Determining soil moisture using a neutron detector on a thermal airship. Innovative measurement methods is one of the topics featured at the **2nd TERENO-OZCAR conference.**

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TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

Newsletter 1/2023

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2ND TERENO-OZCAR-CONFERENCE

25–28 September 2023 in Bonn

Global change is transforming our planet and our living environment. Regional consequences can be very similar, but also very different. The conference in Bonn at the end of September will provide insights into new findings around the Critical Zone - the uppermost layer of the Earth where all human activities are concentrated. Topics range from hydrology and soil science to socio-ecology. More on page 2.

HELMHOLTZ
ASSOCIATION

2ND TERENO-OZCAR-CONFERENCE

25–28 September 2023

Gustav-Stresemann-Institut, Bonn/Germany

NEWS ON CRITICAL ZONE RESEARCH

For their second international conference, TERENO and the French research infrastructure Observatoires de la Zone Critique: Applications et Recherche (OZCAR) are again expecting international guests from a wide range of disciplines: from hydrology and soil science to geophysics and geochemistry, ecology and social ecology. The participants will focus on the Critical Zone, the uppermost layer of our planet where all human activity is concentrated. "At the conference, we want to look at the latest scientific advances as well as the possibilities of multidisciplinary observatories. The goal is to further improve the integrated understanding of processes in the Critical Zone," says Jülich researcher Dr. Heye Bogena, a member of the conference's Scientific Committee.

Wide-ranging program

After a field trip to the TERENO site Wüstebach, researchers will present their results in lectures, presentations and poster sessions in 14 different sessions spread across three days:

SESSION 1

Innovative sensing methods for environmental research

New observation techniques and innovative analysis methods are expanding the treasure trove of data for research. This session will focus on how the new data can be used on a larger scale to shape, model and identify processes.

SESSION 2

Long-term environmental observation for understanding the Earth system in the Anthropocene

Humans are increasingly impacting the global ecosystem. Therefore, there is a need to closely observe terrestrial ecosystems. This session will compare different perspectives, research approaches, and initiatives for an integrative approach.

SESSION 3

Remote sensing for improved analysis of soil-vegetation-atmosphere dynamics at regional scale

Soil, vegetation, and atmosphere form a highly dynamic zone that influences microclimate as well as weather extremes such as heat waves and floods. Researchers show how they are using remote sensing to gain new insights.

SESSION 4

Temporal variability of Critical Zone processes using high-resolution bio- and geoarchives

Instrumental measurements are often made for a limited time. Bio- and geoarchives, such as tree rings, provide information on climate and environment over hundreds of years. This session addresses interfaces between the two methods that help further assess long-term changes in the Critical Zone.

Important dates

August 14: End of early-bird registration

September 19: Registration deadline

EDITORIAL

Strengthen and expand

Exchange and cooperation are important cornerstones in science. With our second joint TERENO-OZCAR conference, we want to contribute to strengthening and expanding these cornerstones. The conference itself is a result of Franco-German cooperation, and is a perfect example of strengthening scientific exchange across borders. Each partner, for example, contributes additional contacts that the other partner does not have. I look forward to the many contributions and discussions with colleagues from a wide range of disciplines.

This exchange becomes all the more urgent as global change accelerates. Recently, the annual report "European State of the Climate" by the European climate observation service Copernicus once again highlighted the extent of heat and drought. 2022 was the second warmest year and warmest summer on record, with precipitation at 10 percent below average (see page 6).

The conference will give us an opportunity to learn about recent findings and developments – and to discuss how we can use observatories to further understand processes and how we as humanity can best respond to the challenges of global change. This latest issue of our newsletter provides a brief look at the main topics (see page 2–3), along with updates on TERENO and our research – on drought and forests, for example.

Happy reading!

