Scientists at the TERENO SOILCan lysimeter network site in Graswang, Bavaria study soil greenhouse gas emissions over long periods of time using so-called static chambers.

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TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

Newsletter 1/2014

CONTENTS

TERENO International Conference
September 29 – October 3, 2014
Bonn

Long-term research a long-term responsibility

Our Earth is a dynamic system and our environment is constantly changing – the result of both natural processes and human intervention. The job of science is to understand these changes and their impact. We've known for a long time that projects with a short-term time horizon are insufficient for accomplishing this task. Continuous, long-term research is the key to fulfilling our responsibility as scientists, and the only way to determine whether observed changes are the result of short-term fluctuations or lasting trends. At the same time, long-term research should not limit itself to the observation of local changes and local phenomena. Researchers around the world must work together via networks, and collect and exchange data according to established standards and guidelines.

HELMHOLTZ ASSOCIATION

WATER'S UNKNOWN WAYS

A virtual river landscape for better weather forecasting


© Joergsam

Water and energy fluxes between groundwater, subsurface, land surface, and atmosphere are tremendously complex. To better understand the physical processes involved, a DFG research unit is relying on virtual reality. With the help of Jülich's supercomputer JUQUEEN, researchers are developing a computer model to simulate an entire river catchment using the Neckar River catchment area as their real-life model for the virtual landscape. The team's objective is to use the model to improve weather and flood forecasting. Several TERENO partners are involved in the project.

Forecasting models for river basins often consider only a portion of the complex processes involved in water flows. Models that focus primarily on the atmosphere, for example, often simplify the effect of land surface and subsurface. When the model's predictions do not align with actual measurements, the model can statistically adjust, but due to the simplified assumptions these adjustments might violate physics. "Our goal is to reproduce the actual physical interrelationships as much as possible," explains Clemens Simmer, Professor of Meteorology at the University of Bonn and speaker for the German Research Foundation (DFG) research unit "Data Assimilation for Improved Characterization of Fluxes across Compartmental Interfaces". The team of researchers wants to integrate into the new model previously neglected interactions between the terrestrial hydrosphere, atmosphere and land surface. The objective is to create a virtual river landscape, which will enable more reliable forecasts – not only for water runoff, but also for the entire water balance of catchment areas.

Constant corrections to the model

To achieve its objective, the team of hydrogeologists, hydrologists, meteorologists, fluid mechanics experts as well as environmental physicists, soil physicists and geophysicists is developing and testing so-called integrative data assimilation techniques. These techniques involve a constant process of correcting model state variables and parameters with the help of observational data in order to gradually achieve more precise models and more accurate forecasts. "There is no way to avoid such adjustments. Some factors, such as the exact distribution of precipitation across space and time, the state of the subsurface or the dynamics of soil moisture and groundwater, are simply too complex to measure or are not measureable at all with today's technologies," explains Prof. Harrie-Jan Hendricks-Franssen from the Forschungszentrum Jülich, who is also one of the DFG project coordinators. The virtual river landscape fills these gaps. "Given our complete familiarity with the states found there, we can develop and test our methods much more effectively," he adds.

Following completion of the first three-year funding period, the team plans to apply their model to an existing research area at one of the four TERENO observatories. ■

DFG Research Unit 2131 "Data Assimilation for Improved Characterization of Fluxes across Compartmental Interfaces"

- Participating institutions: Universities of Augsburg, Bonn, Hamburg, Hannover and Tübingen, the European Space Agency, as well as institutes from the Forschungszentrum Jülich (FZ Jülich) and the Helmholtz Centre for Environmental Research – UFZ.
- Funding: 2.1 million euros to 2016

www2.meteo.uni-bonn.de/for2131/doku.php

EDITORIAL

Long-term data is the key

© Chris Taube

Long-term environmental observation is at the core of TERENO's work, and we have aligned our focus and instrumentation with the German Research Foundation's 2013 strategy paper on terrestrial research in Germany, which stipulates that future research infrastructures for terrestrial ecosystem research must support systematized, long-term research that is both multi-scale and cross-compartmental. Ultimately this is the only approach that makes sense if we want to understand how ecosystems react to changes over the long term. Only with long-term data can we recognize developments and validate our prediction models. At the same time, long-term data allows us react to threats in a timely manner, to minimize any negative impact on society, and to develop adaptation strategies. With LTER, the network for long-term ecology and ecosystem research, we have a group that brings together research in this area at the regional, national and international level (see pp. 3 and 8). The trend towards long-term observation and research networks can be seen in other countries as well. Australia, with its Terrestrial Ecosystem Research Network (TERN, see p. 8), is just one example.

Our goal for the international TERENO conference from September 29 to October 3, 2014 in Bonn is to make a significant contribution to dialogue and networking across the terrestrial research community. Participants in the five-day event will include representatives from around the world and from all relevant disciplines, who will join us in Bonn to discuss current developments, new methods and future trends (see p. 4). We look forward to a big turnout and a lively discussion!

I hope you enjoy this issue of the TERENO newsletter.

Sincerely, **Harry Vereecken**
TERENO Coordinator

SETTING THE COURSE TODAY FOR TOMORROW'S DATA

Long-term research as global challenge – Interview with Dr. Stefan Klotz, co-founder of LTER-Germany


© UFZ / André Künzelmann

Dr. Stefan Klotz heads the Department of Community Ecology at the Helmholtz Centre for Environmental Research – UFZ. A plant ecologist with degrees in biology and chemistry, Klotz is co-founder of LTER-Germany and president of the European Ecological Federation (EEF). His research focuses on plant ecology, invasive species, as well as the relationship between climate change, land-use change and plant-community dynamics and ecosystems.

One of Germany's leading experts for long-term research is Dr. Stefan Klotz from the Helmholtz Centre for Environmental Research – UFZ. An expert in plant ecology, Klotz is co-founder of LTER-Germany, the national network for long-term ecosystem research, which is also member of LTER's European and international networks. In the following interview, Klotz talks about the need for long-term research and the challenges associated with it.

