacobi, ETH Zurich

Johanna Jacobi gathering data on coca (*Erythrotylum coca*), deforestation and agroforestry alternatives in the Chapare, Bolivia. © Waldo Pinto, 2015

Festival of traditional recipes in Gworie Kunkwa, Ghana. Agrobiodiversity is not only important in fields but also on the plate. The relationships of food traditions, bio-cultural diversity and sustainable agriculture are another research topic of the AET group. © Sara Baga

Johanna Jacobi holds an SNSF Eccellenza Professorial Fellowship and leads the Agroecological Transitions (AET) group at ETH Zurich. Her master thesis in India with the International Water Management Institute (IWMI) of the Consultative Group on International Agricultural Research (CGIAR) convinced her of the need to apply quantitative and qualitative methods in agricultural research, and that research should take place together with farmers, who hold valuable knowledge. For her doctorate she conducted research on social-ecological resilience of cocoa farms in Bolivia with the University of Bern and the Research Institute for Organic Agriculture (FiBL), which brought her to the topics of dynamic agroforestry and agroecology. She did a postdoc at UC Berkeley with Miguel Altieri on different types of agroforestry systems and factors that hinder or enhance their adoption. This brought her closer to political ecology perspectives and to the Latin American Scientific Society of Agroecology (SOCLA) of which she is still an active member. From 2015 to 2020 she lived in Bolivia coordinating a Swiss R4D project on food system sustainability in Bolivia, Colombia, Brazil, Kenya, Zambia and Ghana. During that time, Johanna's own research on sustainability and resilience in agri-food systems took an agroecology approach through implementing "Transformative Pilot Actions" with local groups of actors in a reflective, co-creative manner using a method (FoodSAF) that she had developed together with Prof. Stephan Rist. In 2020, her habilitation thesis titled "Transdisciplinary Pathways to Agroecology and Sustainable Food Systems" was accepted with honors at the University of Bern. This compilation on food and agricultural sustainability made clear that 1) a focus on power relations in food systems is necessary for future research and 2) it is essential to concomitantly review and analyze how transdisciplinary co-creation methods link to this. Consequently, Johanna's Eccellenza scholarship research focuses on "Food Democracy" and the influence of more democratic and inclusive food system governance on the sustainability of value chains (coffee and soybean in Brazil and DR Congo). At ETH Zurich, Johanna teaches political ecology of food and agriculture, as well as qualitative and transdisciplinary methods in agricultural and food system research. She is founding member of the non-profit organization "Agroecology Works!" and leads an "Urban Agroecology Living Lab" that enhances local, seasonal organic food initiatives in Zurich. Johanna also led the research study that accompanied the first Swiss Citizens' Assembly on Food Policy, applying questions of food democracy in Switzerland. Further research activities of her group include underused legume crops for climate-resilient agriculture, always linking sustainability and social topics – inspired by the famous saying by Brazilian environmental defender Chico Mendes, that addressing environmental concerns without taking into account social justice issues is only gardening.

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https://agroecological-transitions.ethz.ch

PhD Program Plant Science

Research & Technical Skills

Creative Science Communication	07.–08.02. / 10.02.2023 (2 ½ days, 1 ECTS)
Scientific Writing II	02.02. / 06.02. / 09.02.2023 (3 days, 1 ECTS)
Crop Phenotying (ETHZ 751-4106-00L)	24.02.–23.6.2023 (Fridays 8:00–12:00, 2 ECTS)
Teaching in Science at University	28.02. / 07.03. / 14.03. / 21.03. / 28.03. / 04.04. / 23.05.2023 (9:00–12:00, 7 x ½ days, 1 ECTS)
Filmmaking for Scientists	20.–22.03.2023 (3 days, 1 ECTS)
Concepts in Evolutionary Biology (UZH BIO 395)	27.–28.03.2023 (1 ECTS)
Ethics and Scientific Integrity for Doctoral Students ETH VVZ 751-1040-00L (previous Responsible Conduct in Research)	09.03.2023 (14:00–16:00) 05.04.2023 (9:00–13:00 (2 x ½ days, 1 ECTS)
Scientific Presentation Practice	2.04. / 19.04.2023 (2 days, 1 ECTS)
Biology of Orchids	29.04. / 06.05.2023 (2 days, 1 ECTS)
Next Generation Sequencing 2 (UZH BIO634)	08.-09.05.2023 (2 days, 1 ECTS)
Disease-Basic Plant Diagnostic	13.–15.06.2023 (3 days, 1 ECTS)
Managing your Publication Workflow and your Open Data	04.07. / 06.07.2023 (2 days, 1 ECTS)
Alpine Plant Ecology – International Summer School 2023	16.–22.07.2023 (6 days, 3 ECTS)