Your **Harry Vereecken**

TERENO Coordinator


© Achim Brauer


© UFZ/André Künzelmann


© KIT/IMK-IFU

2ND TERENO-OZCAR-CONFERENCE

25–28 September 2023

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SESSION 5

Measuring and modeling water storage dynamics

There are still many unanswered questions about water storage in the Critical Zone. What are the water and substance turnover rates. How do reservoirs and associated fluxes dynamically respond under changes in climate forcing and anthropic transformation, such as land use change or intensified agriculture? This session will address how monitoring and modeling can be improved.

SESSION 6

Biogeochemical processes at the soil and catchment scale

Biogeochemical and hydrological processes that occur between soil, vegetation, atmosphere and hydrosphere are important factors in the Critical Zone and the cycling of water, carbon and nutrients. This session will focus on approaches to better monitor, understand and model these processes – including broader spatial and temporal scales.

SESSION 7

Novel methods for the integration and exploration of environmental data

Often, data are not collected and stored according to consistent patterns. Specific tools and strategies are needed to make data more accessible and to connect existing infrastructures. This session will address specific requirements, techniques, and solutions.

SESSION 8

Extreme events in the Critical Zone: Water and matter transport during floods and droughts

Floods and droughts, erosion and sediment transport can have severe impacts. This session will focus on improved monitoring and modeling of the physical processes responsible for such events.

SESSION 9

Intermittent streams and processes at the groundwater-surface water interface

Droughts affect water partitioning, flow pathways and biogeochemical processing of materials. They can exacerbate water quality problems caused by human inputs of nutrients and pollutants. This session will focus on two particular issues: intermittent streams – which are streams that dry up repeatedly – and the interface between groundwater and surface water.

SESSION 10

Water and biogeochemical cycles in Earth system models

Models can be used to predict how the Earth system will evolve. As such, they provide the basis for strategies we can use to mitigate or adapt to climate change. However, uncertainties in quantifying water and biogeochemical fluxes are still a problem. This session will present ways to better describe the land surface and specifically the Critical Zone in Earth system models.

SESSION 11

Mountain ecosystems in a changing world

Mountain regions such as the European Alps and Pre-Alps are particularly affected by the climate crisis: temperatures are rising faster than the global average trend and extreme events such as droughts and heavy rainfall are occurring more frequently. This session will discuss interactions such as between biogeochemistry and biodiversity, but also feedback mechanisms such as glacier melt, influence on matter exchange and altered erosion processes.

SESSION 12

Model data fusion: Improving model prediction and process understanding

Model data fusion is a powerful approach to combine models with different data. This session will focus on ways to use the approach to better understand processes in the Critical Zone and improve predictions, including new fusion methods, using new data types or using machine learning.

SESSION 13

Mineral/biota interactions, rates and processes in the formation of the Critical Zone

Interactions between mineral phases and living organisms affect the composition, organization, functioning and evolution of the Critical Zone in a variety of ways. The goal of this session is to decipher specific interactions - between mineral and soil compartments and the structure and functioning of ecosystems, including their living organisms.

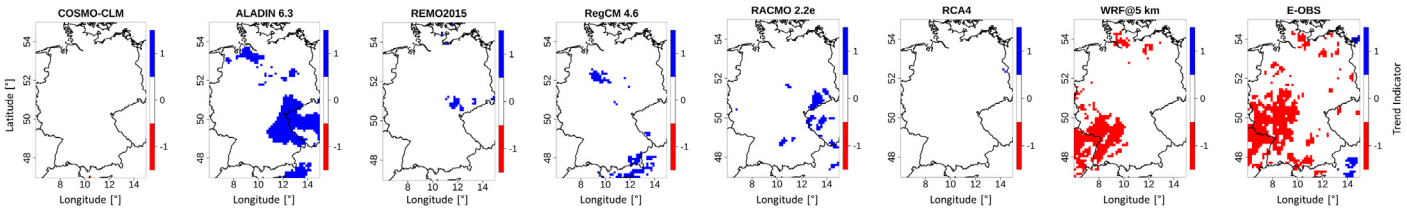
SESSION 14

Challenges in understanding Critical Zone processes in Africa

Africa is strongly affected by the climate crisis. However, much less environmental and climate data is collected there than in Europe. In order to develop adaptation strategies, for example, local water, energy and biogeochemical cycles need to be better understood. This session will explore concepts for long-term observations that take into account data scarcity and limited local technical infrastructure.

