Winter measurements
Located some ten kilometers south of Jülich, TERENO's Selhausen site is also part of the Europe-wide ICOS network.

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TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

Newsletter 1/2016

CONTENTS

Data needs rules

To analyze and predict the local impact of global changes, researchers need one thing more than anything else: high-quality, long-term data. At the same time, it's not enough to simply provide a big pile of data. Uniform rules and standards are required to control the quality of data, and to regulate how data is saved and published. TERENO accounts for this with its updated data policy, which requires, among other things, that participating researchers share their data with researchers around the world free of charge. TERENO's new Data Discovery Portal is designed to facilitate this kind of free, global access to data.

HELMHOLTZ ASSOCIATION

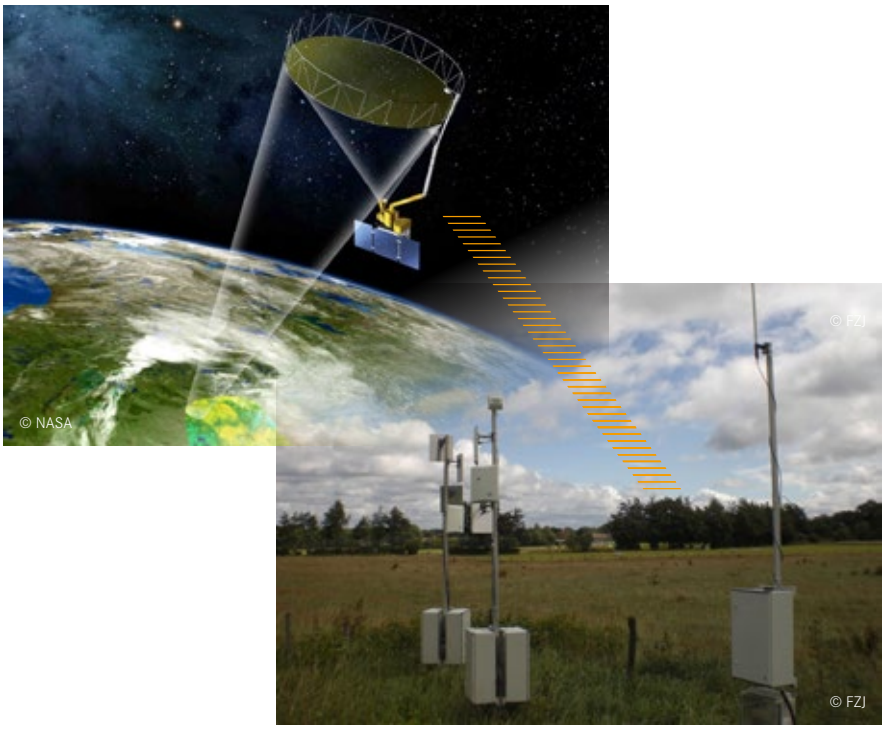
NEW STATUS FOR ICOS

As of January 2016, the European environmental research infrastructure "Integrated Carbon Observation System" (ICOS) will take on the status of a European Research Infrastructure Consortium (ERIC), which endows research infrastructures such as ICOS with a legal personality recognized in all member states. The new "ERIC" status opens up new opportunities for ICOS, which was established by European climate researchers in 2008 to standardize the measurement of carbon dioxide (CO_2) and other greenhouse gases across Europe. Among the goals of ICOS is to provide the observational basis for a complete European carbon balance. To this end, ICOS conducts standardized measurements throughout Europe, including at TERENO sites. The European Commission has established the new ICOS-ERIC consortium for an initial period of 20 years. ■

▶ more

SMAP'S ACTIVE SENSOR NO LONGER DELIVERING DATA

TERENO continues validating NASA radiometer data



With the help of SMAP satellite data, researchers can generate very precise estimates of soil moisture content. Satellite data is compared with ground-based measurements taken at stations such as TERENO's Rollesbroich site.

All went according to plan at first. After a successful launch of NASA's Soil Moisture Active Passive (SMAP) mission in January 2015, the satellite's radar and radiometer instruments began delivering a continuous stream of data by the end of March. But in July the satellite's radar, the active microwave sensor, stopped transmitting data. As a result, SMAP can now only transmit data from its passive sensor, the radiometer. The good news: this data is also very valuable, as demonstrated by images provided of the flooding in South Carolina in October.