Digital Skills www.plantsciences.uzh.ch/en/teaching/coursecatalogue/digitalskills.html

Microbiome I: The Microbiome of the Plant-Soil System (ETHZ: 751-5127-00L)	23.02.– 01.06.2023 (Thursdays 10:00–12:00, 2 ECTS)
Statistical Modelling	05.–07.06.2023 (3 days, 1 ECTS)
Advanced Data Management and Manipulation using R	09.06. / 16.06.2023 (2 days, 1 ECTS)
Microbiome II: The Microbiome of the Plant-Soil System (ETHZ 751-5127-01L)	12.06.–15.06.2023 (4 days, 1 ECTS)
General Linear and Linear Mixed Models in R	12.06./ 15.06./ 19.06./ 22.06./ 26.06./ 29.06.2023 (6 days, 2 ECTS)
Genetic Diversity: Analysis	19.06.–30.06.2023 (2 weeks, 2 ECTS)
Reporting using R Markdown & Shiny	07.07. / 14.07.2023 (2 days, 1 ECTS)

PhD Program Plant Science

Crosslisted Courses

Global Change and Biodiversity from an Interdisciplinary Perspective (UZH ECO 400)	08.–12.5.2023 (5 days, 2 ECTS)
Frontiers in Plant Microbiomics (Uni Basel)	23.03./ 30.03./ 27.04./ 04.05./ 11.05./ 25.05./ 01.06.2023 (7 x ½ days, 1 ECTS)
Center for Reproducible Science (UZH) https://www.crs.uzh.ch/en/training.html	
Open and Reproducible Science: General Reasons and Approaches (UZH 10SMOS_1)	21.02.–04.04.2023 (Tuesdays 16:15–18:00)
5 Steps to Good Data Science Practice in R (UZH 10SMOS_2)	18.04.–30.05.2023 (Tuesdays 16:00–18:00)
ReproducibiliTea Journal Club - Ten simple rules for good research practice - Reproducible research in data science - eLife's new publishing model	Thursdays 16:30 09.03.2023 16.03.2023 30.03.2023
Functional Genomics Center (UZH-ETHZ) https://fgcz.ch/education.html	
RNA Next Generation Sequencing – A Practical Course (UZH BIO675 Life Sciences)	26.–30.06.2023 (5 days)
Introduction to Proteomics Data Analysis and Beyond	07.–09.03.2023 (3 days)
Genetic Variation Analysis Course (UZH BIO694)	08.–10.03.2023 (3 days)

PhD Program Science and Policy

Communicating Science	27.03. / 11.04.2023 (2 days, 2 ECTS)
Evidence-based Policy-Making	03.04. / 28.05.2023 (2 days, 2 ECTS)
Science and Policy Talk: Prepare Yourself and Submit a Successful Science and Policy Application	24.05. 2023 (17:00–18:30)