Dr. Klotz, why do we need long-term research?
Ecological and natural processes cannot be measured in terms of seconds or minutes. A flower can open or be pollinated before our eyes, but it can take decades, even centuries, for a forest to grow and develop. Moreover, environmental change is usually gradual and occurs with larger temporal fluctuations that overlie the trend. Only through continuous, long-term research can we distinguish between long-term trends and short-term fluctuations or isolated events. For this we need to observe land use and environmental parameters as well as soils, water and biodiversity.

What has been the role of long-term research?
Up until now, long-term research has not been given the recognition it deserves. People who are directly affected by changes – foresters, for example – recognized much earlier that natural processes need to be tracked continuously. So long-term investigations of forested areas have a long tradition here in Germany. In the United States, it wasn't until the 1980s that people began considering long-term ecological research across defined areas or landscape segments. But one problem we have in Germany is financing longer-term projects. Funding is often limited to three years, which is the usual timeframe for a PhD dissertation. It has been and continues to be difficult to secure longer-term funding.

How can long-term research establish itself in spite of this?
One of the functions of the Helmholtz community here in Germany is to establish larger research infrastructures in Germany and to make these available to the scientific community, as was done with TERENO. The large scope of this project has helped to secure a longer-term framework. In addition, we must continue to work on the national and international level to establish and expand networks in order to secure research areas, research facilities and experimentation facilities over the long term. This is exactly what LTER achieves with its national and international-level networks for long-term ecological and ecosystem research. LTER is also important because it allows scientists to define common goals.

What sort of common goals?
We need to get the parameters right – to clarify and define the parameters that we should be observing and measuring. Currently at LTER we are working on defining a basic set of information and data that needs to be compiled. We also consider methodological approaches, data access, data evaluation and well as different rating scales. We need to be aware of the fact that our efforts today, and the direction we set, will determine the data that will be available to us in the future.

Was this different in the past?
In the past it was common that each group conducted its own research, on its own. The problem with this is that a research team might identify a trend in a certain area, but we don't know whether this is a local phenomenon or whether it is connected to a more global trend. The goal should be to conduct our scientific investigations in many different geographic or climatic regions according to the same model or "template" so that we can then compare the results. Only then do we know whether a trend is specific to a certain habitat, an ecosystem or an entire region. This is only possible through collaboration, and TERENO is a textbook example of this.

What do your international colleagues think about TERENO?
In many countries TERENO is considered a model – a blueprint – both in terms of research method and content. People notice that TERENO works very well not only on the organizational level, but that it is also starting to generate some interesting and exciting results. Still, for some countries it's a bit more difficult than for Germany to make the necessary resources available and establish something like this, which is why I would like to see Europe work closer together on this. Then it's important that Germany contributes its wealth of experience with international collaboration on long-term research, especially with regard to research parameters, research methods and data analysis. ■

FOCUS ON MAJOR CHALLENGES

TERENO International Conference
September 29 – October 3, 2014
Bonn

International TERENO conference provides overview of current terrestrial environmental research

For five days at the end of September, Bonn will be at the center of terrestrial environmental research as the TERENO project hosts its first international conference, which will bring together scientists from around the world to discuss current developments and new approaches in research. Some 300 participants from all disciplines of geosciences research are expected to be on hand for 15 different sessions on a variety of topics. The conference will focus mainly on the major challenges facing geoscientists today, especially those associated with climate change, land-use change and the resulting changes to the environment. Lectures by renowned experts will kick off each of the conference's 15 sessions, including Prof. Dr. Dara Entekhabi from the Massachusetts Institute of Technology, Prof. Dr. Marek Zreda from the University of Arizona and Prof. Dr. Abad Chabbi from France's Institut National de la Recherche Agronomique, coordinator of the EU project AnaEE (Analysis and Experimentation on Ecosystems). Poster presentations will complement the lectures and, following the four days of sessions, participants will have the opportunity to take part in a field trip to the nearby Wüstebach test site within the "Eifel/Lower Rhine Valley" TERENO observatory. ■

Venue
University of Bonn

For further information about the program, the sessions and the field excursion to TERENO's Wüstebach site:

www.tereno-conference2014.de


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Trends and Topics

Innovative measurement techniques


© FZJ

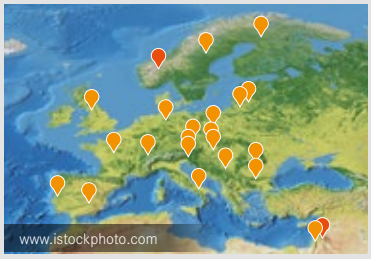
Soil moisture is an important factor in water cycle research. Researchers at the conference will introduce innovative measurement techniques such as the Cosmic-ray Moisture Probe (COSMOS, see also page 11), a comparatively new technology that uses cosmic radiation to assess near-surface soil moisture levels across larger areas. COSMOS can be applied, for example, to improve the efficiency of irrigation management. The conference will also feature techniques using radio sensors and new remote sensing methods for monitoring in the so-called Critical Zone. The goal is to demonstrate how modern observation technologies and innovative analyses can be used to gain new insight from existing data (Session 13: Innovative sensing methods for the Critical Zone).

Improving water quality prediction


© UFZ / André Künzelmann

New technologies have made it possible to significantly improve local monitoring of water quality, and these technologies have also enabled new insights into watershed hydrology and biogeochemical processes (see also page 13). But to continue to improve water quality predictions, new strategies must be developed that do even more to combine monitoring and modeling. Such techniques will also be presented at the conference, along with promising approaches to interpreting continuously collected water quality data, and papers that analyze hydrological processes with the help of such data (Session 3: Improving water quality management using new water quality modeling and observation strategies).