▶ **https://www.tereno-conference2023.de/en**

DROUGHT: ADJUSTING MODELS CORRECTLY TO THE TARGET REGION



The calculation of the WRF model (2nd from right) comes closest to observed drought trend 1980-2009 (far right).

Droughts have moved into the public spotlight in Germany, too, after the dry last few years. In order to assess future risks and better understand interrelationships, simulations with regional climate models are essential. Researchers from the Karlsruhe Institute of Technology (KIT) have compared different models. Their study shows the importance of proper model adjustments to the target region.

"We wanted to investigate the ability of todays's models to reproduce previous droughts in Germany and their characteristics – i.e., frequency, duration and severity," says Dragan Petrovic of KIT's Institute for Meteorology and Climate Research (IMK-IFU), lead author of the study. Based on data availability, the researchers decided to study the years 1980 to 2009, during which about 20 droughts occurred with an average duration of 3.1 months. The researchers analyzed drought in the outputs of six regional models, each with a resolution of 12.5 kilometers and based on parameterizations for all of Europe, while taking into account the effects of certain processes. In addition, they evaluated their own simulation at resolutions of 15 and 5 kilometers, for which they used the Weather Research and Forecasting Model (WRF model). "By including this simulation, we were able to investigate both the performance of the individual models and the influence of resolution and parameterizations," explains Petrovic.

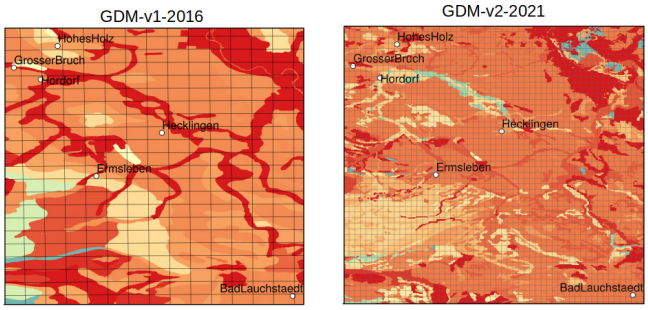
The results showed that higher resolution and the use of tailored parameterizations did not lead to significantly better results. "Depending on the specific analysis goals, computational resources could be saved," Petrovic says. The trend analysis revealed that only the WRF model was able to reproduce drought trends spatially accurately. The researchers attribute this to the adjusted parameterizations in the WRF model. This highlights the importance of tailored model settings to the target area. "Our results are particularly relevant in the context of climate change, where an appropriate reproduction of trends is crucial," emphasizes co-author Prof. Harald Kunstmann.

Dragan Petrovic et al. (2022). *Droughts in Germany: performance of regional climate models in reproducing observed characteristics.* NHESS 22.

▶ DOI: 10.5194/nhess-22-3875-2022

GOOD AGREEMENT

The Drought Monitor of the Helmholtz Centre for Environmental Research - UFZ provides daily information on the state of soil moisture in Germany. Recently, the UFZ started using a higher resolution for the Drought Monitor simulations: 1.2 x 1.2 kilometers instead of 4 x 4 km. A study shows that soil moisture calculated with the new resolution agrees very well with measured data.



Significantly higher: the new resolution of the simulations (r.)

The Drought Monitor is based on daily soil moisture simulations with the mesoscale hydrological model (mHM), which UFZ researchers developed at the UFZ in 2010 and have continued to improve since then. The model incorporates data from some 2,500 German Weather Service weather stations. The study compares simulation results and observational data on soil moisture at a depth of up to 60 centimeters. For this purpose, the participating scientists from UFZ, Forschungszentrum Jülich and Karlsruhe Institute of Technology used measurement data from sensor networks, cosmic-ray stations and lysimeters, among others from 32 TERENO sites.