PSC course catalogue
www.plantsciences.uzh.ch/en/teaching/coursecatalogue.html

Contact
psc_phdprogram@ethz.ch

Digital Skills

Compositional Data Analysis in Plant Sciences

– New PhD Course

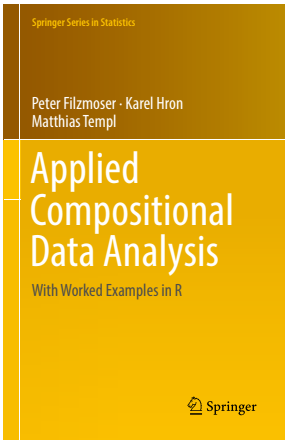
The list of compositional data in plant sciences is long:

(i) Different cell types in plant tissues, such as the proportions of parenchyma cells, collenchyma cells, and sclerenchyma cells;
(ii) Data on the proportions of different pigments in plant tissue, such as the proportions of chlorophyll, carotenoids, and flavonoids in the leaves of a plant;
(iii) Proportions of grasses, forbs, and shrubs in a grassland ecosystem;
(iv) Proportions of different crop species in a field, such as the proportions of corn, soybeans, and wheat in a multi-crop field;
(v) the root, stem and leave weight of a plant;
(vi) soil composition;
(vii) microbiome and metabolomics data; and many more data in plant science are compositional or include compositional parts.

Instead of analyzing raw compositional data, specialized methods must be used that take into account the compositional nature of the data. The so-called log-ratio analysis is a way to achieve independence between (compositional) variables, whereby log-ratio transformations are applied before analysis. Although even these transformations are simple, compositional data analysis isn't simple. It is the meaning of a transformation that matters. Compositional analysis avoids biased estimates and offers many possibilities, but only if used skillfully.

This course taught by Prof. Matthias Templ (FHNW) is based on the book "Applied Compositional Data Analysis" by Springer (Filzmoser, Hron, Templ, 2018) and the R package robCompositions, but while the book is intended for all sciences and also contains detailed mathematics on compositional data analysis, this course is tailored to plant scientists.

The feedback from students of the fall 2023 semester was very positive and all would recommend the course to others who have such data and wish to learn about compositional data analysis. This course will be offered again in fall 2024.



Applied Compositional Data Analysis
With Worked Examples in R
by Peter Filzmoser , Karel Hron , Matthias Templ
Springer, 2018
ISBN : 978-3-319-96420-1

https://link.springer.com/book/10.1007/978-3-319-96422-5

ENGAGE

Evidence-based dialogue on trade-offs in wicked societal problems – New initiative

Key societal challenges such as climate change, energy transition, biodiversity loss, emerging pests and invasive species, or the transition to sustainable agriculture are complex and rapidly evolving. They involve conflicts and trade-offs between different societal objectives, needs and interests. We thus need a science-policy dialogue conscious of these societal realities while supporting the identification of trade-offs and potential solutions to serious societal problems.

In 2022, the ETH Board approved a total of ten "Joint Initiatives". With the Joint Initiatives, the ETH Board is boosting the activities covered by the Strategic Areas of the ETH Domain, as defined in its Strategic Plan 2025–2028. The initiatives strengthen the cooperation and coordination between the institutions of the ETH Domain in relation to the selected Strategic Areas.

https://usys.ethz.ch/en/research/joint-initiatives.html

As part of the Joint Initiative "ENGAGE – Evidence-based dialogue on trade-offs in wicked societal problems", groups from participating ETH Domain institutions such as ETH Zurich, EPFL, Eawag, Empa and WSL will create a national level platform for dialogue between science and society.

PSC teaching expertise

PSC will contribute to the ENGAGE Joint Initiative by developing and implementing teaching formats that train researchers and stakeholders on how to engage in policy dialogues on wicked societal problems in an open, respectful, and solution-oriented manner. Case studies and results from ENGAGE will be integrated in existing and newly developed workshops and training modules. Participants will be scientists from different disciplines as well as experts from policy and practice such as public authorities, interest groups and associations, as well as political parties and members of parliament.

The ENGAGE teaching program will enhance courses offered by the PhD Program in Science and Policy with new case studies. This PhD Program is unique in Switzerland. It combines life, environmental, earth, agricultural, engineering, energy or food sciences with the development of skills and competencies for the science-policy dialogue and interface.