Networking


www.istockphoto.com

Climate change affects all areas of terrestrial systems, and will result in reactions on the part of these systems at different spatial and temporal scales. To meet these challenges, terrestrial environmental research relies on long-term observation across these different scales. The goal is to not only to create a long-term research infrastructure, but to establish international networks to promote dialogue and the development of common standards. The conference will inform about ongoing and planned activities designed to achieve these goals, and participants will discuss how best to initiate national and international cooperation across disciplines (Session 12: Networking of long-term infrastructures for terrestrial research).

NEW MODELS FOR NITROUS OXIDE AND WATER TRANSPORT

Two MICMoR PhD students conduct research at TERENO's Scheyern site.

Florian Heinlein taking measurements with the laser scanner

The geoecologist Christoph Thieme and meteorologist Florian Heinlein have three things in common: both began their PhD studies at the Helmholtz Zentrum München in April 2012, both are members of the Helmholtz Research School "Mechanisms and Interactions of Climate Change in Mountain Regions" (MICMoR), and both are taking advantage of TERENO's agricultural research farm in Scheyern, Bavaria, to test their simulation models. While Thieme measures nitrous oxide exchange between soils and the atmosphere, Heinlein is studying water transport in maize plants.

As part of his doctoral studies, Thieme is developing a model to simulate the impact of atmospheric stability on nitrous oxide exchange between soils and the atmosphere. The project is part of research topic #4 at the Helmholtz Regional Climate Change initiative (REKLIM) entitled "The land surface in the climate system". Thieme's model simulates both the formation of nitrous oxide in the soil as well as the effect of meteorological factors on nitrous oxide transport from the soil into the atmosphere.

Dependent on atmosphere

Nitrous oxide, also called dinitrogen monoxide (N_2O) or laughing gas, is produced mainly by microorganisms in agricultural soils. A very persistent greenhouse gas, nitrous oxide is also considered – since the ban on hydrochlorofluorocarbons (HCFCs) – the dominant ozone-depleting substance, which is the motivation behind today's efforts to reduce nitrous oxide emissions in agriculture. But achieving this reduction is difficult, because the underlying processes have not yet been adequately understood and documented. Up until now, models have not considered the impact of meteorological factors. The rate of nitrous oxide exchange between soil and near-ground atmosphere, for example, is dependent on atmospheric conditions. Factors such as wind speed and atmospheric stability play an important role.

Thieme's model is designed to close this knowledge gap, and he relies on the modular ecosystem simulation software Expert-N. "With this software we have a more precise description of the upper boundary conditions at the soil atmosphere interface. To achieve a first approximation we used an approach analogous to ohmic resistance, which is dependent on meteorological parameters," explains Thieme. The new model is then validated using N_2O flux measurements taken in Scheyern, for which Thieme uses quantum cascade lasers – special semiconductor lasers that emit in the infrared portion of the electromagnetic spectrum.

Transport processes in plants

Florian Heinlein wants to model the impact of climate change on crop growth and yield quality based on the simulation of plant-internal transport processes. His research project is part of the DFG Research Unit 1695 "Agricultural Landscapes under Global Climate Change – Processes and Feedbacks on a Regional Scale". To verify the results of his model, Heinlein measures water transport in maize plants both at the Scheyern agricultural research farm and with the help of Helmholtz Centre lysimeters. Using terrestrial laser scans, Heinlein also determines the structure of the maize plants, which he then compares to the modeled plant architectures created with the help of the Lindenmayer System – a model used for the geometric representation of plant organ development.

Webcam images are used to record winter wheat growth and critical climatic events

These architectures also provide input for an existing water flux model to measure sap flux within individual plants. To be able to efficiently simulate larger plant populations, Heinlein uses a simplified version of this water flux model, which considers only the vertical water transport in combination with root and leaf-area indices. The simplified version acts as an evapotranspiration module for integration into the modular ecosystem simulation software Expert-N. "We expect these models to be more sensitive to climate changes than conventional evapotranspiration models," explains Heinlein. Because the Expert-N software is also coupled to the widely used Weather Research and Forecasting (WRF) model, Heinlein's research not only helps improve the simulation of agricultural plant growth. The more realistic evapotranspiration models also allow for better simulations of the water exchange between soil and atmosphere, which would help improve weather and climate simulations. ■

www.micmor.kit.edu
www.helmholtz-muenchen.de/en/scheyern2
www.reklim.de/en.html
https://klimawandel.uni-hohenheim.de/home

NEW INSIGHT INTO THE NITROGEN CYCLE

Jülich method allows researchers to analyze hydroxylamine in soils.

Scientists from the Forschungszentrum Jülich (FZ Jülich) are currently applying a breakthrough new method to detect the presence of hydroxylamine (NH_2OH) in soil samples taken from TERENO's Wüstebach site in summer 2013. Because hydroxylamine is highly reactive and found only in extremely low concentrations in the soil, it has been virtually undetectable in soil samples until now. Initial results indicate that hydroxylamine plays a key role in the formation of nitrous oxide (N_2O).