"Our results for the one-kilometer resolution show that the simulated and observed soil moisture dynamics agree well for the vegetation-active period," says UFZ researcher and lead author of the study, Friedrich Boeing. For the winter months, however, the agreement was lower. "We attribute this to methodological uncertainties in both simulations and observations," says the head of the Drought Monitor, Dr. Andreas Marx.

From the researchers point of view, the new resolution is currently the best compromise between the need for increased model resolution and the model's capabilities in terms of German-wide data availability and process representation. Nevertheless, the work on better models and thus better information on droughts continues.

Friedrich Boeing et al. 2022. *High-resolution drought simulations and comparison to soil moisture observations in Germany.* Hydrology and Earth System Sciences, Vol. 26, Issue 19, 5137-5161.

▶ DOI: 10.5194/hess-26-5137-2022

Volunteers investigate the macrozoobenthos in the Prießnitz River near Dresden.

CITIZEN SCIENTISTS PROVIDE VALID DATA

Researchers are often concerned that data from citizen science projects would not be of the required quality. But with their study on ecological assessment of small streams, a team of researchers led by the Helmholtz Centre for Environmental Research (UFZ) and the German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig has shown that such data can actually be suitable for scientific use.

In 2022, about 300 volunteers collected data on 28 streams in the citizen science project FLOW. The volunteers assessed stream hydromorphology, collected physico-chemical parameters and analyzed the benthic invertebrate community, which can be used to evaluate the ecological status of streams. The UFZ and iDiv team compared the volunteers' results with those of the 'German Monitoring of Small Streams'. In this project, researchers had studied more than 100 water bodies in Germany (see TERENO Newsletter 2021/2), including the TERENO site Holtemme and the 28 streams studied by FLOW.

The results of the citizen scientists and UFZ scientists are very similar in many areas. The volunteers were able to correctly identify the majority of invertebrates at family level, resulting in valid bio indicator (SPEAR-pesticides) values. However, macroinvertebrate identification down to species level is generally not realistic in a citizen science project due to lack of experience, time, and laboratory equipment.

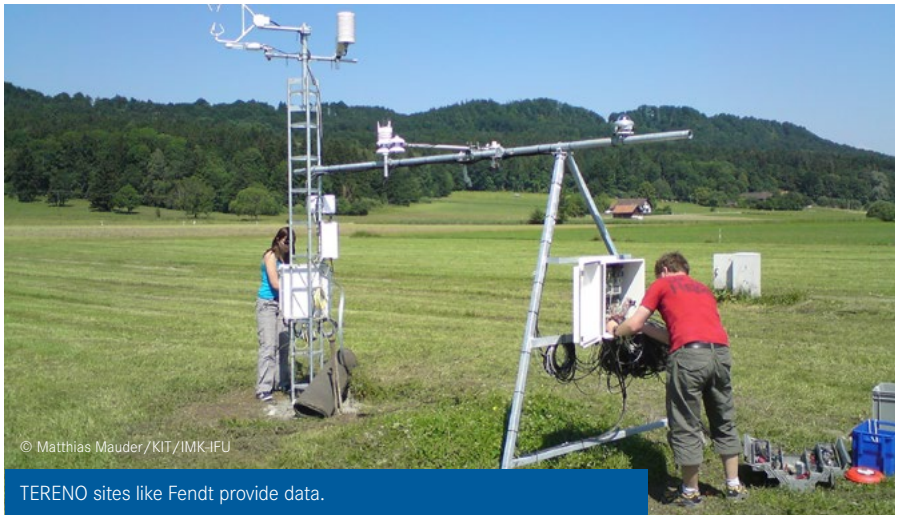
UFZ researcher and FLOW project coordinator Julia von Gönner concludes: "Volunteers are capable to collect useful and valid data on stream status if they are properly trained and if monitoring events are well coordinated. Citizen science freshwater monitoring can fill important data gaps, for example for small streams below 10 km² catchment area that aren't covered by the European Water Framework Directive Monitoring."

Julia von Gönner et al. 2023. *Citizen science for assessing pesticide impacts in agricultural streams.* Science of The Total Environment, 857, 159607.

