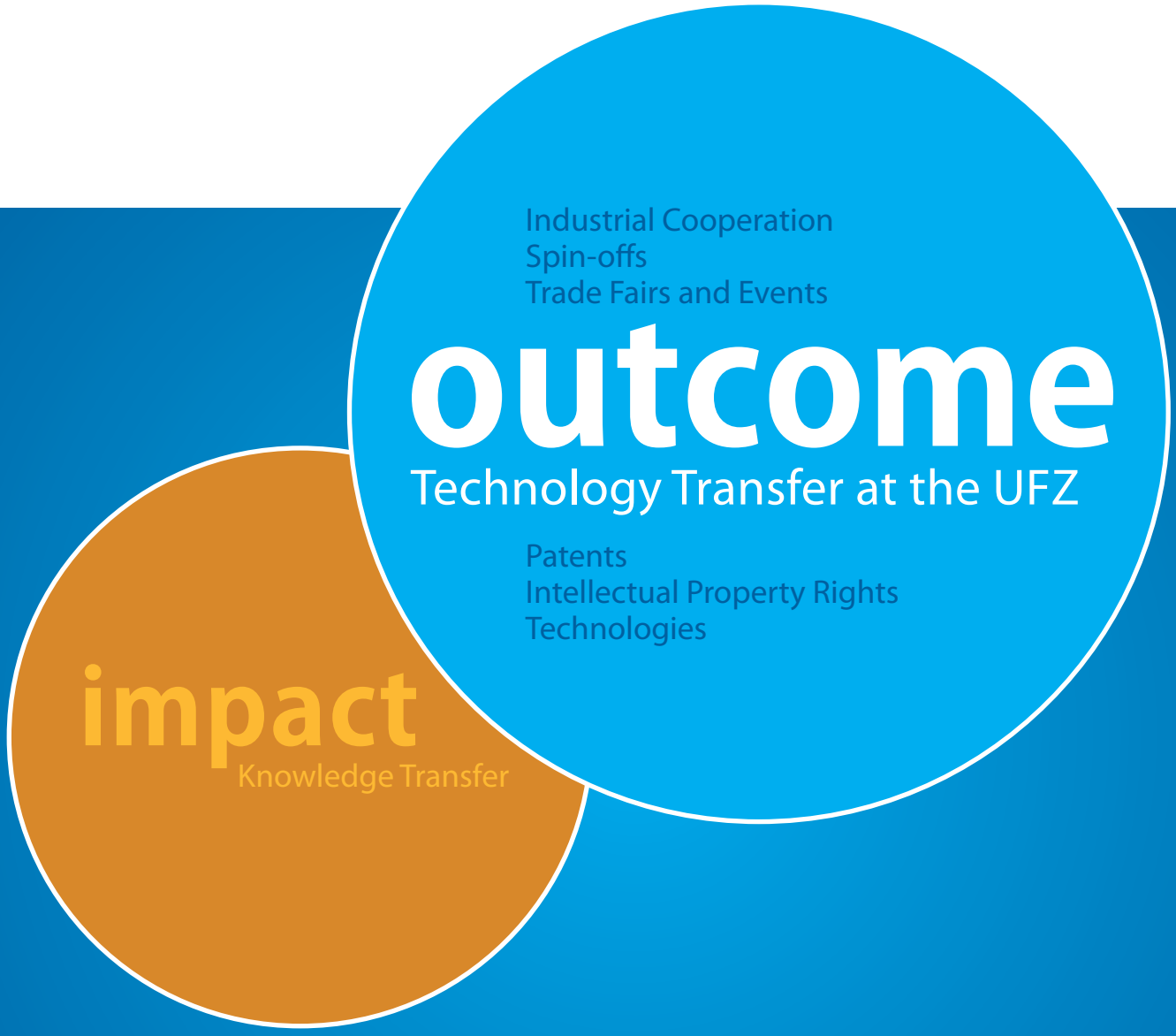
Annual report 2018



HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

UFZ - outcome 2018

About the UFZ

Helmholtz Centre for Environmental Research GmbH

Our Vision

The UFZ is one of the world's leading research centres in the field of environmental research and enjoys high social recognition. It offers ways for a sustainable use of natural resources for the benefit of humans and nature.

Our Mission

Biodiversity, functioning ecosystems, clean water and intact soils are our natural bases of life. In light of global change, all staff at UFZ share the objective to demonstrate and promote ways in which excellent research can reconcile social development with a healthy environment. The UFZ is a reliable partner for politics, businesses and civil society in the process of understanding the impacts of human activities on the environment and to develop options for social decision-making processes. Therefore, the UFZ addresses societal challenges and creates knowledge and technologies which help to identify potential conflicts between environmental and societal demands at an early stage and to develop precautionary measures.

Our Structure

The UFZ was founded in 1991 and employs 1,100 people at its locations in Leipzig, Halle (Saale) and Magdeburg. The UFZ is a member of the Helmholtz Association of German Research Centres.