TERENO is among several partners worldwide responsible for validating the quality of the soil moisture data products generated by SMAP. Soil moisture data from the TERENO observatory Eifel/Lower Rhine Valley is automatically transmitted to NASA via TERENO's own data portal TEODOOR for comparison with SMAP data. Currently, three different methods for inverting soil moisture for SMAP are being discussed. "For the Rur River catchment area, it seems that the single channel algorithm using vertical polarization (SCA-V) delivers the best results," says Dr. Carsten Montzka from Forschungszentrum Jülich. "But we still need some more time to verify this and continue to fine-tune the algorithms." ■

▶ NASA Mission Soil Moisture Active Passive (SMAP)

EDITORIAL

Data to meet your needs

Environmental data is too valuable to keep under lock and key, which is why we want to make the data collected at TERENO observatories available to the entire scientific community. It is also important to us to provide this data in such a way that it brings maximum benefit to the researchers or members of the general public interested in using it for their work. This is why we have put data quality-control processes in place, and given users the ability to access and compile data in a way that best suits their own specific needs. Our data portal TERENO Data Discovery Portal (DDP – see p. 4) provides users several options for this, including a range of different measurement stations, and the option of specifying definite investigation time periods as well as other parameters.

But TERENO offers more than just data. Researchers at universities or research institutes can also take part in TERENO field projects, such as the next ScaleX campaign (see p. 7). The longstanding collaboration with the German Research Foundation's Transregio 32 project (pp. 3 and 5) provides a good example of how data can then be used to generate useful forecasting models.

I hope you enjoy this issue of the TERENO Newsletter.

Sincerely, **Harry Vereecken**
TERENO Coordinator

THE CHALLENGE OF DATA ASSIMILATION

Transregio 32 enters final phase – Interview with Prof. Clemens Simmer and Insa Thiele-Eich

Early 2015 kicked off the third and final phase of Transregio 32 (TR32) "Patterns in Soil-Vegetation-Atmosphere-Systems – Monitoring, Modelling and Data Assimilation" – a notable accomplishment, since not all DFG special research projects manage to secure funding for the maximum period of twelve years. Since its inception in 2007, TR32 has collaborated closely with TERENO's Eifel/Lower Rhine Valley observatory. In a conversation with TERENO Newsletter, TR32 spokesperson Prof. Clemens Simmer and scientific coordinator Insa Thiele-Eich (both from the University of Bonn) take stock of progress so far and provide a look ahead.

With the help of SMAP satellite data, researchers can generate very precise estimates of soil moisture content. Satellite data is compared with ground-based measurements taken at stations such as TERENO's Rollesbroich site.

Prof. Simmer, what are the most important results so far?

Clemens Simmer: We achieved our original objective. We wanted to develop a tool for high-resolution quantification of energy, water and carbon dioxide fluxes in small catchment areas like the Rur River catchment, and we achieved that with the TerrSysMP model (see p. 5). On top of that, Transregio has not only increased the region's visibility among the geosciences research community, but we have become one of the leaders in Germany in the area of radar.

Why are these kinds of models so important?

Insa Thiele-Eich: Flows of water, energy and nutrients cannot be measured by observation alone. Because there are so many small-scale processes involved, we need a model that can account for the full range of physical interactions and interrelationships, all the way down to the groundwater. Our goal now is to continue to fine-tune the model and make it even more precise, so that simulation results correspond as perfectly as possible with field measurements.

Simmer: We hope – and the hope is justified – that the model can also correctly simulate the processes for which we have no actual field measurements. We can then use the model to calculate water and energy inputs into the Rur River catchment, see how much remains there, and how much exits the catchment.

What is the biggest challenge involved here?

Simmer: We're talking about data assimilation, i.e. the link between modelling and observation. Soil and atmosphere, for example, are coupled via evaporation. To travel through the air, say a distance of 100 meters from point A to point B, a water molecule needs just a few seconds, but in the soil it might take several days. To be able to account for this in the set of mathematical rules that govern the data assimilation is still a real challenge for us. We are placing added focus on this in the DFG research group FOR2131, which was born out of TR32.

And how do you verify the model?