Collecting soil samples using a sample tube called a liner

The soil sampling at the Wüstebach site is connected to an ongoing initiative on the part of the Eifel National Park to transition the park's predominant conifer monoculture into natural mixed-deciduous forest, which also impacts the area along the Wüstebach stream. TERENO is studying the effects of this initiative on key soil parameters (see Newsletter 2/2013) such as pH levels, the concentration of carbon and nutrients, as well as nitrogen turnover. In natural ecosystems, nitrogen, which is essential for both plant growth and human and animal nutrition, circulates in a largely closed cycle. But fertilizer and land use changes initiated by humans can lead to nitrogen surplus, which can cause environmental problems such as nitrate in ground and surface waters or the emission of nitrous oxide into the atmosphere. A key process here is nitrification, by which microorganisms in the soil convert ammonium to nitrite and release nitrous oxide as a byproduct. Hydroxylamine is a reactive intermediate in the first step of nitrification. "Our analysis shows a close correlation between hydroxylamine concentrations and N_2O emission rates, which points to nitrification as a key process in the formation of N_2O," reports Prof. Nicolas Brüggemann. To shed further light on the issue, Brüggemann and his team are planning additional investigations, including a second soil sampling along the Wüstebach in summer 2014 to examine the effects of deforestation on nitrification and N_2O formation. ■

ECOSYSTEM CLIMATE TEST

The Helmholtz Centre for Environmental Research – UFZ now features a unique outdoor laboratory. The Global Change Experimental Facility (GCEF) at the Bad Lauchstädt site allows scientists to conduct experimental research on the impact of climate change on ecosystems. These experiments make a valuable contribution to understanding the relationships between climate change, land use, and the functions of terrestrial ecosystems, and are a perfect complement to research being conducted at the TERENO observatories.

The new outdoor laboratory GCEF: Providing over 19,000 square meters of research space

The GCEF consists of 50 field plots – each with an area of 16 x 24 meters – on which five common land-use types are being investigated: conventional agriculture, organic farming, intensive grassland farming and extensive grassland farming, including both mowing and sheep grazing. Half of the plots simulate a future climate, i.e. a climate researchers are predicting for the earth a few decades from now. Movable roofs and walls are employed to prevent nightly heat dissipation, thus increasing the average temperature, and to reduce precipitation levels in the summer, while an overhead sprinkler system increases precipitation levels in the winter months. On the other half of the plots, the climate remains unaffected. Rather than focusing on the agricultural yield of the plots, GCEF researchers are investigating the ecological functions of each of the systems and focusing in particular on essential processes in the soil – which have received little attention in the past – as well as species interactions and small genetic changes within the species as a result of climate change. ■

Measuring carbon dioxide and methane fluxes above a GCEF field plot using infrared spectroscopy

www.ufz.de/gcef

HANDS-ON EXPERIENCE ALONG THE WÜSTEBACH

University of Bonn students examine carbon fluxes at the TERENO site.

Water-extractable organic carbon is considered a good indicator for evaluating the dynamics of carbon fluxes in soils, which play an important role in today's global climate-change research. As part of their coursework, four University of Bonn students measured water-extractable organic carbon concentrations at the TERENO site along the Wüstebach stream. The students' findings will be integrated into ongoing TERENO investigations.


© FZ Jülich

As part of their University of Bonn project seminar, Sara Bauke, Beate Koch, Maren Stollberg and Frederik Thiemann analyzed soil samples that TERENO scientists had taken at the Wüstebach site in summer 2013, just before the Eifel National Park began clearing the spruce forest there. The cutting was part of the national park's effort to restore the park's original mixed deciduous forest – a renaturation project for which TERENO is providing science and research support (see newsletter 2/2013).

The four students focused their investigations on the soil types most common along the Wüstebach: Cambisol, Planosol and Gleysols. They measured the concentration of water-soluble organic carbon in relation to soil sample depth, soil moisture and nitrogen content, and their findings indicate that concentrations of water extractable organic carbon vary greatly along the Wüstebach. Their findings also revealed that these measurements could help identify spatial and temporal changes in the soil's so-called "O horizon", the organic layer, as well as in the soil's mineral layer, known as the "A horizon".

Insight into today's research

"Our goal was to familiarize the students with working with the soils, but we also wanted them to understand how to use the wealth of additional data provided by the TERENO site to help interpret their measurements. In this way they gained some insight into long-term scientific observations, as well as some of today's most current research topics," says Dr. Roland Bol from the Forschungszentrum Jülich, who supervised the students together with Dr. Eva Lehndorff from the University of Bonn. For the four students it was a new and interesting experience, and an opportunity to apply their classroom knowledge to a concrete project. "The fact that our findings have made at least a small contribution to current global climate-change research is definitely something special," says Beate Koch on behalf of her fellow students.

Their research was part of the project seminar "Soil Ecology and Soil Conservation" offered by the University of Bonn's Faculty of Agriculture to provide prospective agronomists, microbiologists and geoscientists with hands-on experience. Another project seminar will be offered in the winter semester 2014/15, and students will again have the opportunity to conduct soils research at the "Eifel/Lower Rhine Valley" TERENO observatory. ■

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SOILCAN EXPANDED

Additional lysimeter hexagon for the "Northeastern German Lowland" observatory


© GFZ

TERENO in the media

Radio report about the lysimeter station at Dedelow, broadcasted August 4, 2014 (in German)

www.swr.de/blog/diedurchblicker/2014/08/04/eine-lysimeteranlage-fuer-die-uckermark

The German Research Centre for Geosciences (GFZ) and the Leibniz Centre for Agricultural Landscape Research (ZALF) have installed an additional lysimeter hexagon in Dedelow in Germany's Uckermark region (Brandenburg). This brings the number of lysimeter devices at this site of the "Northeastern German Lowland" TERENO observatory to twelve. The devices are part of TERENO's SOILCan project, the world's largest lysimeter experiment, which includes more than 100 devices in all.

The new hexagon in Dedelow contains three heavily eroded soils and three colluvial soils influenced by groundwater. This provides a representative look at the ground moraine landscape. Among other topics, researchers from GFZ, ZALF, and the universities of Cottbus and Augsburg are researching weathering, pedogenesis and feedback mechanisms resulting from erosion and deposition processes, which play an important role for water and nutrient dynamics on landscape level. "This allows us to include new sites in the lysimeter study – sites that can in fact be prevalent over wide areas, but which we had not investigated until now," explains Prof. Dr. Michael Sommer, head of ZALF's soil landscape research institute (Institut für Bodenlandschaftsforschung). ■

"TERN TRANSFORMS AUSTRALIA'S ECOSYSTEM RESEARCH"

Nationwide network takes on ecological challenges

About five years ago, Australian scientists identified no less than 22 major ecological challenges facing their continent, ranging from global issues such as climate change and coastal flooding to regional problems such as fires, water supply and non-native plant and animal species. One answer to the complex ecosystem-related challenges is TERN, the Terrestrial Ecosystem Research Network.