Our Research Structure

IMPRINT

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Layout
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Susan Walter, UFZ (Title)

Publisher
Helmholtz Centre for Environmental Research GmbH - UFZ
Permoserstraße 15 | 04318 Leipzig

www.ufz.de

Photos
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T. Hametner, UFZ (15/2)
D. Hildenhagen, UKL (8)
A. Künzelmann, UFZ (9, 10, 14/1&3, 15/3, 16/2&3)
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Dear reader,

The UFZ carries out excellent research within a wide range of topics related to the environment. It generates sound knowledge and technological solutions to manage our natural resources in a sustainable way, to the benefit of society and environment. The transfer of knowledge and technologies into society and business is an integral part of the UFZ mission and activities.

For our research endeavours, our institute has a unique infrastructure. Together with over 600 partners from all over the world, we have established a network of know-how that catalyses innovation. The selected examples in this brochure will serve as a first insight into our broad range of technology transfer activities, which include the following topics:

- German Environmental Award 2018
- UFZ Technology Transfer Award 2018
- Examples of our Top Stories
- Innovative Minds at the UFZ
- Excerpt from „News from the UFZ“
- Exemplary Technology Platforms
- Offers and Contacts

We are looking for partners from the business sector. Would you like to join forces with us and develop our innovative approaches to products and production processes further – based on your processes and market know-how?

Then my colleagues and I will be delighted to hear from you.

Yours sincerely,

Dr. Joachim Nöller
Head of the Department
Knowledge and Technology Transfer

P.S.: We are not only responsible for the transfer of technology but also the transfer of knowledge.
We offer a wide range of activities to provide decision-makers from politics, businesses, society, and the general public with tailor-made knowledge. Together, we develop options and management tools further in order to solve your specific problem. Just read our brochure “impact“.

You can find further information on our website:
www.ufz.de/technologytransfer

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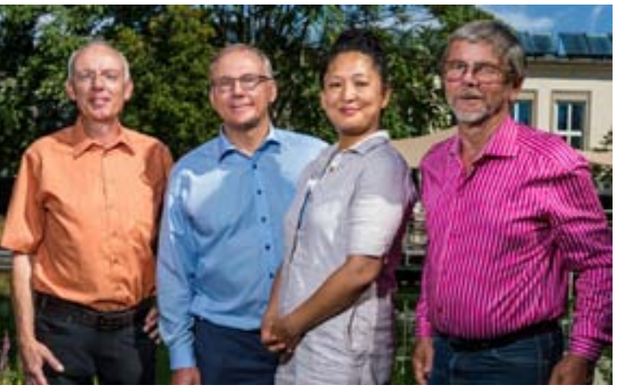
Dr. Manfred van Afferden, Prof. Roland A. Müller, Dr. Mi-Young Lee and Wolf-Michael Hirschfeld



... were honoured for developing principles for a decentralised wastewater management solution in Jordan, and for helping to implement it at the political level.

Two environmental biotechnologists, Prof. Roland A. Müller and Dr. Manfred van Afferden, and the economist Dr. Mi-Yong Becker (née Lee), all of them scientists at the UFZ, plus Wolf-Michael Hirschfeld, initiator of the Training and Demonstration Centre for Decentralised Sewage Water Treatment (BDZ), jointly received the German Environmental Award from the German Federal Environmental Foundation (DBU). The Leipzig-based team of experts shared the environmental prize with marine biologist Prof. Antje Boetius.

Drinking water polluted with faeces is a problem for around two billion people worldwide. However, only 20 % of the global wastewaters are being treated properly. In the rural areas of Jordan alone, 45 million m³ of wastewater per year reach the groundwater without any or with inadequate treatment only. Against this background, the prize-winning team has been working in Jordan since 2006 as part of the research group on Integrated Water Resource Management funded by the Federal Ministry of Education and Research (BMBF), focussing on groundwater protection by treating and reusing wastewater. They developed an actively aerated horizontal and vertical filter system. It stands out due to its high water and energy efficiency, operational robustness and treatment performance. It can also be target controlled, for example with regard to removing nitrogen and pathogenic bacteria. Beyond the application of the technology in Jordan, it was also included in the technical guidelines of the German Association for Water, Wastewater and Waste (DWA) 2017, i.e. the filter systems now define the German standard of technology in wastewater treatment.

In Jordan, the UFZ started up a research and demonstration site in 2010 at which eleven water treatment plants were operated, developed and adapted to Jordanian conditions. The site also acted as an information platform to exchange experience between citizens, local and regional decision-makers, students and scientists. On the other hand, training activities for pupils, students, scientists as well as specialist personnel from companies and authorities are carried out here. In 2012, the UFZ, funded by the BMBF and the Jordanian Water Ministry, established the Implementation Office for decentralised wastewater management in Amman. The local presence in the Jordanian Water Ministry helped to facilitate stakeholder acceptance and achieve the implementation of the innovative wastewater management approach. The team also developed a practical decision support tool which helps to plan future wastewater management projects. It takes into account geographical, technical and socio-economic data and helps to prevent planning errors and thus reduce investment risks.