▶ DOI: 10.1016/j.scitotenv.2022.159607

RECORDING GREENHOUSE GASES MORE ACCURATELY

Six institutions are setting up an Integrated Greenhouse Gas Monitoring System (ITMS) in Germany, including the TERENO partner Karlsruhe Institute of Technology (KIT). With the ITMS, the researchers want to record even more precisely where in Germany, and from which sources, greenhouse gases are released or absorbed.



TERENO sites like Fendt provide data.

To this end, the partners are measuring the exchange of greenhouse gases between the land surface and the atmosphere at numerous locations. TERENO and the German part of the European research infrastructure "Integrated Carbon Observation System" (ICOS) are the main components. The partners are also modeling the responsible processes with the help of simulation models. The goal is new calculations of greenhouse gas sources and sinks with a high degree of reliability.

"If we know in even greater detail, spatially and temporally, where greenhouse gas emissions exactly come from, concrete measures to reduce local emissions can be better evaluated," clarifies Dr. Ralf Kiese from the KIT Institute of Meteorology and Climate Research. The IMTS data could not only help to assess measures, but also, for example, to control the trade with CO2 certificates more precisely.

Other partners of the ITMS, which is funded by the German Federal Ministry of Education and Research, are the Max Planck Institute for Biogeochemistry, German's National Meteorological Service, the University of Bremen, the German Aerospace Center, as well as the German Environment Agency and the Thünen Institute of Climate-Smart Agriculture.

EUROPE IN 2022: EXTREMELY HOT AND DRY

In 2022, average temperatures in Europe reached new highs. According to the annual report "European State of the Climate" of the European climate observation service Copernicus (C3S), the overall average temperature was about 2.2 degrees Celcius higher than before industrialization. It was the second warmest year warmest summer on record. Temperatures in Europe are rising twice as fast as the global average and faster than on any other continent.

It is not only the high temperatures that worry scientists, but the increase in droughts as well. In 2022, 10 percent less precipitation fell than the average. The water level of almost two-thirds of the rivers in Europe was below average. Heat and drought led to a record loss of 5 cubic kilometers of ice from Alpine glaciers. The hot and dry conditions also favored the development of forest fires. Carbon emissions from wildfires in the summer of 2022 were the highest since 2007.

Understand and adapt

It is not only that the glaciers on Greenland have already suffered irreparable damage, but effects of heat and drought were also being felt in our everyday lives, such as in agriculture, shipping and the energy industry. Dr. Carlo Buontempo, director of C3S, speaks of an alarm signal and stressed that it is crucial to understand climate dynamics in Europe in order to adapt to or mitigate the negative impacts of climate change.

The annual report is based mainly on data collected through the EU's Copernicus program, including satellites and ground- and air-based measurement systems, but also model-based estimates. TERENO provides measurement data that can be used in the Copernicus program to calibrate the instruments as well as to validate the data products of the European sentinel satellites. This contribution has also taken into account the EU Copernicus Cal/Val Solution project, completed at the end of 2022, which identified existing data sources (see TERENO Newsletter 2021/1).

▶ EUROPEAN STATE OF THE CLIMATE 2022

© Achim Brauer/GFZ

The lake Tiefer See – an important TERENO site

CLIMATE RECONSTRUCTION AND CLIMATE CHANGE

Geoarchives provide important information for researching climate and environmental changes. They are a focus of TERENO's Northeastern German Lowland Observatory, which is coordinated by the Helmholtz Centre Potsdam – GFZ German Research Centre for Geosciences. On the occasion of DEUQUA 2022 in Potsdam, a conference of the German Quaternary Association DEUQUA, the GFZ has published an overview of Quaternary research at the observatory.