More detailed information on the Science & Policy course program

www.plantsciences.uzh.ch/en/teaching/phdsciencepolicy/courses.html

Science & Policy Blog

The Science & Policy Blog gives you a broad overview about recent research work and contributions by fellows and scientists working at ETH Zurich, Universities of Zurich and Basel at the science-policy interface.

blogs.ethz.ch/Science_and_Policy

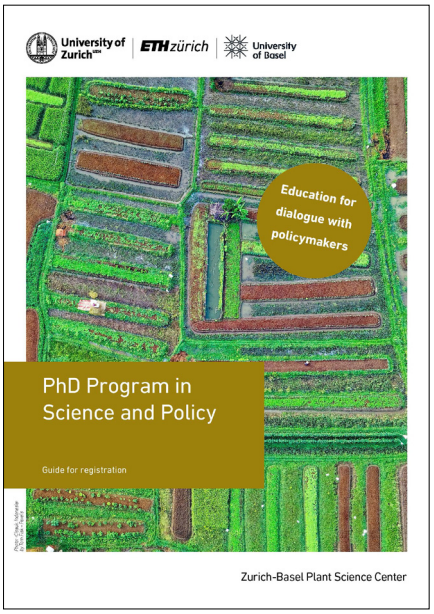
Upcoming

PSC members interested in developing and shaping teaching formats for a successful science and policy dialogue will be invited to the **ENGAGE workshop on June 21**.

This workshop will be co-organised by Melanie Paschke & Luisa Last (PSC), Martijn Sonnevelt (WFSC) and Sabine Hoffmann & Hanna Salomon (Eawag).

Information and registration
sabine.hoffmann@eawag.ch

Contact at PSC
luisa.last@usys.ethz.ch



Dreaming of your own start-up?

Are your research results marketable? Do you think your developed product or services should be out in the market? Do you consider becoming a female founder?

Join the *fem*inno program and let's work on your start-up idea. Don't worry if this idea is still in an early stage, we will show you how to evaluate whether you are on the right track.
*fem*inno is an entrepreneur and career development for female researchers (PhD, postdoc, group leader, and (associate) professor). Even if you reject your start-up idea at the end of the program you still learn a lot about entrepreneurship, leadership, communication, and you will grow as a person, to be ready for your next career move in academia or outside.
We start with call 7 in September 2023, and it ends early March 2024. In 12 days, you get training from lots of female coaches and mentors. A career retreat, innovation workshop, seminars on pitching, fundraising, patents wait for you, as well as a course to train your negotiation skills. Company visits round off the program.
Secure your spot amongst 20 enthusiastic women from Swiss universities. We'll be accepting applications starting June 2023, see here for more information.

Do you have doubts whether the program is suitable for you?
Don't hesitate to contact *fem*inno program coordinator Daniela Gunz.

Contact: daniela.gunz@usys.ethz.ch

Participants of call 6. © Daniela Gunz

feminno

More information on the feminno mentoring program:

www.feminno.ch

Science and policy talk:

– Prepare yourself and submit a successful science and policy application

by Dr. Sophie Girardin (Politics scholarships holder, Scientific Policy Grants

Sophie Girardin is a life sciences engineer working for the Parliamentary Services in the Federal Palace in Berne. She will provide insight into her career path from academia to politics and to political administration in Switzerland. Sophie will talk not only about her day job and her potential impact on politics and policy-making in the Parliament, but also about how her studies prepared her for a career at the intersection of academia and politics. She will offer advice on how to successfully apply for the Scientific Policy Grants fellowship and where to find similar fellowship opportunities after completing your doctoral studies.