Founded in 2009, the TERN network brings together over 40 universities, facilities and other organizations. "TERN transforms Australia's ecosystem research," says Dr. Eva van Gorsel from Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO). "To overcome the challenges we face and find solutions, we not only need to expand infrastructure and collect long-term data, but also must strengthen the connections between ecosystem scientists and collaborate across disciplines." CSIRO was one of the main initiators of TERN; today it supports the network's continued expansion and takes advantage of the network for its own work as Australia's national research organization.


© Sam Bentley-Toon

A central aspect of TERN: Working together with Australia's Aboriginals


© Aaron Greenville

Cloudburst over Cravens Peak in Central West Queensland

Fruitful research

TERN has installed numerous instruments for observing flora and fauna across a diverse range of ecosystems and regions. To make the data accessible and usable for all researchers, methods were standardized and new solutions for data collection and analysis developed. Today TERN has generated more than 1,000 research products, including a national data portal, as well as over 850 published data sets and some 200 publications. "All of society benefits from these results; it is the basis for being able to effectively manage and sustainably use Australia's ecosystems," says von Gorsel, who heads the TERN OzFlux network, which focuses on the exchange of carbon dioxide, water vapor, and energy between terrestrial ecosystems and the atmosphere.

TERN's success has attracted international interest, and it collaborates today with research facilities in the US, as well as with the European infrastructure network Analysis and Experimentation on Ecosystems (AnaEE). The first contacts have been made to TERENO as well. Potential areas of cooperation between TERN and TERENO include water and material fluxes, as well as data management. To help foster the partnership, TERN will be on hand at the international TERENO conference in Bonn. ■

www.tern.org.au

LTER-D: LONG-TERM ECOLOGICAL RESEARCH WITH WORLDWIDE STANDARDS

2014 marks the 10th anniversary of LTER-D, the German Long-Term Ecosystem Research Network. Founded in 2004, the network serves as a platform for communication, documentation and collaboration among scientists involved in long-term, system-oriented and interdisciplinary ecological research in Germany. The network of research sites reaches from the coasts of the Baltic and North Seas to the Bavarian Alps in the south. The network also covers marine areas, such as the Deep Sea Observatory HAUSGARTEN in the Arctic Ocean run by the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI). TERENO's well-equipped regional observatories are an integral part of LTER-D.

LTER-D is a member of the international LTER umbrella organization ILTER as well the European regional network LTER-Europe. One of the main objectives of national and international collaboration is to harmonize research and data management methods to ensure the comparability of data and research results from sites around the world. The network also devises projects designed to explore the many facets of global change.

The German Long-Term Ecosystem Research Network comprises scientists from universities as well as from non-university research institutions such as the Leibniz Association and the Helmholtz Association.

The network relies on the cooperation from the national park system and biosphere reserves, which provide the ideal settings for long-term, site-based ecosystem research, and is indebted to them for their valuable contributions. ■

For more information:
www.ufz.de/lter-d/index.php?en=15578

VISION REALIZED

Advisory Board commends TERENO's progress

During a two-day meeting in Klink/Müritz last September, TERENO's international Advisory Board praised TERENO for the important goals it has achieved so far, and for developing into a highly effective cross-disciplinary initiative within the Helmholtz community. The board emphasized TERENO's highly collaborative relationships – not only within and between the affiliated Helmholtz centers, but also with its many university, non-university and government affiliates. The board also discussed TERENO's future development and recommended to pursue closer ties with the international initiative "Critical Zone Observatories" (see TERENO Newsletter 2/2013). The meeting, which was organized by the German Research Centre for Geosciences (GFZ), also included a field trip to the "Hinnensee" observation facility in nearby Müritz National Park, which is an important site in TERENO's "Northeastern German Lowland" observatory. The Hinnensee facility comprises a large swath of natural forest surrounding Hinnensee lake, where the GFZ has installed measurement instruments to investigate hydrological and dendrochronological dynamics, as well as long-term landscape dynamics. ■


© Müritz Nationalpark

CHANNELING KNOW-HOW

CAWR
Center for Advanced Water Research

The Helmholtz Centre for Environmental Research – UFZ and the Technische Universität Dresden (TU Dresden) have bundled their know-how and resources to establish the new Center for Advanced Water Research (CAWR). The combined strengths of UFZ and TU Dresden, including more than 500 affiliated scientists, make CAWR visible centre with a broad expertise in water research in Europe. At the focus of CAWR's research agenda is the integrated water resource management in the face of global change. This includes water quality, water resource management in arid and urban areas, as well as aspects such as water policy, social change, and climate change. CAWR benefits from existing data-collection and research infrastructure, including UFZ's major contribution to the partnership with its "Harz/Central German Lowland" TERENO observatory. CAWR is also included in the Helmholtz water network and supports the goals of the Water Science Alliance, the platform for Germany's water research community. ■

www.ufz.de/cawr/index.php?en=32016


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Young researcher honored

Dipl.-Ing. Simon Kögler from the Helmholtz Centre for Environmental Research – UFZ received the outstanding young scientist award ("Nachwuchspreis"), including 1,000 euros in prize money, at the "Innovative Feuchtemessung in Forschung und Praxis" conference hosted by the Competence Center for Material Moisture (CMM) in Weimar in September 2013. As TERENO field engineer, Kögler was recognized for his work comparing two methods for calibrating soil moisture sensors. Kögler's results allow to calibrate many such low-frequency sensors in a way that is efficient and minimizes wear and tear on the material. ■