Thiele-Eich: As part of one of our sub-projects "Reanalyse" we are feeding the model with measurement data from the last several years. And in the CASCADE experiment, which is planned for 2018, we will then validate the simulation results. In addition, we will be applying to take part in the US Department of Energy's Atmospheric Radiation Measurement (ARM) program.

Simmer: If this is approved, ARM will come to the Rur catchment with their mobile measurement station, which includes aircraft. If you combine this with the existing measurement network, established thanks to the close collaboration between TERENO and TR32, then our instrumentation would be about as good as it gets.

What will future research look like when TR32 concludes at the end of 2018?

Simmer: We have already initiated several new possibilities as part of the "Geoverbund ABC/J" geosciences network. Along with the DFG research group, we meteorologists in Bonn are helping coordinate the "HD(CP)2" project funded by the Federal Ministry of Education and Research. Our job here is to work with other German partners to investigate the impact of land surface on clouds and precipitation. Our TerrSysMP model has also been designated to serve as a key tool in Bonn's special research project TerraWatt. We suspect that land-use changes over the last 50 years have had a bigger impact on the local climate than global climate changes. And TerrSysMP will move on to simulate much larger areas: the whole of Europe, West Africa and Australia.

What will happen with the measurement network in the Rur catchment?

Thiele-Eich: Thanks to TERENO it will remain in use after the end of TR32, providing researchers – including us – with a continuous source of data.

Simmer: The collaboration with TERENO has played a very important role throughout TR32. This kind of infrastructure would hardly have been possible through Transregio alone, and TERENO brings valuable know-how that TR32 couldn't cover on its own. And Jülich's expertise in the area of soil research and soil modelling, as well as in the use of high-performance computer infrastructure, was absolutely essential.

Prof. Simmer, Ms. Thiele-Eich, thank you very much! ■

▶ Transregio 32 (TR32)

A NEW GATEWAY TO THE WORLD OF DATA

TERENO Data Discovery Portal now online / Data policy revised

At TERENO's four observatories, large amounts of data are gathered on water and material fluxes, energy exchange processes, or changes in microorganisms, flora and fauna. TERENO has now updated the way in which researchers can access this world of data. TERENO's new Data Discovery Portal (DDP) improves and simplifies the use and exchange of data. At the same time, TERENO has revised and updated its data sharing policy.

"The Data Discovery Portal (DDP) builds on the existing TEODOOR (TEreno Online Data RepOsitORy) infrastructure," explains Dr. Ralf Kunkel from the Agrosphere Institute at Forschungszentrum Jülich. This TERENO network is comprised of independent local data infrastructures, which are connected by standardized web services (see Newsletter 1/2011). The portal's new start page allows direct access to data collected from monitoring stations in the four observatories – everything from cosmic-ray sensors, to climate stations, to stations monitoring river water levels. Improvements have also been made to the search function, including data query by keyword, full text search within documents or metadata search with the option of applying temporal, spatial and thematic filters. Users can then either visualize the selected data or download it in CSV format for easy import into spreadsheets or other data analysis programs.

Start page of the updated TERENO data portal

Ensuring quality

Quality assessment and control is an important prerequisite for data publication. In the Eifel/Lower Rhine Valley TERENO observatory, for example, sensor data from more than 800 stations is collected automatically, which adds up to about 300,000,000 data values per year. "About half of the data needs to be quality assessed before being published," says Kunkel. Since 2014 the observatory and its data management system is certified by the ISO 9001 quality management standard. "We have developed a number of working directives, standard operation procedures and forms to regulate how data is imported, quality-checked and stored," says Kunkel. The researchers developed a quality assurance procedure for the Eifel/Lower Rhine Valley observatory, which has now also been implemented at Forschungszentrum Jülich. Every monitoring station is assigned a person responsible for assessing data quality on a continuous basis. In addition, institute members meet with the responsible researcher once a month for "flagging-days" to review historical data and further develop the quality-assurance rules and parameters. The web-based tool "INSPECT" was developed especially to support these workflows. Plans are now in place to implement this process at the Helmholtz Centre for Environmental Research – UFZ, the Karlsruhe Institute of Technology (KIT), and the Helmholtz Centre Potsdam – German Research Centre for Geosciences (GFZ).