The Quaternary is the youngest time interval of the Earth's history. It began about 2.6 million years ago and is characterized by large climatic fluctuations known as ice ages. The current section of the Quaternary is the Holocene, a warm period that has lasted for nearly 12,000 years, "Because of the fluctuations, the Quaternary is ideal to investigate natural climate variability as baseline for the present anthropogenic climate change. Research at the TERENO's observatory is at the interface of observing the impact of present climate change and, at the same time, advance our understanding how climate and extreme weather situations are recorded in these archives as fundamental information for climate reconstruction," says Prof. Achim Brauer, head of the Climate Dynamics and Landscape Evolution section at GFZ.

To obtain information from the past, GFZ scientists interpret so-called proxy data, i.e. chemical, physical and biological data from lake sediments and tree rings. For this purpose, they observe and measure lake sedimentation at the Tiefer See and tree-ring formation of beech, oak, and pine in the Müritz National Park. The publication presents the monitoring concepts and infrastructure of the sites, such as the main phases of sediment formation and the driving processes. It also describes why stable oxygen isotopes in tree-rings of pine are a suitable proxy. Important results are also included: For example, GFZ researchers identified a previously undetected episode of reduced tree vitality of pine trees from 1963–1992. The cause was SO2 air pollution. Deciduous oak was not affected by this.

Achim Brauer et al. 2022. *Lakes and trees as climate and environment archives: the TERENO Northeastern German Lowland Observatory.* DEUQUA Spec. Pub., 4, 41–58.

▶ DOI: 10.5194/deuquasp-4-41-2022

FEWER IONS, MORE DOMINANT SODIUM AND CHLORIDE

Since 2020, Dr. Eliza Płaczkowska has been conducting research for her SOLUTION project at the TERENO site Wüstebach. The visiting scientist from Poland is working with Prof. Michael Leuchner at RWTH Aachen University. The project, funded by the Polish National Agency for Academic Exchange (NAWA), focuses on investigating the effects of forests and precipitation partitioning on denudation – various processes that erode Earth's surface. In an interview, the hydrologist tells about the project's objectives and some surprising findings she has come across.


© Eva Haas

Mrs. Płaczkowska, what do you research?
The main objective of the project is to determine how land use changes, specifically deforestation and reforestation, affect the water chemistry in a small headwater catchment. Headwaters play an important role as they serve as the origin of water, nutrients, and sediments that flow downstream. These areas are highly sensitive to any environmental changes. Given the dynamic nature of our environment, including climate change and modifications in land use and land cover, understanding the effects of such changes on surface water quantity and quality is crucial. Clean water resources are essential, for example, for drinking water and irrigation.

Why did you choose Wüstebach?
The historical context of the forest was the main reason. Following World War II, spruce trees were planted for reforestation, leading to the establishment of monoculture spruce forests, a common occurrence in various parts of Europe. Unfortunately, many spruce forests are currently facing the threat of drought-induced mortality. This issue poses a substantial problem as it not only impacts the forests themselves but also affects other components of the natural environment, including water quality. In 2013, nine hectares of spruce trees in the Wüstebach catchment were removed to facilitate the regeneration of a more natural forest ecosystem. This transformation provides an ideal opportunity to investigate the effects of land cover changes on the natural environment. Due to the long-term environmental monitoring conducted by TERENO in this area a rich set of data is available.

Are there already first results?
We have obtained preliminary results, which, in some aspects, align with findings from other regions, but in other aspects, they differ significantly. For instance, we observed an increase in concentration of ions associated with biological activity, such as nitrate and potassium, in the stream water, which is consistent with similar studies. However, we were surprised that the concentration of other ions has decreased.

What explanation do you have?
During the deforestation, only the tree stems were removed, leaving the tree's root system intact within the soil. The soil was well protected during logging works by covering harvester lanes with branches. As a result, the disturbance was minimal, and soil erosion was almost non-existent. This could potentially explain the findings. Another surprising observation was the dominance of sodium and chloride ions in the Wüstebach stream. This is considered unnatural since chlorides typically occur in very low concentrations in the environment.


Eliza Płaczkowska during studies at Wüstebach catchment © Mona Ziemes

Could you clear this up?
Yes, in the upper part of the catchment, an asphalt road is located just 150 meters away from the stream. During winter, this road is treated with de-icing salts, and our research revealed that these salts significantly alter the ionic composition of the stream water. It is important to note that higher concentrations of sodium and chloride are not limited to the winter season but persist throughout the year. This suggests the presence of a subsurface buildup of de-icing salts in the soil, which are then washed out with every rainfall event.