Finally, when the Jordanian cabinet passed the first political framework for decentralised wastewater management in the Arab world in 2016, the German team was actively involved in this. According to the political message, decentralised wastewater systems will in future be used nationwide to protect the groundwater resource. This vision has also drawn other countries' attention and a collaboration of the UFZ with the Sultanate of Oman is already picking up steam, with joint R&D currently under way.

UFZ - outcome 2018

German Environmental Award 2018

"In an unprecedented project in Jordan, the Leipzig team of experts has shown how the water shortage in one of the most severely affected countries can be successfully overcome with a holistic, innovative approach. It has set the course for a better future for Jordan, in which a large part of the population will have access to clean drinking water and wastewater will be treated efficiently".

Prof. Otmar D. Wiestler
President of the Helmholtz Association

"With their conviction that effective water protection can be achieved through decentralised wastewater treatment, the interdisciplinary team of experts has developed innovative system solutions in a difficult political environment and helped to make them consensus and put into practice."

Alexander Bonde
DBU Secretary General

"I am very pleased that the excellent work of our Leipzig team has received such extraordinary recognition with the German Environmental Award. The project is a prime example of the problem-oriented, interdisciplinary way of working at the UFZ. […]. The team of applicants has thus helped decentralised sewage systems in Germany and abroad to make a breakthrough and is making an important contribution to achieving the United Nations Sustainable Development Goal 6, which aims to ensure the availability and sustainable management of water and sanitation for all."

Prof. Georg Teutsch
Scientific Director of the UFZ

"Against the background of climate and demographic change, we also see great application potential for decentralised water infrastructure systems in Europe's fast-growing cities, for example in the design of resource-efficient urban quarters. […]
I am particularly pleased that our interdisciplinary approach was appreciated. The successful implementation of the project was only possible because we were able to work very closely, cross-disciplinarily and together with our partners on the holistic implementation of the system solution over a longer period."

Prof. Roland A. Müller
Head of Centre for Environmental Biotechnology at the UFZ

Source: UFZ press release

With a prize money of €500,000, the German Environmental Award, which is awarded annually by the DBU, is the largest environmental prize in Europe. The DBU award is in recognition of personalities who contribute or have contributed to protecting the environment in an exemplary manner.

Prof. Roland A. Müller & Dr. Manfred van Afferden
Department of Environmental and Biotechnology Centre

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Dr. Katrin Mackenzie

... as head of the working group ”Environmental catalysis – Reductive Processes“ in the Department of Prof. Kopinke, was honoured for excellent technology transfer in developing the innovative material Carbo-Iron® for the remediation of contaminated soils and aquifers.

Clean groundwater (GW) is a valuable resource and the basis for a healthy life. Contaminations of GW with organic solvents such as chlorinated hydrocarbons are frequent, rather persistent and require in most cases cumbersome cleaning. In Germany alone – an industrial nation with the highest environmental standards and requirements – there are over 300,000 cases of suspected contamination. With a view to other countries and continents, the need for innovative and practicable technologies for the remediation of contaminated sites today and in the future is huge.

With Carbo-Iron®, a new in-situ reagent for groundwater treatment was developed. The combination of colloidal activated carbon and supported nano-structures of zero-valent iron (20-30 wt-% iron) gives a new environmentally friendly reducing agent. It opens up pathways for plume control in aquifers contaminated with halogenated organics because of the high particle mobility in porous media which is a pre-condition for the generation of a wide in-situ sorption/reduction zone. As known for zero-valent iron, Carbo-Iron® is also able to reduce a broad spectrum of halogenated hydrocarbons. Carbo-Iron® is so to speak the better alternative to nano-iron.

Carbo-Iron® did not only prove to be a better alternative to nano-iron at the laboratory scale. Field tests carried out in Lower Saxony and Hungary together with the project partner Golder Associates showed a convincing performance of the new material. Within the framework of the EU project “NanoRem”, Carbo-Iron® has been successfully tested in the project‘s up-scaled trials by Intrapore GmbH, the licensee of Carbo-Iron®.

The knowledge gained with Carbo-Iron® is also a valuable basis for new tailor-made reactive particles. In the framework of the BMBF project “ContaSorb”, which started in February 2017, development of new sorption-active in-situ applicable particle types is underway, which will extend the spectrum of reagents and catalysts applicable in in-situ GW remediation.

For further information please contact: Dr. Katrin Mackenzie.

The UFZ Technology Transfer Award is awarded to honour UFZ colleagues who have delivered outstanding achievements – in transferring research results into practice, in excellent work and for commitment to UFZ beyond the regular professional tasks.