When
24 May 2023
17:00 – 18:30
ETH Zentrum

Registration
https://ethz.ch/staffnet/en/service/courses-continuing-education/details.9550o.html

Early Career Meeting (ECM)at SwissPLANT

For the last 25 years, members of the Swiss Plant Biology community have organized a 3-day conference that is primarily attended by PIs. The venue is usually a hotel in the mountains, where researchers focus on presenting their latest findings, discuss science and create opportunities for community development during poster sessions and shared meals.
Its organizer, the **Swiss Society of Plant Biology**, decided to also engage in the promotion of young talents. Thus, in 2023 it launched the Early Career Meeting SwissPLANT (ECM), inspired by the Gordon Research Conferences and their 1-day pre-meeting for young scientists.
The ECM is meant as an event for young researchers organized by young researchers. The meeting is aimed at PhD students nearing the completion of their project and postdocs. In 2023 the organizing committee was composed of Henry Janse van Rensburg and Wojciech Wietrzynski, both from University of Basel. The call was so successful that they had to select the applicants. During the 2-day meeting, all 26 participants gave a talk and presented a poster. The program was packed, but the group still had lively discussions about the topics presented and found some time for outdoor activities. Christian Fankhauser (University of Lausanne) and Klaus Schläppi (University of Basel) attended as mentors and remained in the background. At the end, ECM participants selected the two best talks: Natalia González Gaarslev (University of Lausanne) and Lena Hyvärinen (University of Geneva) had the opportunity to give a presentation during the subsequent SwissPLANT conference that all ECM participants also attended, and all of them contributed their poster.
All in all, the ECM participants were very satisfied with the meeting and gave positive feedback. This meeting prepared them for the follow-up conference, particularly when the area of study is broad as it is the case with the SwissPLANT conference that spans plant biology from ecology, evolution to molecular mechanisms.

The Swiss Society of Plant Biology decided to hold an ECM in 2024 and will again submit a funding proposal to the Swiss Academy of Sciences that gratefully supported the pilot in 2023.

Contact: sylvia.martinez@unibas.ch

SwissPLANT conference 2023 in Les Diablerets © Sylvia Martinez

NEXT EARLY CAREER MEETING SWISSPLANT
16–17 January 2024, Les Diablerets

The selection of participants will be based on the submitted abstract. The call will be published in late summer.

Committee members
Kyle Bender and Léa Frachon, both from Zurich University

Organizer
Swiss Society of Plant Biology

https://plantbiology.ch

NACHTAKTIV – Scientainment for Youth

NACHTAKTIV combines entertainment, art and science. Every two months, on Thursday evenings, PSC organizes a party-style event in a museum aimed specifically at young people (15-30 years). Science activities are led by students of ETH Zurich, University of Zurich and University of Basel. Selected Spin-offs enrich the program with their inventions. Each event focuses on themes that complement the museum's current exhibition.

www.nachtaktiv.live

This program receives funding from the Gebert Rüf Foundation.

https://youtu.be/YwMo-jBoMvE
https://creativelabz.ch/nachtaktiv-das-erwartet-euch/

Call for participation

On 11 May 2023, PSC will organize a NACHTAKTIV event at the Mühlerama in Zurich. The theme “Bake It” is about bread and cereals in all its forms. From politics of wheat, to different ways of growing and baking it.

On 22 June 2023, the NACHTAKTIV event takes place in the Botanical Garden of the University of Zurich. The topic “Plant Dating” will highlight how plants search for mates and what is needed to successfully produce offspring.

PSC is looking for students who would like to present their work in an entertaining way, preferably with hands-on experiments. If you are interested in engaging, please contact Beatrice Kiser.

beatrice.kiser@usys.ethz.ch

Dialog im Quartier

In the next three years, neighborhood events on sustainable nutrition will be held in Zurich community centers. The events are based on the interventions developed in our PSC outreach program “Dialog im Quartier”. The aim is to achieve lifestyle and consumer habits that respect the 1.5°C climate target households.
Through brief interactions, neighborhood residents are encouraged to change their eating habits at home as well. The focus will be on hands-on activities and workshops as inspiration for implementing the Planetary Health Diet (PHD) and on food waste prevention. Event formats include a "tavolata" (= dinner table), where residents bring a dish they have prepared, based on recommendations from the PHD.
Together with GZ Riesbach, GZ Buchegg, GZ Wollishofen, GZ Wipkingen, GZ Schindlergut und Treffpunkt City.

https://deinquartiernachhaltig.org

This program receives funding from Umwelt und Gesundheitschutz Zürich.