"The data sharing policy has been revised based on the wealth of experience gathered within TERENO over these first several years," explains Kunkel. Among other things, the policy – which has already been signed by all TERENO partners – stipulates that data collected within TERENO be published as soon as possible. "We want to make this data available to the worldwide scientific community as soon as possible," says Kunkel, who specializes in data management. TERENO publishes its data almost exclusively under a Creative Commons license.

Automatic referencing

TERENO's data specialists are also considering ways to reference verified data; one option is with a persistent identifier (PID). "A PID makes the data permanently accessible and citable," says Kunkel. "But we still need to find a way to generate PIDs automatically when data sets are created." (see also Newsletter 1/2015) The GFZ has already begun assigning digital object identifiers (DOI) to individual monitoring stations, and 20 stations are currently referenced by DOIs. ■

▶ TERENO Data Discovery Portal (DDP)

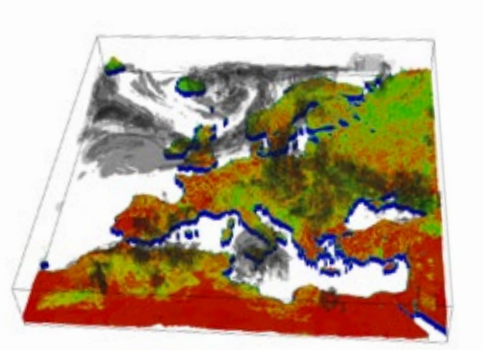
▶ TERENO Data Policy

NOTHING IS LOST ON TERRSYSMP

Platform simulates interactions within coupled terrestrial systems

Understanding the Earth system requires an understanding of the complex interactions between various compartments such as atmosphere, soil and groundwater. Using computer models to accurately simulate these interactions is, to say the least, a major challenge. "Terrestrial water, energy and nutrient flow processes are not only very complex, but also take place on very different spatial and temporal scales," explains Prof. Stefan Kollet, a researcher at Forschungszentrum Jülich.

In collaboration with colleagues from the German Research Foundation's (DFG) Collaborative Research Centre Transregio 32, Kollet has developed the Terrestrial Systems Modeling Platform (TerrSysMP). This platform provides fully coupled simulations, i.e. simulations in which atmospheric, land-surface and groundwater models actually interact with each other. This is in contrast to other simulations, which often use isolated models and only cover processes in the respective compartment. "These kinds of isolated models do not fully account for important interactions," says Kollet, "but with TerrSysMP we have closed the cycles completely so no mass or energy gets lost."



© FZJ/Universität Bonn, Meteorologisches Institut

Fully coupled simulation:
Cloud water content (gray) and soil moisture (colored) in Europe in June 2013

TerrSysMP runs amongst others on Jülich supercomputers JUQUEEN and JURECA. Researchers have begun using TerrSysMP to simulate flows of terrestrial water, energy and nutrients for the whole of Europe. "Currently we are applying TerrSysMP to Europe and its watersheds with a resolution of 12 x 12 km, but we've already conducted test runs with a spatial resolution of 3 x 3 km," reports Dr. Klaus Görgen, scientific coordinator of Jülich's Simulation Laboratory Terrestrial Systems. Currently, the team is conducting various validation experiments to assess how well the simulations match "real" observations and measurements of the natural system. One approach, for example, is to re-initialize the atmospheric component on a daily basis while land-surface and groundwater components run continuously. So far, precipitation and runoff patterns generated by TerrSysMP, for example, have corresponded well with actually measured values. Researchers are optimistic that they will soon be able to analyze, among other things, the impact of groundwater on water and energy balances. This could help them generate improved flood forecasts or other projections for more effective water resource management. TERENO research also stands to benefit from the TerrSysMP modeling platform. ■

▶ Centre for High-Performance Scientific Computing in Terrestrial Systems

TERENO WORKSHOP 2015 FOCUSES ON REMOTE SENSING

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Some 70 scientists came together at the end of October 2015 in Oberpfaffenhofen, Germany for the 8th TERENO workshop "Remote Sensing and Soil" to discuss current research results, new developments and trendsetting approaches in terrestrial environmental research and remote sensing.