Dr. Katrin Mackenzie
Department of Environmental Engineering

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From biogas plant to biorefinery – combined production of medium-chain fatty acids and biogas

Many products of our daily life contain medium-chain fatty acids, especially caproic acid (C6) and caprylic acid (C8). They are precursors of lubricants, cleaning agents, cosmetics, food and feed additives, pharmaceutical products or bioplastics. However, medium-chain fatty acids are sourced from tropical vegetable oils like palm kernel or coconut oil, whose production conditions are, at best, questionable from an environmental viewpoint.

A sustainable way for the production of medium-chain fatty acids …

The UFZ scientist Dr. Heike Sträuber from the Department of Environmental Biology has developed the Capraferm® process, which is based on anaerobic fermentation with mixed bacterial cultures for the microbial conversion of complex biomass into medium-chain fatty acids. There are several advantages of the Capraferm® process: it is flexible regarding the types of biomass used and can be based on energy crops (e.g. maize silage), agricultural and municipal residues and wastes, such as the organic fraction of household waste, or residues from food production. Furthermore, neither the substrates nor the reactor need to be sterilised, the process is robust against variations in the substrate quality and does not require expensive inhibitors for undesired methane production.

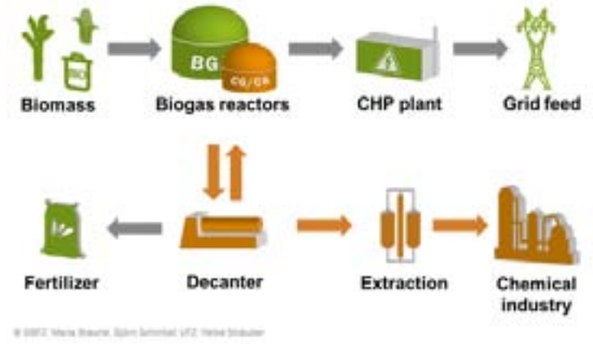
… and new business models for biogas plant operators

In cooperation with the Deutsches Biomasseforschungszentrum (German Biomass Research Centre, DBFZ), Heike Sträuber and Maria Braune from DBFZ jointly developed a process that combines anaerobic fermentation with a downstream processing to separate the fatty acids from the fermentation broth. This can be installed as a bypass to an existing biogas plant or realised as an independent plant. The concept was developed further in the framework of the CapAcidy project funded by the German Federal Ministry of Education and Research. Together with the University of Leipzig and several industry partners, the application of the fatty acids in end products was successfully tested. Currently, production has reached pre-pilot scale.

With the integration of the production process into existing biogas plants, materials and energy can be produced from regional biomass in the same plant and at the same time. Thus, future biogas plants may not only produce biogas and fertiliser, but also platform chemicals from residual and waste materials in an environmentally friendly and resource-saving manner. This offers new business models for an economic operation of biogas plants as well as new concepts for regions that are affected by the fossil fuel phase-out and proposed energy transition beyond fossil fuels.

For their R&D effort, Heike Sträuber and Maria Braune were awarded Science Prize (10,000 Euros) at the 12th Biogas Innovation Congress in Osnabrück in May 2019.

For further information please contact: Dr. Heike Sträuber.



Dr. Heike Sträuber
Department of **Environmental Microbiology**

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Water, air and pollinators – a new way of high throughput particle analysis

A good ecological status of our surface water and groundwater is an important prerequisite for a sound environment. Water quality and composition are governed by the EU Water Framework Directive (WFD, Directive 2000/60/EC). One indicator for the status of water bodies is the composition of phytoplankton. According to the WFD, it shall be assessed six times per year in the period between April and October.

From microscopic counting of phytoplankton species…

The current assessment requires manual microscopic counting and subsequent species analysis by a trained taxonomist. However, according to the service specifications of the German Society for Limnology, the analysis of a single sample takes between 60 and 180 min. Moreover, it is restricted to 400 individuals.

To overcome these disadvantages, the UFZ scientist Dr. Susanne Dunker from the department of Physiological Diversity has developed a high-throughput method using multi-spectral imaging flow cytometry in combination with deep learning. The image cytometer has a unique laser configuration and measures two non-co-linear fluorescence signals of the phytoplankton simultaneously. It thereby allows a first separation of different spectral groups and subsequent species identification based on morphological information and artificial intelligence.

… to an automated high-throughput analysis

The detection speed of up to to 5,000 particles per second allows to collect a representative number of cells. The analytical method was filed as an international patent application (WO 2019/068352A1).

The method is a powerful tool in several aspects. Firstly, faster monitoring of phytoplankton communities together with morphological information mean that shorter sampling intervals in water bodies become possible. This is crucial for a realistic understanding of phytoplankton dynamics, which have been shown to vary in the scale of a few days. Secondly, the method not only identifies phytoplankton, but also pollen species. This opens up a broad spectrum of applications ranging from air quality monitoring over analysis of the allergenic potential of pollen in asthmatic diseases to plant-pollinator research, or more applied for beekeepers, to assess pollen composition and purity in honeys. The methodology for both fields of species analysis is currently being developed further, together with different academic partners as well as a company.