Tree Stories

– A walking tour in Zurich from Botany to Biogeography

Trees in a city such as Zurich have become a contested topic. They disappear where urban densification competes for their space, yet people love them and fight for them. They are increasingly also seen as a magic bullet against the negative effects of a warming climate in the already hot and dry heat islands of cities. But even if we agree to have lots of trees in Zurich, things don't get easier. Some want native trees to support native biodiversity, while others argue that only alien trees introduced from elsewhere can survive, especially when considering other pressures such as a lack of healthy soils and the emergence of new pests and diseases. There is ample scientific data to support any of these arguments. But will statistics alone help citizens to envision their future green city?

The trees of the world for a multicultural city

Instead of discussing data, PSC is asking a group of artists and ecologists from all over the world, to share their stories about a particular tree during an evening walk through the old town of Zurich as part of the Abenteuer StadtNatur festival.

http://abenteuer-stadtnatur.ch

Trees have long been symbols of cultural identity, representing belonging to a place, or indeed loss of place. We wonder what trees in Zurich mean for people who live in Zurich but come from elsewhere. Do they feel at home when they encounter a tree they knew from their country? Do they form new relationships with Swiss tree species, or indeed with a tree from still another corner of the world? What does it mean to be a native or alien citizen or tree in the global city of Zurich? By talking about personal relationships and stories we hope to find a common ground to think about tree diversity and ecosystem of Zurich in a more engaging way. Our identities, shaped by gender, class, ethnicity, memory, economics, politics are as important to our ecological relationships with the urban environment as Latin names and physiological characteristics of trees.

Call for participation

If you are interested in telling a *Tree Story* as an ecologist then please contact Juanita Schläpfer.

juanita.schlaepfer@usys.ethz.ch

Parameters: 10–15 min. talk under your chosen tree on Wednesday 24 May 2023 in Zurich Kreis 1.

Artwork by Janeth Berrettini.

TreeKI

– Understanding how AI can be useful for biodiversity research

PSC has designed a new school class workshop and learning materials about artificial intelligence – suitable for young people from the age of 12. By using a self-designed tree identification AI, the participants can learn how an artificial neural network works. At the same time, participants immerse themselves in the world of plants and explore how plant researchers can monitor plant diversity. TreeKI offers an introduction to the topic of AI for the classroom in an innovative and playful way and has a modular structure. In collaboration with the ETH Waldlabor we do offer excursions.

This program receives funding from the SNSF Agora and DIZH.

TreeKI at Informatiktage 2023, 28–29 March 2023

https://informatiktage.ch/plantsciencecenter/treeki-pflanzenvielfalt-mit-kuenstlicher-intelligenz-erkennen-2-

Continued education for teachers, 27 September 2023

www.ife.uzh.ch/de/llbm/weiterbildung.html

Scientifica 2023

– What holds the world together?

Workshop with families at the Guggachbrache in Zurich during the StadtNatur festival in Spring 2021.© PSC

Ecosystem perception: a creative, immersive experience for families

Scientifica, the largest science festival of ETH Zurich and University of Zurich, offers hands-on presentations of research. PSC invites families to participate in an art-science workshop. In the workshop «Ecosystem perception», connections that represent the complex networks in nature become visible.
In this workshop we combine methods from aesthetic education with basic methods of scientific research, such as observing, linking, ordering, interpreting and making visible. This makes it possible to create access to complex topics such as ecosystems and climate change through creative work.
The workshop focuses on the dialogue between the meadow as urban space, the participants, and the interpersonal dialogue. We see dialogue as the central key in designing with various materials, as well as in scientific research. A positive approach to the environment is thus possible and the participants gain their own insights and opinions on scientific topics. One of the most fascinating networks is that of fungi. After the participants make their own network visible with yarn, they will be able to get to know the mycorrhiza network in a scientific experiment with the participation of RESPONSE Fellow Alberto Linares Quiros.