When will you be able to present your results?
The first results were published at the end of December 2022. The project will continue until the end of November this year, and the final results will be published thereafter.

Eliza Płaczkowska et al. *The Impact of Partial Deforestation on Solute Fluxes and Stream Water Ionic Composition in a Headwater Catchment.* Water 2023, 15 (1), 107.
▶ DOI: 10.3390/w15010107


© Nadav Lensky

A GOOD COMPLEMENT

Since September 2022, Dr. Ido Sirota has been conducting research as a Humboldt Research Fellowship at Helmholtz Centre Potsdam – GFZ German Research Centre for Geosciences, where he studies lake sediments. These are layers of minerals and organic materials that are deposited on the lake bottom over time. "Geologists usually use sediments to study the past. I'm interested in modern processes, in understanding the sedimentary system and its dynamics," the Israeli explains. During his time at the Hebrew University in Jerusalem, Sirota had worked on sediments in the Dead Sea.

"The research of Achim Brauer's team at the GFZ and my work fit together very well," says Sirota."On the one hand, we are conducting similar investigations, and on the other hand, my approach complements previous work at the GFZ." The focus is on the Tiefer See in the TERENO observatory "Northeast German Lowlands." Thanks to many years of monitoring, numerous data bases are available, which have by no means all been evaluated. In addition, Sirota is carrying out further observations. "For me, it is also so interesting because lakes in Germany are very different from those in Israel, and especially from the Dead Sea. This concerns, for example, the environment, climate and land use," says Sirota.

The visit to Germany is his first extended research stay abroad. But he felt at home from the start, likes Potsdam and also the vicinity to the big city of Berlin – even if many things are different from his home country. "Especially the winter with the wet and cold weather was very unfamiliar," he reports with a laugh. His two-year scholarship runs until 2024. He will spend the first year at the GFZ. How he will continue after that is still open.

NOTHING WORKS WITHOUT TECHNOLOGY (I)

All Helmholtz centers participating in TERENO have teams that ensure that equipment and measurements function properly - and thus make research possible in the first place. Today we introduce the team from the Institute of Bio- and Geosciences (IBG-3) at Forschungszentrum Jülich.


© FZJ/Marius Schmidt
Nils Becker

"Our team works for various national and international observing platform. In addition to TERENO, these include the Helmholtz observing platform MOSES and the European research infrastructure ICOS. We also participates in measurement campaigns," reports Marius Schmidt, who supervises the team. Members of the team include electrical engineer Daniel Dolfus, electrotechnician Nils Becker, chemical lab technician Odilia Esser and biology lab technician Sirgit Kummer. "The brings broad expertise in electrical engineering, measurement technology, data transmission and computer science. It also conducts labor-intensive laboratory and field studies," says Schmidt.

The focus is on the construction, operation and maintenance of stationary and mobile meteorological and micrometeorological measuring equipment. This includes climate stations, cosmic-ray stations and, in particular, several eddy-covariance stations for observing greenhouse gases. "Some of the stations have been producing continuous measurement data for more than 12 years and are well known in the international scientific community," Schmidt said.


© FZJ/Marius Schmidt
Daniel Dolfus, Odilia Esser, Sirgit Kummer (v. l)

The team also conducts plant measurement campaigns on leaf area index, biomass and nutrient levels - from sample collection and its processing, to laboratory testing, data analysis and documentation of measurement results. Another core task of the team is the quality control of continuous meteorological data for the TERENO data portal, calibration of infrared gas analyzers, repair and calibration of sensors, and preparation of technical documentation within the certified ISO 9001 management system.

Harry Vereecken at the award ceremony during the General Assembly of the European Geosciences Union (EGU).