For further information, please contact: Dr. Susanne Dunker.

from left to right: T. Hornick (UFZ/iDiv), S. Dunker (UFZ/Div), R. Treudler (UKL), P. Remmler (UFZ)

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EXIST Transfer of Research Grant for Radio Wave Technology

RWInnoTec team receives prestigious funding grant from the German Federal Ministry for Economic Affairs and Energy (BMWi)

EXIST Transfer of Research is a funding programme of the German Federal Ministry for Economic Affairs and Energy (BMWi) which aims at supporting outstanding research based start-up projects.

Shortly before Christmas 2018, the UFZ received a positive funding decision for the RWInnoTec project as part of the EXIST Transfer of Research funding programme. Building on many years of work in research and development of radio wave technology, a four-member interdisciplinary team at the UFZ has be given the opportunity from March 2019 onward to prepare for a spin-off conceptually and professionally. The goal is to successfully set up a company at the end of the funding period in 2022.

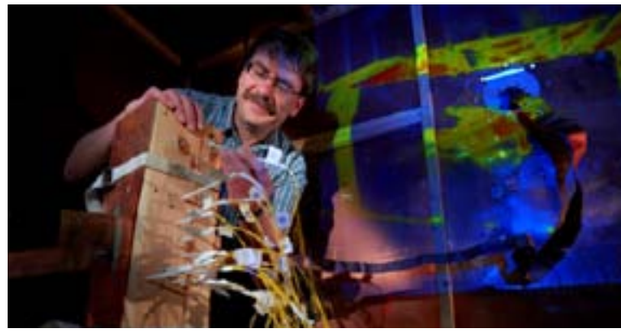
After handing in the written application in January 2018, the founding team was able to convince a panel of experts in Berlin of its idea and were one of the few teams, which obtained a recommendation for funding. Based on the results of a number of research projects that were successfully carried out within the innovation network RWTec (in German), the team demonstrated the wide range of possible application of the technology in the environmental, energy and construction sector.

Company to focus on novel road repair and water damage restoration methods

The company to be founded will concentrate primarily on the repair of road damage by developing appropriate technical equipment and machines. Due to high demand and the associated potential of radio wave technology, additional application areas, such as the drying of wet walls and building foundations, will remain in focus of the founding team. The planned cooperation with the Leipzig University of Applied Sciences (HTWK) aims to establish new innovative processes and products and complement the knowledge of the UFZ in the field of environmental technologies especially in civil engineering and automation. In addition, the company will be incorporated into the RWTec innovation network, currently coordinated by the FTZ (Forschungs- und Transferzentrum Leipzig e.V.) at the HTWK, in order to be able to offer member firms tailor-made radio wave technology and services, thus enabling the company to optimally close existing technology gaps.

The RWInnoTec Team – interdisciplinary experts with a common goal

Dr. Markus Kraus is a physicist and heads the project team. Dr. Ulf Trommler is a chemist by profession and a computer expert, Martin Arlt studied civil engineering and has expertise in road construction and Maria Kraus will complete the team with her business expertise. Dr. Ulf Roland, head of the working group of Applied Environmental Physics at the UFZ and expert on radio wave technology for many years, will take on the mentor role for the team.



Development of radio wave technology in the working group of Dr. Ulf Roland, TUCHEM Department

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Innovative minds

Department of Physiological Diversity

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Dr. Susanne Dunker

Dr. Susanne Dunker holds a Diploma in Biology. She received her PhD at the Institute of Biology, Department of Plant Physiology at the University of Leipzig, where she also started her career as a Post-Doc. In 2015 she moved to UFZ and iDiv (German Centre for Integrative Biodiversity Research) and now heads the working group ”Imaging Flow Cytometry”.

With her research, on one hand, she focuses on unravelling the mechanisms of phytoplankton growth and community formation as these are important indicators for water quality and ecology. On the other hand, she investigates pollen diversity, which is known to be linked to several ecosystem services, like air quality and pollination success, and has an impact on human health. To address related research questions, she invented a new imaging flow cytometry setup and combined it with deep learning approaches for an automated high throughput species recognition. Together with cooperation partners from academia and industry she is currently in the process of developing the method further and establishing it for different applications.

Department of Solar Materials

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Prof. Bruno Bühler

Prof. Dr. Bruno Bühler started his academic career at the Swiss Federal Institute of Technology (ETH) Zurich where he studied biology and biochemistry. During his PhD he specialised in the field of biotechnology. After a short stint as a Postdoc at ETH, he became group leader of the “Applied Bio-Catalysis” group at the Chemical Biotechnology laboratory of the Biochemical and Chemical Engineering Department at the TU Dortmund University in 2004. In 2014, he received his Venia Legendi in Dortmund. After moving with his working group to the UFZ, Department of Solar Materials, he became Professor for Applied Biocatalysis at the Martin Luther University Halle-Wittenberg.