Call for participation

If any other PSC members would like to participate, please contact
juanita.schlaepfer@usys.ethz.ch

When
2 September 2023
13:00 and 15:00

Age
Ideal for all aged 8 and up
(Children accompanied by an adult)

Where
Häldeliweg 19
(Behind the ETH greenhouses)

Public registration requested
scientifica.ch

Creative Science Communication

– A new PhD Course

After many years of experience in designing art and science workshops, science fairs and exhibitions, Manuela and Juanita from PSC have developed a Creative Science Communication Course for PhD students. The course includes theory of science communication and impact assessment, and we share tips and best practice to help students design an outreach activity to reach their target audience. The first course took place in February 2023 and feedback was very positive. Even if their research was "difficult to communicate" students were helped by design methods focusing on creating interactive prototypes.

A particularly gratifying outcome is that all the prototypes developed by the students were of such high quality that we and the students were able to present them to an organization, Phänomena, which is developing a large science fair in 2024.

The course Creative Science Communication will be offered again in Spring 2024.

Yes! I would recommend this course to others. The course was very useful and allowed me to develop ideas that I did not know I was able to imagine.

Course participant, 2023

Activity that visualizes how microbes are spreading. Antibiotic resistance in hospitals can be traced back to soils. It is important to prevent this by keeping soil protected from contamination.

The activitiy was developed by Sarah van den Broek, a PhD student in Gina Garland's group at ETH Zurich. The research group studies the impacts of antibiotics derived from human excreta fertilizers on soil-microbial-plant ecosystems.

Evolution in Action

11–15 June 2023
Congressi Stefano Franscini, Monte Verità, Switzerland

The international conference brings together researchers with a common interest in genomic technologies and their application to evolutionary questions.

Evolutionary biology plays a central role in understanding mechanisms and processes that shape biological systems. Despite its relevance for many scientific fields, researchers addressing evolutionary questions often work somewhat isolated in their respective discipline, discouraging interdisciplinary discussions.
The genomic revolution has strongly altered the research field of evolutionary biology. Sequencing technologies have become so powerful and affordable that the genetic variability of entire genomes and even of many individuals can be directly studied. Such approaches enable research especially on rapid evolutionary changes and are key to understanding, e.g., the evolution of human, animal, and plant pathogens, domestication principles, and processes underlying rapid adaptation. These are socially important topics, as seen for example in the speedy emergence of virus variants in SARS-CoV-2 or the adaptation of wild species and crops to climate change.
With this conference, we aim to facilitate interdisciplinary research integrating biology, medicine, agricultural, and computer sciences to address evolutionary questions that are relevant to our changing world and society.

www.evolution.uzh.ch/en/conference.html

Chloroplast Biology 2023

26–27 June 2023, ETH Zurich

The two-day conference aims to provide an opportunity to present current research on chloroplasts and to strengthen collaboration between scientists.

Deadlines
30 April for abstract submission, 14 May for participation

Organizers
Barbara Pfister, Mayank Sharma, Samuel C. Zeeman, ETH Zurich

Registration and abstract submission
https://chloroplast2023.ethz.ch

Organizer: URPP Evolution in Action: From Genomes to Ecosystems, University of Zurich

Conference Committee: Simon Aeschbacher, Chiara Barbieri, Ueli Grossniklaus, Beat Keller, Verena Schünemann, Kentaro Shimizu, University of Zurich

Plant Biology Europe Congress 2023
3–6 July 2023 Marseille, France

The conference is held under the umbrella of the Federation of European Societies of Plant Biology and is organized by the French Society of Plant Biology.

https://fespb.org/congresses/

SwissPLANT 2024
17–19 January 2024, Les Diablerets

Scientific committee: Cyril Zipfel (chair), Simon Aeschbacher, Rie Shimizu-Inatsugi, Florian P. Schiestl, Sara Simonini, Sofia van Moorsel, Tobias Züst, University of Zurich.