The workshop began with a general TERENO status update as well as an overview of various activities and projects, including the Helmholtz Alliance "Remote Sensing and Earth System Dynamics" and the ScaleX project (see p. 7). TERENO Coordinator Prof. Harry Vereecken from Forschungszentrum Jülich reported on the six Critical Zone Observatories established recently in the TERENO observatories, as well as efforts to expand TERENO sites and international collaboration projects. He also introduced plans to establish a new PhD program "TERENOfellows".

Latest insights

Experts from various TERENO partner institutes then presented on various remote sensing topics relevant to TERENO research, including remote sensing of soil, precipitation and land-atmosphere interactions. Soil landscape modelling was another important topic on the agenda. Workshop participants also had the chance to discuss ongoing TERENO projects and activities, such as improving data management, remote sensing, the SoilCan lysimeter network, the SoilNet wireless sensor network, and soil moisture measurements using cosmic-ray sensors.

At the conclusion of the workshop, members of the scientific steering committee met with the TERENO Advisory Board to discuss past progress and future developments. The independent Advisory Board experts indicated that TERENO is well on track and should continue its very successful research in the observatories. ■

▶ Workshop agenda and presentations

THE CITY OF THE FUTURE

New Helmholtz initiative pools expertise / TERENO CT investigates urban systems

The city of the future should be both livable and sustainable. But global change poses a number of different challenges to achieving this. With the goal of developing comprehensive solutions for the world's urban centers, eight Helmholtz centers have pooled their resources and know-how to launch the Helmholtz Urban Research Initiative system:city. All six TERENO partners are taking part in the project.

More than half of all people on earth live in cities today, and urban population numbers continue to rise. This poses a long list of challenges: energy supply, environmental pollution, resource management, demographic change, climate change, land-use dynamics – all against the backdrop of social tensions and the occasional economic crises. Cities today must be more resilient than ever if they're going to adapt to the ever-changing conditions and requirements. Sure enough, demand is high for urban planning and development strategies that consider cities as complex, holistic systems. The new Helmholtz Urban Research Initiative has identified this need and plans to fill it. The initiative brings together experts in engineering, natural sciences and social sciences. "Our objective is to work together to define goals for more sustainable urban development. We want to partner with local stakeholders to implement new technologies and action recommendations under real-world conditions and at key demonstration sites," says Prof. Stefan Emeis from the Institute of Meteorology and Climate Research (IMK-IFU) at the Karlsruhe Institute of Technology. "We are also analyzing local and regional governance options," adds Prof. Sigrun Kabisch from the Helmholtz Centre for Environmental Research – UFZ. As part of a one-year planning phase, researchers involved in the initiative are first developing an integrated urban research concept.

TERENO is also contributing to the initiative. The Coordination Team (CT) Urban System, established in 2013, monitors the growth and shrinkage of cities. "In the Leipzig-Halle metropolitan area we gather data on population development, land-use changes and the impact on ecosystem services as well as environmental and climate parameters," reports Dr. Ellen Banzhaf from UFZ. "Our investigations focus on land consumption, mitigating environmental risk and parameters related to quality of life, resource efficiency and resilience in cities." ■

Members of the Helmholtz Urban Research Initiative system:city

- German Aerospace Center (DLR)
- Forschungszentrum Jülich
- Helmholtz-Zentrum Berlin für Materialien und Energie (HZB)
- Helmholtz Centre for Environmental Research – UFZ
- Helmholtz-Zentrum Geesthacht – Centre for Materials and Coastal Research (HZG)
- Helmholtz Centre Potsdam – GFZ German Research Centre for Geosciences
- Helmholtz-Zentrum Muenchen – German Research Center for Environmental Health (HMGU)
- Karlsruhe Institute of Technology (KIT) (project coordinator)

▶ TERENO Coordination Team Urban System

CLOSER TIES TO CZO RESEARCH IN CHINA


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As Germany continues to make progress in establishing and expanding its national network of Critical Zone Observatories (CZOs) (see also TERENO Newsletter 1/2015), preparations are also being made for an international network. In September 2015, 36 researchers from Germany and China convened for a joint symposium in the Chinese city of Nanjing to discuss current developments and latest research results. Symposium participants were also joined by American CZO expert Henry Lin, who is Professor at Pennsylvania State University, USA, and member of the TERENO Advisory Board.