Bruno Bühler and his team investigate redox biotransformations (oxygenases, dehydrogenases), in vivo cascades and fermentative approaches, to engineer microbial cells for the eco-efficient production of bulk and fine chemicals as well as fuels and bioactives from renewable (CO_2 and sunlight) and fossil resources. His research results have led to several patent applications. He is responsible for long-standing partnerships with companies like Evonik and BAYER to further develop these approaches within a framework of joint projects and research contracts.

Innovative minds

Department of Environmental Microbiology

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Dr. Heike Sträuber

Dr. Heike Sträuber earned her PhD in the former work group Microbial Physiology at UFZ and at the University of Leipzig in the field of Biochemistry. After Postdoc positions at UFZ and SIAB (Saxon Institute for Applied Biotechnology), she became a senior scientist in the research group “Microbiology of Anaerobic Systems” at the UFZ in 2015.

Heike Sträuber pursues her research to gain a deeper understanding of microbial relationships and activities in the anaerobic fermentation process to improve the efficiency of biomass conversion to carboxylate platform chemicals or methane. For this purpose she uses microbial chain elongation with lactic acid and ethanol as well as the combination with syngas fermentation. Based on these research findings, Heike Sträuber developed an anaerobic fermentation process, named CAPRAFERM® for the production of caproic and caprylic acid from complex biomass, which is now being further developed to a bio-refinery concept with several partners from academia and industry.

Department of Analytical Environmental Chemistry

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Prof. Kai Uwe Goss

Prof. Dr. Kai-Uwe Goss is the Head of the Department Analytical Environmental Chemistry (AUC). With a Masters in Environmental Sciences and a PhD in Environmental Chemistry, his research interest has long been to understand how chemicals are taken up, transformed and discharged by organisms, thus being able to predict bioaccumulation or toxicity.

His current R&D activities focus on a tool that models how chemical substances are distributed within (vertebrate) organisms. Such knowledge is highly in demand for different sectors in the industry, especially to assess potential risks of pharmaceuticals or cosmetics. In addition, Kai-Uwe Goss and his colleagues run the LSER (Linear Solvation Energy Relationship) database, which facilitates the exchange of knowledge with the scientific community and with stakeholders like regulatory organisations. Several user workshops have also been conducted. Since 2016 the database has been used by 2,600 different users from 30 different countries all over the world and the LSER website has had about 200,000 page views till date. Furthermore, the know-how has been implemented in the Cosmoperm software module as a result of a joint R&D project with the company COSMOlogic.

Developing a new standard method for indoor radon measurement

Due to the EU basic standard on radiation protection and the German Radiation Protection Act, a new monitoring obligation for indoor areas (including day-care centers, schools, etc.) and commercial areas came into effect on January 1, 2019. The standard requires appropriate ventilation measures being initiated if the limit value exceeds 300 Bq/m³.

Together with the Saxon State Office for Environment, Agriculture and Geology (LfULG, Department of Radiation Protection) and the Dresden-based Sarad GmbH, the Department of Environmental Informatics at the UFZ will develop a new standard for future measuring of indoor radon as well as ventilation concepts linked to it.
The measurements will be carried out at several pilot sites in the Ore Mountains region (Erzgebirge). Sarad GmbH and UFZ will jointly contribute with their technical and modelling expertise to determine actual radon levels in apartments, schools and workplaces for reliable onsite monitoring of radon activity and concentration. In addition to an optical and acoustic warning, electronic messages, for example to SmartHome systems or mobile phones, and/or radio-controlled ventilation technology can also be selected.

At the end of the joint project, a resource-efficient solution which complies with the legal radon reference value will be developed.

For further information please contact Prof. Holger Weiß (holger.weiss@ufz.de) or Ralf Trabitzsch (ralf.trabitzsch@ufz.de).

Patents granted for new process of drying and decontamination of masonry

Radio wave technology is a new concept for direct heating of a wide range of materials. The process can be used in construction, for example for drying or decontamination of masonry, for chemical-free wood preservation and for the conditioning of fresh concrete. In comparison to conventional heating methods, it is characterised by a targeted and uniform heating with high penetration depths. Harmful substances such as fuel oil residues, solvents or wood preservatives can thus be removed in a controlled and rapid manner.

Since 2014, the basic technology has been studied in the frame of the BMWi-funded ZIM network “RW-Tec“ (ZIM: Central Innovation Programme for SMEs), coordinated by the UFZ and with the aim to develop operational processes and products which will then be introduced to the market by the network’s industry partners.

The innovative strength of the researchers is also reflected in a high number of inventions. Two patents have recently been issued: a European patent for drying and decontamination of masonry, concrete, wood and other solids (EP 2 354 349), and a German patent for a method and apparatus for non-invasive dielectric heating by means of capacitive coupling (DE 10 2016 107 547), which was developed in close cooperation with the Leipzig University of Applied Sciences (HTWK).