SOIL MODELERS GO ONLINE

The International Soil Modeling Consortium (ISMC) has been online since the end of April 2014. Among other features, the website introduces visitors to new technologies and methods for quantifying and modeling soil processes. ISMC, which was initiated by the Agrosphere Institute at Forschungszentrum Jülich, is aimed primarily at soil modelers and experimental soil scientists. The goal is to improve and increase the role of soil modeling in addressing some of today's global challenges. The consortium wants to help improve collaboration and synergies with other areas of research, and to stimulate the development of transnational research activities. ■

http://soil-modeling.org

REKLIM CONFERENCE ON REGIONAL CLIMATE CHANGE

October 6 – 10 | Berlin, Germany

The international conference "Our Climate – Our Future. Regional Perspectives on a Global Challenge" will bring together scientists from an array of disciplines specializing in the regional impacts of climate change. Topics include strategies for climate change mitigation and adaption, regional climate system modeling as well as climate change in the past. Special attention will also be paid to the atmospheric interactions and the role of land surface in the climate system, sea level changes, Arctic change and extreme meteorological events. The conference is being organized by the Helmholtz Climate Initiative REKLIM (Regionale Klimaänderungen/Regional climate change). ■

www.reklim-conference-2014.de

STRONGER FOCUS ON BIOGEOCHEMICAL PROCESSES

Experts unanimous at Chapman conference

The Chapman conferences organized by the American Geophysical Union (AGU) bring experts together from around the world to discuss innovative approaches in important areas of research. In October 2013, experts from the soil systems sciences, hydrology, and biogeosciences met in Tucson, USA for the "AGU Chapman Conference on Soil-mediated Drivers of Coupled Biogeochemical and Hydrological Processes Across Scales". The conference focused on new strategies to improve the way processes and critical drivers in the biogeosphere are observed and understood. Conference organizers included scientists from TERENO member-institutions Forschungszentrum Jülich and the Karlsruhe Institute of Technology (KIT).

The topics presented at the conference ranged from transport and exchange processes of organic and gaseous compounds, to the impact of soil formation and functions on ecosystem services. Participants agreed that research must increase its focus on the role of biogeochemical processes in soils – in particular the way in which these processes impact climate variables and climatic fluctuations. New measurement techniques such as Stable Isotope Analysis could make a significant contribution to better understanding biogeochemical and hydrological processes. Participants also broadly supported the idea of creating a worldwide network of Critical Zone Observatories to provide researchers with access to long-term data. Discussions also focused on the need to define ecosystem services more clearly, including the importance of biogeochemical and hydrological processes for these services. ■

Harry Vereecken, Michael Young, Peter Troch and Paul Bertsch. Strategies to Observe and Understand Processes and Drivers in the Biogeosphere. Eos, Transactions American Geophysical Union, Vol. 95, Issue 2, page 16. DOI: 10.1002/2014EO020004.

▶ http://onlinelibrary.wiley.com/doi/10.1002/2014EO020004/abstract

DETECTION TOOL

TERENO'S "Water Isotopes" working group hosts workshop

Measuring the stable isotopes of oxygen and hydrogen with the help of a cavity ring-down spectrometer

In October 2013, the TERENO working group "Water Isotopes" got together at the German Research Centre for Geosciences (GFZ) for its second workshop. Sixteen researchers from the University of Augsburg and Helmholtz Centres in Jülich, Leipzig, Karlsruhe, Potsdam and Munich met to discuss the latest developments and results from their research using water isotopes. The workshop participants also visited Müritz National Park within the TERENO observatory "Northeastern German Lowland", where GFZ conducts hydrological and dendrochronological monitoring.

Isotopes are variants of a given chemical element, each with a different number of neutrons in the atomic nucleus. Most interesting for water research are the so-called stable isotopes, which do not decay. Stable isotopes of the elements hydrogen and oxygen are useful tools for detecting and quantifying changes in the water cycle. The working group's third workshop will take place in the fall of 2014 at the Forschungszentrum Jülich (FZ Jülich). ■

BIG POTENTIAL

A look back on the first Helmholtz Alliance workshop

Some 100 scientists from the "Remote Sensing and Earth System Dynamics" Helmholtz Alliance convened in October 2013 for their first project workshop. Over the course of the four-day event, participants discussed the project's current status as well as the tasks ahead. Founded in 2013, the initiative develops biophysical and geophysical remote sensing products using next-generation satellites, with the goal of gaining new insight into the Earth system.

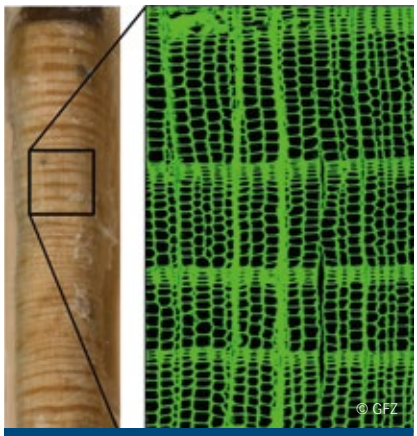
Following the opening plenary session, the agenda moved on to an overview of ongoing activities in each of the four main areas of research: biosphere, geosphere, hydrosphere and cryosphere. The overview revealed a large number of cross links between the research topics and work packages, even at this early stage in the project. In the next two days, each sphere was addressed individually with an expert talk and seven presentations by doctoral candidates and postdocs, who shared promising results from their research. "Both demonstrated the tremendous potential of the Alliance when researchers from various disciplines join forces like this," said initiative coordinator Prof. Irena Hajnsek from the German Aerospace Center (DLR). On the final day, additional sphere-based meetings were held to define the next steps. ■

http://hgf-eda.de/?page_id=329

NEW METHOD ALLOWS MORE PRECISE LOOK INTO CLIMATE HISTORY

Scientists often analyze the tree rings of the Scots pine to better understand the history of our climate, but the methods used up until now involve various uncertainties. As part of her PhD dissertation, which involved work conducted at the German Research Centre for Geosciences (GFZ), Wei Liang, from Potsdam, Germany, has developed a new method to examine wood cell structure, which allows for more robust and reliable climate reconstructions for the last several centuries.