Among the topics discussed by symposium participants were uniform standards for observatories and data collection. China's own national CZO network, launched by the China Academy of Science in 2014, consists of six modern research stations established starting in 1988 as part of the Chinese Ecosystem Research Network (CERN). The symposium also considered research topics of common interest to both countries, such as the consequences of land use and climate change on hydrological processes and nutrient transport – topics that could serve as the basis for establishing CZOs in Germany and China, as well as a larger international network. Symposium participants resolved to initiate more joint research projects to further intensify the exchange between German and Chinese scientists on these topics.

The symposium was organized by TERENO Coordinator Prof. Harry Vereecken together with Prof. Xinhua Peng from the Chinese Academy of Science, with financial support from the Sino-German Science Center. ■

▶ Chinese Ecosystem Research Network (CERN)

FROM SITE TO REGIONAL SCALE

ScaleX campaign in the Bavarian Alps/pre-Alps TERENO observatory / Phase 2 open to newcomers in 2016


© IMK-IFU

Mountainous regions such as the Alps are especially diverse and complex landscapes, often characterized by varying terrain, a range of different soil types, as well as diverse vegetation, land-use and water availability. This spatial complexity poses challenges for measuring and modelling things like nutrient flows, precipitation or subsurface water movement. The complex environment poses a challenging question for researchers: how well can site-specific measurements reduce modelling uncertainties and close the balances of energy and matter flows? The ScaleX campaign in the Bavarian Alps/pre-Alps TERENO observatory addresses this question by combining observations of surface fluxes with remote sensing techniques, airborne measurements and modelling.

Combining ground-based and airborne measurements

In June and July 2015 researchers from various institutions carried out the first phase of ScaleX at the Fendt site. Using various ground-based instruments, researchers conducted high-resolution vertical profile measurements of wind speed, wind direction, temperature and moisture in the boundary layer. In addition to these automated measurements, they conducted airborne measurements during several more intensive observation periods. This allowed them to collect observation data on a maximum scale of 10 km x 10 km x 10 km. The data can now be used to drive and validate both process models and regional-scale models. Taking part in Phase 1 of the ScaleX campaign were the Karlsruhe Institute of Meteorology and Climate Research – Atmospheric Environmental Research (IMK-IFU), which organizes the campaign, along with the University of Augsburg, the German Aerospace Center (DLR), Germany's National Meteorological Service (DWD), the Helmholtz Centre for Environmental Research – UFZ in Leipzig, the European Academy of Bozen/Bolzano (EURAC), as well as the Troposphere Research division of the Karlsruhe Institute of Meteorology and Climate Research (IMK-TRO). ■

Join in!

The second phase of the ScaleX campaign will begin in 2016, and interested researchers/institutions are welcome to get involved. As in Phase 1, numerous measurement instruments will be deployed, including 3D-Doppler-LIDAR and SODAR remote sensing techniques, ultralight aircraft provided by IMK-IFU, as well as unmanned aerial vehicles from the University of Augsburg. Prior to Phase 2 there will be a workshop at IMK-IFU from February 15–16, 2016.

▶ contact: benjamin.wolf@kit.edu

▶ www.imk-ifu.kit.edu/scalex.php

WHEN THE SNOW MELTS

In the European Alps a large portion of precipitation is in the form of snow, and annual snowmelt is considered a key factor in the hydrological cycle of such mountainous environments. Snowmelt is especially important for the dynamics of stream runoff. Since fall 2014, some innovative snow observation techniques were added to the already established snow measurements in TERENO's "preAlpine" observatory in the course of a postdoc project funded by the Helmholtz Water Science Alliance.

"We are interested in the spatial distribution and temporal evolution of the snow cover in the sub-alpine environment," explains project head Dr. Jakob Garvelmann, a postdoc at the Karlsruhe Institute of Meteorology and Climate Research – Atmospheric Environmental Research (KIT/IMK-IFU) conducting his research at Campus Alpin in Garmisch-Partenkirchen. "This involves gathering snow data for hydrological modelling on different scales in the Ammer catchment."