For further information please contact Dr. Ulf Roland and Dr. Ulf Trommler (ulf.roland@ufz.de or ulf.trommler@ufz.de)

Robust autosampler in demand for diverse applications in water research

The autosampler was developed in cooperation with TU Darmstadt and built at UFZ. Six autosamplers were installed in the semi-arid cloud forests of the Dhofar mountains and one in the extremely dry Rub al-Khali in June 2017 in order to investigate how much groundwater leaks into the Arabian Sea, which precipitation events are relevant for groundwater renewal and which areas water leaks into. This information is based on the analysis of stable isotopes in the water.

The field trials ended in December 2017, and the team around Dr. Jan Friesen, UFZ, is currently adapting the autosampler’s structural design in order to make the plans available to the scientific community. The

UFZ - outcome 2018

News from the UFZ

device has generated interest not just with respect to research in remote areas, but also close to home: several autosamplers will soon be used to monitor the water balance of green roofs and, within the frame of the major project MOSES (Modular Observation Solutions for Earth Systems), in the area of river ecology.

For further information please contact Dr. Jan Friesen (jan.friesen@ufz.de) .

Bubblemeter – Development of an innovative measuring device for the quantification of rising gas bubbles in water bodies

Surface waters are globally significant sources of the greenhouse gases carbon dioxide and methane. Due to the particularly high greenhouse effect of methane, the determination of methane release is of particular significance. Methane emissions are mostly caused by ebullition and are extremely variable both in space and time.

Until now, there has been only one single commercial measuring device worldwide for the continuous measurement of rising gas bubbles in water, which is quite complex and expensive. However, for a representative measurement in a reservoir, several devices are necessary.

In a co-operation with the IAUT Institute at the Otto-von-Guericke University of Magdeburg, the Department of Lake Research at UFZ developed a prototype of a new type of instrument. The apparatus consists of an inverted funnel, a new type of bubble detector and a special mooring. The device was verified in the laboratory and in various field tests in the Bautzen Reservoir.

In 2018 an improved prototype was developed and will be tested during ongoing measurements of the TregaTa project at Bautzen Reservoir. In the future, the device will also be used in large infrastructures of the UFZ such as MOSES and TERENO to better understand the spatio-temporal variability of methane emissions from surface waters.

For further information please contact Dr. Matthias Koschorreck (matthias.koschorreck@ufz.de)

UFZ researchers develop a new method for quantifying the degradation of Lindane and other HCHs

Lindane belongs to a group of chemicals known as HCHs (hexachlorocyclohexanes) and was used as an insecticide in Germany for many years.
In 2003 the use of Lindane in agriculture was banned throughout the EU due to its strongly toxic effect and its long-term persistence. However, in some areas soil and groundwater are still heavily contaminated with this substance. To implement efficient environmental management, it is important to know whether the pollutant is being degraded and how quickly.

Researchers at the UFZ have now developed a method that makes it possible to quantify the biodegradation of lindane and estimate the length of time required for the chemical to safely decompose. The study appears in the current edition of the Journal of Environmental Science and Technology.

The UFZ researchers’ innovative approach is to combine two detection methods: isotope and enantiomeric fractionation. In laboratory tests, they developed a model that allows the degree of degradation to be measured using specimens taken from the environment. The method makes it possible to measure the biodegradation of the substance when it is transported in water or with soil particles. This will allow scientists to work out how long HCHs can be expected to be present in the environment.

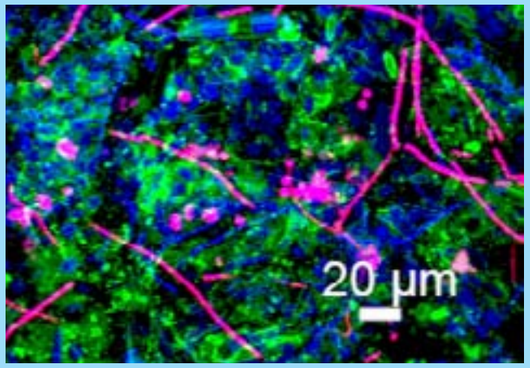
The research was supported by data and sampling assistance from Ökologisches Großprojekt Bitterfeld-Wolfen, Landesanstalt für Altlastenfreistellung Sachsen-Anhalt and Chemiepark Bitterfeld-Wolfen GmbH.

For further information, please contact Dr. Hans Hermann Richnow (hans.richnow@ufz.de) .

Technology platforms

ACROSS – Validation of satellite data

ACROSS (Advanced Remote Sensing - Ground Truth Demo and Test Facilities) provides field data across different spatial and temporal scales and environmental compartments in order to enhance the interpretation of satellite data for environmental science. The UFZ partly coordinates the ACROSS infrastructure and contributes to the terrestrial platform by investigating hydrogeophysical and ecological parameters like soil moisture, temperature, carbon and water fluxes.



