LEIBNIZ SCIENCE CAMPUS
PHOSPHORUS RESEARCH
ROSTOCK

Activity Report 2019

Katalysis LIKAT Leibniz-Institut für Katalyse e.V.
INP Greifswald
Leibniz Institute for Baltic Sea Research Warnemünde
IPK Gatersleben
FBN Leibniz Institute for Farm Animal Biology
Universität Rostock Traditio et Innovatio

Content

1 Development of the Leibniz ScienceCampus Phosphorus Research Rostock (Introduction)

The Leibniz ScienceCampus Phosphorus Research Rostock (P-Campus) is linking the phosphorus research of more than 100 scientists from 6 research institutes in different disciplines working in 27 third-party funded projects. It focuses on three main areas in the support of phosphorus research by its members: strengthening of **networking**, **internationalization** and funding of **graduate students**.

In 2019, numerous events were initiated by the P-Campus to promote networking at all levels. Internal meetings and workshops took place to intensify both the networking of scientists at the P-Campus and scientific cooperation/exchange among them. Besides the events for the PhD students being involved in phosphorus research, regular meetings took place between different groups of the P-Campus. In the summer semester 2019 the lecture series "Die Wege des Phosphors in der Umwelt und Möglichkeiten der P-Nutzung" containing of 6 presentations was organized by the coordination office of the P-Campus.

Especially the P-Campus Symposium (26.04.2019) and the International P-Campus Symposium (12.-13.11.2019), at which the international scientific advisory council of the P-Campus participated, can be highlighted as events for all members of the P-Campus. Furthermore, the P-Campus is an active member of the 'Deutsche Phosphor Plattform (DPP)' and the European Sustainable Phosphorus Platform (ESPP). Further networking activities were e.g. the integration of further PhD students of partner institutes with topics in the field of phosphorus research from various sources of funding. Regardless of the personal exchange the PhD students had e.g. the opportunity to exchange views in a bigger group during the organized P Breakfast (17.12.2019, first P Breakfast with the new PhD students) and the P-Campus symposium.

Moreover, members of the P-Campus are internationally active all year round. The P-Campus has contributed to the financial support of young scientists in their **international activities** and co-financed the participation in the IPW9 (July 2019) and a research stay at the ETH Zurich (Nov 2019) of two PhD students. Without financial support of the P-Campus, these conference trips and presentations of their results would not have been possible for the young scientists.

The **graduate school phosphorus research** is the core of the graduate concept of the P-Campus and has the overarching goal of an excellent graduate education. Thematic training and the lively exchange of information among PhD students are supported by different events such as thematic workshops, professional training and informal meetings. The start workshop 'P analytics' at the Biological Station Zingst in November (CW 48) was organized and co-supervised by for the new PhD students of the P-Campus.

In 2019, several important third party funded projects, which can be assigned to the P-Campus, were raised or started, e.g. "RePhoR-MV: Regionales Phosphor-Receycling aus Klärschlämmen in Mecklenburg-Vorpommern" and "MitoBOX: The mitochondrial basis of hypoxia tolerance in marine mollusks" (see Table 1, all projects of 2019).

In the first half year, the last seed projects were granted by the use of remaining funds of the first funding period. To continue the successful concept of the seed projects the first 6 seed projects were granted from June 2019 on. Part of the projects runs until the first half year 2020.

The following five publications received the **Publication Award 2019**, since authors of at least two partner institutes were involved in the peer-reviewed publications:

Berthold, M., Wulf, R., Reiff, V., Karsten, U., Nausch, G., Schumann, R. (2019) Magnitude and influence of atmospheric phosphorus deposition on the southern Baltic Sea coast over 23 years - Management implications for coastal waters. Environ Sci Europe. 31, 27 (MNF, IOW), OA

Gerlinger C., Oster, M., Borgelt, L., Reyer, H., Muráni, E., Ponsuksili, S., Polley, S., Vollmar, B., Reichel, M., Wolf, P., Wimmers, K. (2019) Physiological and transcriptional responses in weaned piglets fed diets with varying phosphorus and calcium levels. Nutrients 2019, 11, 436 (FBN, AUF), OA

Grandane, A., Longwitz, L., Roolf, C., Spannenberg, A., Murua Escobar, H., Junghanss, C., Suna, E., Werner, T. (2019) Intramolecular base-free catalytic Wittig reaction: synthesis of benzoxepinones, J. Org. Chem. 84, 1320 (LIKAT, UMR)

Strauch, S.M., Bahr, J., Baßmann, B., Bischoff, A.A., Oster, M., Wasenitz, B., Palm. H.W. (2019) Effects of ortho-phosphate on growth performance, welfare and product quality of juvenile african catfish (Clarias gariepinus). Fishes 4, 3 (AUF, FBN), OA

Wacker-Fester, K., Uptmoor, R., Pfahler, V., Dehmer, K.J., Bachmann-Pfabe, S., Kavka, M. (2019) Genotype-specific differences in phosphorus efficiency of potato (Solanum tuberosum L.). Front Plant Sci 10, 1029 (AUF, IPK), OA

40 publications were published in **cluster I P in the environment**. Especially the following publications can be highlighted, since they evaluate data sets, which extend in time and space, respectively additionally asking specific analytical questions (allocation to the former cross-sectoral issue P analytics).