Garvelmann uses newly developed Snow Monitoring Stations (SnoMoS) and digital time-lapse cameras to observe snow cover dynamics and micrometeorological conditions. At the Fendt field site, the Helmholtz Centre for Environmental Research – UFZ is also operating a SnowPack Analyzer to measure the water content of the snow pack. In winter 2015/2016, the cameras in Fendt will be installed within the new wireless sensor network SoilNet. "This combination should help us to better understand the spatio-temporal variability of soil moisture during snowmelt," says Garvelmann.

Cooperation with TU München

At TERENO's Graswang site, snow depth data is also being continuously collected with SnoMoS and time-lapse cameras. This winter the researchers will also conduct a joint project with Technische Universität München (TUM) in a headwater catchment of the Ammer River (Dreisäulerbachgebiet) near Graswang. "Another goal of our detailed investigations of snow cover dynamics and runoff generation mechanisms during snowmelt is to improve flood forecasting," explains Garvelmann. ■


© IMK-IFU/Garvelmann

At the Graswang site, installing a SnowFox system to measure cosmic radiation

CLUES IN THE WATER

Isotopes reveal sources of nitrogen in Bode River catchment

Eutrophication, an increase of plant nutrients in water, can disrupt the natural equilibrium of surface waters, and nitrate, which is commonly used as fertilizer, is one of the major causes of eutrophication. Researchers at the Helmholtz Centre for Environmental Research – UFZ have completed an analysis the various sources of dissolved nitrate in Germany's Bode River, a tributary of the Saale River. To do this they measured stable isotope patterns – an established method in the field of hydrology.

Eutrophication can have far-reaching consequences. Blue-green algae blooms can result in lower levels of dissolved oxygen in the water and the death of many aquatic plants and animals. Ensuring water quality requires prevention measures such as coordinated land-use management. This, in turn, requires analysis of local nitrogen dynamics including information on nitrate sources, nitrate mobilization rates, and microbial processes such as denitrification. Fortunately, this is exactly the kind of information that the isotopes can provide.

Working in TERENO's Hydrological Observatory Bode, UFZ researchers analyzed the regional and temporal variation of various sources of nitrates. The Bode catchment, an area covering over 3,000 km^2, is an important component of the TERENO Harz/Central German Lowland observatory.

Researchers took water samples at more than 100 locations at various times throughout the year, and uncovered some revealing patterns of nitrate concentration. While atmospheric nitrogen is the dominant source in the Bode River headwaters, higher nitrate loads in the lower reaches of the Bode were attributed to the use of ammonia fertilizer on agricultural lands, as well as to urban sewage. Researchers also found that denitrification in the riverbed – the elimination of nitrate as a nutrient through a transformation of nitrogen – is an important factor in nitrogen dynamics. Their results demonstrated the benefits of isotope analysis for hydrological research in river catchment areas. ■

Christin Müller, Ronald Krieg, Ralf Merz and Kay Knöller. *Regional nitrogen dynamics in the TERENO Bode River catchment, Germany, as constrained by stable isotope patterns.* Isotopes in Environmental and Health Studies, 2015.

▶ DOI: 10.1080/10256016.2015.1019489.

UFZ researcher Christin Müller takes samples of Bode River water

Researchers hope data fusion will help forecast crop yields

DATA FUSION FOR HIGH-RESOLUTION TIME SERIES

Different earth observation satellites such as MODIS, Landsat and RapidEye deliver data in different temporal and spatial resolutions. As part of the Techs4TimesS project, researchers at the University of Würzburg are working on methods for combining this data via data synthesis and data fusion. "Together with computer scientists at Bochum University of Applied Sciences we are developing methods that will allow us to generate time series with extremely high temporal and spatial resolution," explains project team member Thorsten Dahms from Würzburg's Institute of Geography and Geology. "Our aim is to develop models for things like plant growth or forecasting crop yields." Dahms and his colleagues rely on ground-based measurements to validate their methods, and they have decided to use the DEMMIN test site in TERENO's Northeastern German Lowland observatory. "The site is ideal for us for two reasons," says Dahms. "First of all, DEMMIN has a number of very large fields and, second, DEMMIN is very well equipped with measurement instruments."

Over the last two years – and with support from researchers at the German Remote Sensing Data Center (DFD/DLR) at the Neustrelitz site – Dahms and his colleagues have conducted numerous measurements on corn and wheat fields, deriving, among other things, biophysical parameters such as leaf area index (LAI). Now the researchers face the task of analyzing the huge amount of data collected. "Our goal is to generate as much information as possible," says Dahms.