EGU HONORS HARRY VEREECKEN

Professor Harry Vereecken, director at the Institute of Agrosphere at Forschungszentrum Jülich, received the Alfred Wegener Medal, one of the highest honors awarded by the European Geosciences Union (EGU). At the same time, the organisation appointed him an honorary member. With the medal, the EGU recognizes Vereecken's groundbreaking contributions to soil-plant-atmosphere processes with a focus on hydrological and biochemical cycles.

According to the EGU, Vereecken has played a key role in integrating and connecting the individual sub-processes and sub-disciplines. He recognized early on the need for exploring subsurface flow processes by geophysical methods. With his studies, he expanded knowledge of transport processes in heterogeneous soils, both hydrologically and in the transport of contaminants. Using soil moisture, pore pressure, and other variables, he developed modeling approaches for improved knowledge of soil properties. This includes the development of upscaling techniques to link local field measurements with environmental models and satellite observations. In 2016, he and some colleagues founded the International Soil Modeling Consortium (ISMC) with the goal of improving soil process modeling, pooling expertise, and increasing exchange with other Earth system sciences.

Harry Vereecken has also been instrumental in strengthening the observational data base – for example, through the TERENO initative, of which he is one of the founding fathers. TERENO, the EGU says, has become a blueprint for large-scale European and global infrastructures for research on ecology, critical zones and global climate. For example, it paved the way for eLTER RI (European Long-Term Ecosystem, critical zone and socio-ecological Research Infrastructure), a European infrastructure for long-term ecosystem research, whose concept Harry Vereecken helped design.

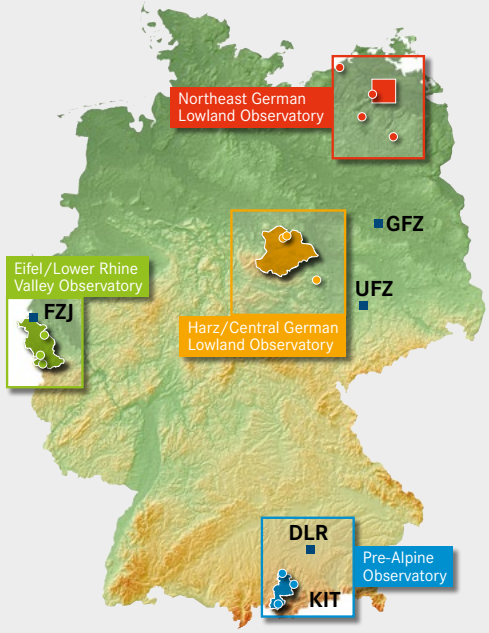
CONTACT | COORDINATION

Dr. Heye Bogena
Institute of Bio- and Geosciences – IBG-3: Agrosphere,
Forschungszentrum Jülich, 52425 Jülich, Germany
Tel.: +49 (0) 24 61 / 61-67 52
E-mail: h.bogena@fz-juelich.de

Dr. Ralf Kiese
Institute for Meteorology and Climate Research,
IMK-IFU, Karlsruhe Institute of Technology,
Kreuzeckbahnstrasse 19,
82467 Garmisch-Partenkirchen, Germany
Tel.: +49 (0) 88 21 / 1 83-1 53
E-mail: ralf.kiese@kit.edu

Dr. Markus Schwab
Helmholtz Centre Potsdam – GFZ
German Research Centre for Geosciences,
Telegrafenberg, 14473 Potsdam, Germany
Tel.: +49 (0) 3 31 / 2 88 1388
E-mail: markus.schwab@gfz-potsdam.de

Dr. Steffen Zacharias
Department Monitoring and Exploration Technologies,
Helmholtz Centre for Environmental Research – UFZ,
Permoserstraße 15, 04318 Leipzig, Germany
Tel.: +49 (0) 3 41 / 2 35-13 81
E-mail: steffen.zacharias@ufz.de



FZJ Forschungszentrum Jülich (Coordination)

DLR German Aerospace Center

KIT Karlsruhe Institute of Technology

UFZ Helmholtz Centre for Environmental Research

GFZ German Research Centre for Geosciences

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