Biofilm – Microscopy unit

At bounderies, microorganisms at interfaces form so-called biofilms, which play a key role in a variety of processes. While microorganisms are systematically applied in biotechnological processes, their action in biofouling or the human body may also result in undesirable effects on product quality or health. The technology platform "Biofilm" comprises several laser scanning microscopes, which allow a thorough investigation of structural and functional properties of biofilms and, therefore, contribute to a better understanding of the processes which occur in biofilms.

Biotechnikum – Bioreactor technology

The bioreactor pilot plant consists of modern bioreactor technology for the cultivation of different microorganisms like bacteria, yeast and fungi. It offers multi- and laboratory bioreactor systems as well as a set of geometrically similar reactors for a scaling up with working volumes. The facility is completed by devices for analytics along the bioprocess and cell separation and thus, enables an integral approach for the investigation, development and optimization of bioprocesses.

UFZ - outcome 2018

Technology platforms

CITEPro – Chemicals in the Environment Profiler

CITEPro provides a platform for high-throughput sample preparation, the automated exposure of cell cultures and aquatic organisms, and the automated analysis of the effects and chemical concentrations for large numbers of chemicals and environmental samples. The platform can increase the sample throughput of established bioanalytical, toxicological and analytical methods and is therefore suited for a wide range of applications including the spatial and temporal resolution of contamination with micropollutants in various environmental matrices from water, sediment and soil to biota and humans.

LSI – Isotope analysis

The Laboratory of Stable Isotopes (LSI) has know-how in the analytics of stable isotopes for more than 25 years. It holds several methodological patents which are licensed and acts as reference laboratory for the IAEA. Core competences are online component specific analyses (GC, TCEA, HPCL), the development of methods for isotope analysis for gaseous, solid and liquid samples, quality control and management as well as the development and calibration of international reference materials.

MOSAIC – Hydrogeological subsurface exploration

MOSAIC (Model Driven Site Assessment, Information and Control) is a platform for the model-based, high-resolution exploration of complex subsurface structures by applying and combining minimally invasive methods. The platform combines various methods such as direct push technologies, on-site analytical methods, geophysical, tomographic, as well as hydrogeological techniques. A further innovative approach is the adaptive site investigation.

Technology platforms

Prometheus: Metabolomic and proteomic mass spectroscopy platforms

The Prometheus platform offers most modern mass spectroscopy (GC and LS/MS) to identify and quantify exogenic and endogenic metabolites in epidemiological studies and cellular models for metabolomic analysis, and targeted and non-targeted proteomic analysis in simple (gel bands, affinity-enriched) and complex samples (extracts from cell culture, tissue, body fluids, microbial consortia). For microbial ecology, we use our Protein-SIP (stable isotope probing) approach and bioinformatics tools. All analyses combine our expertise with cutting-edge lab equipment.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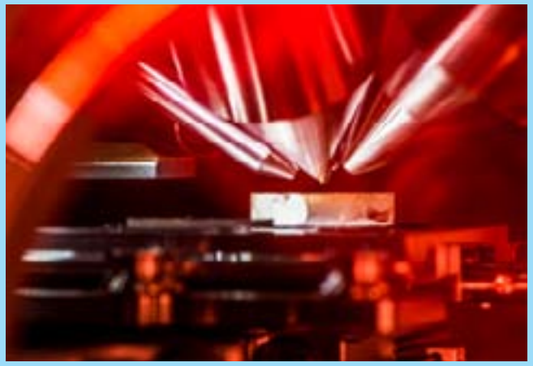

ProVIS – Visualisation of biochemical processes

ProVIS (Platform for visualisation of biochemical processes at the cellular level) provides a unique pool of scientific equipment combining imaging technologies with methods for chemical analysis to study biological samples, structures and surfaces on a nanometer scale. The technology comprises high-resolution atomic force, electron and ion microscopy as well as several mass spectrometry methods which are used to answer questions from fundamental research to applied science.

TESSIN/VisLab – 3D-Visualisation centre

The Visualisation Centre (VisLab) provides a platform for scientists from various fields to explore and analyse complex and spatially heterogeneous data sets. By way of an interactive large-area stereo projection screen, scientists can immerse themselves in the projected environmental data and, thereby, acquire new insights into scientific questions and problems. Furthermore, the platform offers opportunities for knowledge transfer between researchers on the one hand side and to interested citizens on the other hand side.

UFZ - outcome 2018

We offer

Nature-Based Solutions

- (Phototrophic) production of energy carriers and value added compounds from biomasses and waste streams with suitable microorganisms
- Remediation (soil, sediments, water) and Recycling

Tools for Monitoring and Modelling of Environmental Parameters

- Sensors and sensor networks
- Samplers and probes
- Visualisation and information networks

Expertise and Research

- Process controlling, regulatory circuits, sensor technology
- Modular reactor systems and biocatalysts
- Risk assessment of chemicals
- Novel biomarkers, diagnostic approaches and environmental diseases

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