Liang's method uses laser microscopy to conduct a surface scan of tree core samples. As part of her pilot study, Liang was able to measure several cell structure variables, including a complete chronology of the cross sectional area of Scots pine wood cells back to the year 1890. Liang found that the trees formed large cells following a warmer fall/winter season, and that above-average precipitation in the spring and summer was also an important driver of improved cell growth. The significance of this new method is that it allows for robust climate reconstructions over several hundred years for the temperate climate zone. Past reconstructions relied on data from trees in more extreme climatic regions near the latitudinal and altitudinal limits of the Scots pine species. For trees in the temperate climate lowlands, visible changes in the tree rings have been hardly detectable up until now due to the less extreme climatic influence. As a next step, GFZ researchers want to measure additional tree types to shed light on temperature fluctuations in the temperate climate zone lowlands over the last millennium. ■



A tree core sample (left) and a detailed view of the same using laser microscopy

Wei Liang, Ingo Heinrich, Sonia Simard, Gerhard Helle, Isabel Dorado Liñán and Thilo Heinken. Climate signals derived from cell anatomy of Scots pine in NE Germany. Tree Physiology (2013) Vol. 33, pp. 833-844. Doi: 10.1093/treephys/tpt059.

▶ http://treephys.oxfordjournals.org/content/33/8/833.abstract

WHAT NEUTRONS CAN TELL US ABOUT SOIL MOISTURE

4th workshop on Cosmic Ray Soil Moisture Sensing: TERENO makes use of new measurement technology

The Cosmic Ray Moisture Probe (COSMOS) is a comparatively new measurement technique for gathering information about soil moisture over large areas. It is unique in that it measures neutrons in the air above the ground which are generated by cosmic rays from space within air and soil – so-called cosmic ray neutrons. In May 2014 the Helmholtz Centre for Environmental Research – UFZ in Leipzig hosted the 4th international COSMOS Workshop, where 40 scientists from ten countries convened to discuss new developments, research results and current questions related to this new measurement technique. TERENO organized and conducted the workshop in cooperation with the COSMOS project, which is funded by the United States' National Science Foundation (NSF).

The COSMOS technology makes use of a relationship known to science for some 50 years already: the fact that soil moisture near the surface influences the concentration of neutrons in the air just above the ground. But it was 2008 before Marek Zreda from the University of Arizona (USA), introduced a corresponding measurement technology. COSMOS allows scientists, for the first time, to determine average soil moisture for large areas (roughly 30 hectares) using just one centrally located measurement instrument. Researchers hope this will significantly improve our ability to forecast floods, droughts, agricultural yields and other climatic influences. TERENO was among the first in Germany to make use of the new technology and is currently establishing an extensive network of COSMOS probes. As part of a field trip to the Schäfertal test site in the "Harz/Central German Lowland" TERENO observatory, workshop participants were able to see how the COSMOS technology is now being embedded into integrated research projects. ■

www.ufz.de/cosmos

WHEN CITIES SUFFER FROM THE HEAT


© Fotolia /Andrew Kazmierski

Cities, too, need to adapt to climate change, including greater heat stress, since heat waves have the potential to not only significantly reduce quality of life, but also increase mortality rates. TERENO scientists at the Helmholtz Centre for Environmental Research – UFZ have used Leipzig, Saxony's second largest city, as a case study, investigating the current summer heat load there and presenting their results in several studies. In Saxony, temperatures over the last century have risen by nearly 1 degree Celsius on average. Experts fear that by 2060, the average number of days on which the temperature exceeds 30 degrees Celsius will increase to 16 per year, up from 6 today. UFZ's pilot studies show that green space with shrub and tree populations help reduce ambient temperature in the morning and could therefore have a cooling effect on the city. Insulation for top floors and less dense urban structure types would also help protect against extreme indoor temperatures. In the hot summer of 2010, researchers had measured indoor and outdoor temperatures of buildings throughout the city. They found that neighborhoods with detached one-family or two-family homes experienced significantly more natural cooling at night. The city center, on the other hand, exhibited less cooling and the smallest difference between daytime and nighttime temperatures. The researchers also conducted a qualitative survey of several hundred residents, who were asked to report on their subjective well-being during the heat wave. Respondents indicated that heat load was greatest in the workplace and during the daily commute to work. For the researchers, this was a clear indication that the social structures and conventions in our major cities actually exacerbate heat stress on hot days, and that we need to make the necessary adjustments to the way we structure both working and everyday life. ■

Uwe Schlink, Annegret Kindler, Katrin Großmann, Nina Schwarz and Ulrich Franck.
The temperature recorded by simulated mobile receptors is an indicator for the thermal exposure of the urban inhabitants. Ecological Indicators. 2014, Vol. 36, pp. 607– 616. DOI: 10.1016/j.ecolind.2013.09.017.
▶ www.sciencedirect.com/science/article/pii/S1470160X1300349X

Ulrich Franck, Michael Krüger, Nina Schwarz, Katrin Großmann, Stefan Roeder and Uwe Schlink.
Heat stress in urban areas: Indoor and outdoor temperatures in different urban structure types and subjectively reported well-being during a heat wave in the city of Leipzig. Meteorologische Zeitschrift, 2013, Vol. 22, No. 2, pp. 1–11. DOI: 10.1127/0941-2948/2013/0384.
▶ http://dx.doi.org/10.1127/0941-2948/2013/0384

LAND USE IMPACTS WATER QUALITY IN THE BODE CATCHMENT

Researchers at the Helmholtz Centre for Environmental Research – UFZ have conducted a biogeochemical analysis of the catchment area of Germany's Bode River, a tributary of the Saale and an important part of the "Harz/Central German Lowland" TERENO observatory. Characterizations such as these are an important step in selecting the best sites for long-term biological observations and research. The analysis demonstrated that land use in the area has a significant impact on biogeochemical parameters.