https://swissplantscienceweb.unibas.ch/en/swissplant/

More plant science events

https://swissplantscienceweb.unibas.ch/en/events/

25th Anniversary PSC Symposium

8 December 2023, 13:30–18:00
University of Zurich, Aula and Lichthof, Rämistrasse 71

Impact of plant sciences on our lives – food, health, environment and knowledge

Plants are of the center of life. Leading scientists address the contribution of plant sciences research to key challenges: food, environment, health, and knowledge of science. The event discusses some of the most compelling open questions in the field today.

Keynote speaker

With immense pleasure we announce Sir David Charles Baulcombe as keynote speaker. David Baulcombe is a British plant scientist and geneticist. He is Regius Professor of Botany (emeritus post 2019) at the University of Cambridge. David Baulcombe has made an outstanding contribution to plant virology, gene silencing and disease resistance. He discovered a specific signalling system and an antiviral defense system in plants. Baulcombe also helped unravel the importance of small interfering RNA in epigenetics and in defense against viruses. This led to the development of new technologies that promise to revolutionize gene discovery in plant biology. In praise of research in fundamental plant biology Sir David Baulcombe will reflect in his talk on how plant scientists have contributed to the concepts of (cell) biology. He will sketch a brief history of discoveries in plant sciences that still impact us today, and will finish up with some key challenges ahead.

Panel discussion

What are the key research questions to be addressed in the near future?
PSC invites young plant scientists to join the panel organization team.

Exhibition

Moments of Discovery
To celebrate ground-breaking works in plant sciences, PSC invites its members to share their latest discoveries with us. We will be able to present 20 discoveries with an artistic poster.

Apero

From 19:00
Dinner in Uniturm (invitation only)

25 years PSC
plantsciences.ch

Moments of Discovery

PSC is pleased to present a collection on discoveries in plant sciences, from our members.

Call for participation

We hope you enjoy following our "moments of discovery" series on Social media and on our website and consider submitting your landmark discoveries.

Contact
mdahinden@ethz.ch

Program and registration

www.plantsciences.uzh.ch/en/outreach/conferences/Anniversary-Symposium.html

www.plantsciences.ch

The Zurich-Basel Plant Science Center is a competence center linking and supporting the plant science research community at ETH Zurich, University of Zurich and University of Basel.
The center promotes plant and environmental research, education and outreach. It provides platforms for interactions with peers, policymakers, industry, stakeholders, and the public.

PSC MEMBER INSTITUTIONS

ETH Zurich
Department of Environmental Systems Science
Department of Biology
Institute for Environmental Decisions

University of Zurich
Department of Evolutionary Biology and Environmental Studies
Department of Geography
Department of Plant and Microbial Biology
Department of Systematic and Evolutionary Botany
Institute of Evolutionary Medicine

University of Basel
Department of Environmental Sciences

Zurich-Basel Plant Science Center, Managing Office

BLOGS
blogs.ethz.ch/Science_and_Policy
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Pictures
Courtesy of PSC staff or indicated.

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Front image: The research group of Professor Leo Eberl recently identified that the plant root colonizer *Pseudomonas putida* IsoF (green) is able to kill a wide range of soil and plant-associated Gram-negative bacteria, including *P. aureofaciens, P. entomophila, P. chlororaphis, P. fluorescens, P. syringae, P. carotovorum and R. solanacearum.* The overlapping area between two colonies (magenta) indicates bacterial cell death. In addition, microcolonies of *P. putida* IsoF (green) start colonizing and expanding into *P. putida* KT2442 pre-established colony (right end of the picture).
Reference: Putschert-Montenegro et al. (2022). *Pseudomonas putida* mediates bacterial killing, biofilm invasion and biocontrol with a type IVB secretion system. *Nat Microbiol* 7, 1547–1557. https://doi.org/10.1038/s41564-022-01209-6