Groundwork for Sentinel-2

One goal for the project is to provide useful data to farmers, for example, to help them decide where their soil needs fertilizer and where it does not. To this end, project researchers are already in dialogue with farmers in DEMMIN. The project is also laying groundwork for the European Space Agency's Sentinel-2 mission, which will provide high-resolution multispectral images of the Earth's surface via its two sister satellites Sentinel 2A and Sentinel 2B. 2A has been in orbit since summer 2015, and 2B is scheduled to follow in 2016. The Techs4TimesS project is funded by the German Federal Ministry for Economic Affairs and Energy. ■

▶ Techs4TimeS

ON THE LOOKOUT FOR LAUGHING GAS

Nitrous oxide (N_2O), also known as laughing gas, is about 300 times more damaging to the climate than carbon dioxide. One source of the greenhouse gas is the nitrification and denitrification of reactive nitrogen compounds such as ammonia and nitrate. Dr. Benjamin Wolf from the Institute of Meteorology and Climate Research (IMK-IFU) at the Karlsruhe Institute of Technology is investigating which microbiological processes generate nitrous oxide at specific locations. "Special isotopically substituted molecules called isotopomers can provide such information," says Wolf, 34, who was awarded the Erwin Schrödinger Prize in 2013. Together with his colleagues at IMK-IFU, Wolf is developing a measurement technique – involving absorption spectroscopy using quantum cascade lasers – which he hopes to soon deploy for field investigations. "This is a relatively new isotope technique that allows us to analyze very small concentrations of trace gases," says Wolf. "Until just recently it was actually not possible to measure isotopomers directly without first pre-concentrating the air." A geoecologist, Wolf deepened his understanding of the isotope technique as a postdoc at EMPA in Switzerland before returning to KIT in 2014. While the new measurement approach is still in the laboratory phase, the first field tests are planned for spring 2016 at TERENO's Bavarian Alps/pre-Alps observatory. ■

NEW TEAM AT THE TOP OF TERENO-NE

Prof. Bruno Merz

As of September 2015, Prof. Bruno Merz (Head) and Dr. Ingo Heinrich (Coordinator) are the new directors of TERENO's Northeastern German Lowland observatory (TERENO-NE). They succeed Dr. Oliver Bens and Dr. Knut Kaiser.

Dr. Ingo Heinrich

Bruno Merz is head of the Hydrology section at the GFZ German Research Centre for Geosciences, and is Professor for Engineering Hydrology and Management of Georisks at the University of Potsdam. In his research, Merz focuses on the causes and consequences of hydrological extremes; he also investigates hydraulic/hydrological processes as well as changes in the hydrological cycle.

Ingo Heinrich conducts research in GFZ's Hydrology section as well as GFZ's Climate Dynamics and Landscape Evolution section. He also teaches climatology and paleoclimatology at the Humboldt-University Berlin. Heinrich, who is trained as a geographer and specialized in dendrochronology, focuses mainly on the processes occurring between the atmosphere, trees and soil. In addition, Heinrich develops new methods for tree-ring research and works on reconstructing climatic and hydrological parameters. ■

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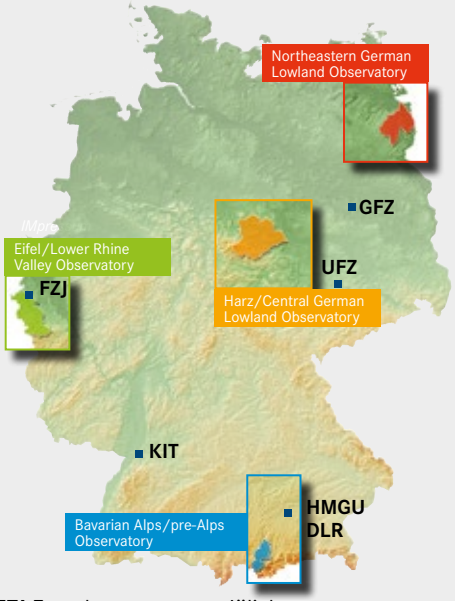

FZJ Forschungszentrum Jülich (Coordination)

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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