Land use in the Bode catchment is largely agricultural. 70% of the catchment area is devoted to agriculture and 7% to urbanized areas, while 23% of total land cover remains forest. The research team analyzed water samples at 21 headwaters and ten downstream sites within the Bode River network both before the growing season, in early spring, and during the growing season, in late summer. For many of the parameters considered, such as nutrients and dissolved copper, researchers found that concentrations in headwaters were lower than in the downstream reaches. They also revealed a positive correlation between nitrate/phosphorus concentrations and the percentage of agricultural land use. Several parameters were affected by punctual anthropogenic loads, e.g. chloride from a salt production plant and dissolved arsenic resulting from past mining activity. The content of humic substances was higher in headwaters than in downstream reaches, indicating to researchers that humic content is positively related to the proportion of forest within the catchment. ■

Norbert Kamjunke, Olaf Büttner, Christoph G. Jäger, Hanna Marcus, Wolf von Tümpling, Susanne Halbedel, Helge Norf, Mario Brauns, Martina Baborowski, Romy Wild, Dietrich Borchardt.
Biogeochemical patterns in a river network along a land use gradient. Environmental Monitoring and Assessment, November 2013, Vol. 185, No. 11, pp. 9221-9236. DOI: 10.1007/s10661-013-3247-7.
▶ http://link.springer.com/article/10.1007%2Fs10661-013-3247-7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MOBILE RESEARCH

Anyone who has ever walked along a stream has likely encountered the slippery film that often grows on the underwater rocks. Scientists use the term "biofilm" to describe these assemblages of microorganisms, such as bacteria, fungi, ciliates and microalgae. Dr. Helge Norf, staff scientist at the Helmholtz Centre for Environmental Research – UFZ, is interested in the significance of biofilms for ecological functioning of streams. "Biofilms not only play a role in the nutrient cycle of various elements such as carbon and nitrogen – and thus in the streams' self-cleaning mechanisms – but also serve as a food source for animals such as snails," explains the 39-year-old biologist. "And yet today we know too little about the ecology of these biofilms." Together with his colleagues at UFZ, Norf wants to learn more about the impact of environmental changes, such as climate change, on biofilm production and the consequences of this for the flow of energy through aquatic ecosystems. To this end, Norf and his fellow researchers are employing Mobile Aquatic Mesocosms (MOBICOS), which are mobile laboratories stationed on site. Norf has coordinated the implementation of this new research platform for the last four years. In the MOBICOS containers, scientists can conduct experiments on stream processes and ecological communities independent of weather or other outdoor conditions. Norf's experience with such outdoor laboratories dates back to his time as a doctoral candidate and postdoc at the University of Cologne, where he worked on the "Ökologische Rheinstation" – a floating river lab on the Rhine River. Today the TERENO observatories benefit from his extensive experience. Norf will not only be conducting his own research, but will also help other scientists take full advantage of the MOBICOS facilities as they investigate nutrient degradation and other stream-related topics. ■

THE ART OF DECOMPOSING SIGNALS


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Dr. Thomas Jagdhuber is an expert in decomposition – or, more precisely, in separating different radar signal backscattering components. At the Microwaves and Radar Institute of the German Aerospace Center (DLR), the 34-year-old postdoc determines soil moisture and soil roughness with the help of Synthetic Aperture Radar (SAR) – a special microwave remote sensing technology. SAR allows wide coverage over large areas, fine spatial resolution, and measurements at short time intervals. The problem, however, is that the electro-magnetic waves of the radar are not only reflected by the soil, but also by the vegetation cover. Thomas Jagdhuber has developed polarimetric decomposition techniques, which "decompose" this mixture of backscatter signals. In SAR polarimetry, only certain polarizations of radar waves are used, and by combining different polarizations, Thomas Jagdhuber can determine which part of the signal originates from the vegetation cover. "We filter this out and what is left represents the soil," explains the DLR scientist. These data can then be used to calculate soil moisture and soil roughness.

Remote sensing techniques have fascinated Thomas Jagdhuber since he began his university studies in Physical Geography and Remote Sensing. His PhD dissertation, written at DLR in collaboration with the University of Potsdam, focused on these new polarimetric decomposition techniques. Since 2012, he further develops these techniques within TERENO. "The numerous monitoring devices on ground within the observatories provide exactly the measurement data we need to validate our results and to advance the decomposition algorithms," emphasizes the DLR researcher. ■

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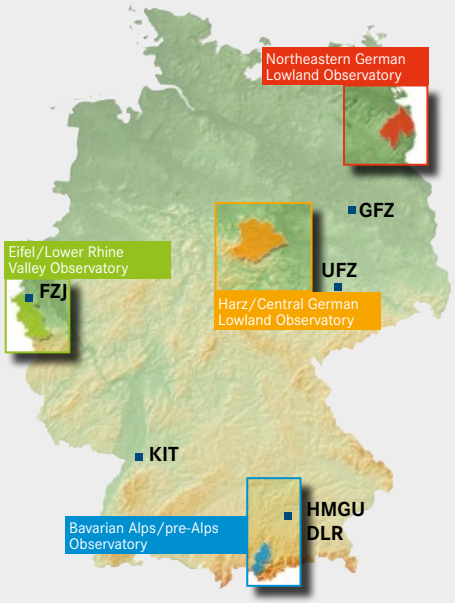

FZJ Forschungszentrum Jülich (Coordination)

DLR German Aerospace Center

KIT Karlsruhe Institute of Technology

HMGU Helmholtz Zentrum Muenchen, German Research Center for Environmental Health

UFZ Helmholtz Centre for Environmental Research

GFZ Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences

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