Berthold, M., Wulf, R., Reiff, V., Karsten, U., Nausch, G., Schumann, R. (2019) Magnitude and influence of atmospheric phosphorus deposition on the southern Baltic Sea coast over 23 years - Management implications for coastal waters. Environ Sci Eur 31, 27, doi 10.1186/s12302-019-0208-y

Bitschowsky, F., Nausch, M. (2019) Spatial and seasonal variations in phosphorus speciation along a river in a lowland catchment (Warnow, Germany). STOTEN 657, 671-685, doi 10.1016/j.scitotenv.2018.12.009

Buczko, U., Steinfurth, K., van Laak, M. (2019) Meta-Analysis of the yield response to phosphorus fertilization based on long-term field experiments. Agricu Forest 65, 7-14, doi 10.17707/AgricultForest.65.4.01

Prüter, J., Leipe, T., Michalik, D., Klysubun, W., Leinweber, P. (2019) Phosphorus speciation in sediments from the Baltic Sea, evaluated by a multi-method approach. J Soils Sedim, doi 10.1007/s11368-019-02518-w

Wirth, M.A., Sievers, M., Habedank, F., Kragl, U., Schulz-Bull, D.E., Kanwischer, M. (2019) Electrodialysis as a sample processing tool for bulk organic matter and target pollutant analysis of seawater. Marine Chem 217, doi 10.1016/j.marchem.2019.103719

In 2019, 20 publications were published in **cluster II Sufficiency and efficiency of P utilization, P recycling**. 5 publications particularly deal with a more efficient animal production.

Gerlinger, C., Oster, M., Borgelt, L., Reyer, H., Muráni, E., Ponsuksili, S., Polley, S., Vollmar, B., Reichel, M., Wolf, P., Wimmers, K. (2019) Physiological and transcriptional responses in weaned piglets fed diets with varying phosphorus and calcium levels. Nutrients, 11, 436, doi 10.3390/nu11020436

Palm, H. W., Knaus, U., Appelbaum, S., Strauch, S. M., Kotzen, B. (2019) Coupled aquaponics systems. Aquap Food Prod Syst 163-199, doi 10.1007/978-3-030-15943-6

Reyer, H, Oster, M, Wittenburg, D, Muráni, E, Ponsuksili, S, Wimmers, K (2019) Genetic contribution to variation in blood calcium, phosphorus, and alkaline phosphatase activity in pigs. Front Gen 10, 590, doi 10.3389/fgene.2019.00590

Strauch, S.M., Bahr, J., Baßmann, B., Bischoff, A.A., Oster, M., Wasenitz, B., Palm, H.W. (2019) Effects of ortho-phosphate on growth performance, welfare and product quality of juvenile african catfish (*Clarias gariepinus*). Fishes 4, 3, doi 10.3390/fishes4010003

Wubuli, A., Reyer, H., Muráni, E., Ponsuksili, S., Wolf, P., Oster, M., Wimmers, K. (2019) Tissue-Wide gene expression analysis of sodium/phosphate co-transporters in pigs. Int J Molec Sci 205576, doi 10.3390/ijms20225576

10 publications were published in **cluster III P in synthesis and catalysis**, 4 of those of PhD student Lars Longwitz of the LIKAT as lead author.

Longwitz, L., Jopp, S., Werner, T. (2019) Organocatalytic chlorination of alcohols by P(III)/P(V) redox cycling. J Org Chem 84, 7863–7870, doi 10.1021/acs.joc.9b00741

Longwitz, L., Spannenberg, A., Werner, T. (2019) Phosphetane oxides as redox cycling catalysts in the catalytic wittig reaction at room temperature. ACS Catalysis, doi 10.1021/acscatal.9b02456

Longwitz, L. Werner, T. (2019) Recent advances in catalytic Wittig-type reactions based on P(III)/P(V) redox cycling. Pure Appl Chem 91, 95–102, doi 10.1515/pac-2018-0920

Longwitz, L., Werner, T. (2019) The Mitsunobu reaction, reimagined. Science 365, 866-867, doi 10.1126/science.aay6635

The **public relations work** of the P-Campus included in 2019 besides text writing, publishing (e.g. Schaub et al. (2019) Nachwuchsförderung und Forschung am Leibniz-WissenschaftsCampus Phosphorforschung Rostock. Wasser und Abfall 10/2019, 40-46), presentations and maintenance of the website also the representation of the P-Campus by an information stand at the University of Rostock during the Long Night of Sciences on April 25, 2019. An interested public was given an understanding of e.g. the sources and paths of P in the environment, the effect of P in the nutrition on (bone) health of farm animals as well as the effect of soil crusts and earthworms on soil and P availability. Moreover, the P-Campus organized the visit of partner institutes of the P-Campus (presentations and guided tours at FBN, AUF and IOW) for journalists of the German Science Journalists' Association on 24 and 25 September 2019 within the scope of their research trip "Phosphorus – and the future of agriculture". One of the journalists published an article about the visit at the P-Campus in January 2020 in the journal 'Nachrichten aus der Chemie' (Osterath, B. "Ressourcenmanagement – Ein paar Schippchen weniger").

2 Goals and Concept

The overarching goal of interdisciplinary cooperation at the Leibniz ScienceCampus Phosphorus Research Rostock is, through a thematically oriented integrated network, to explore options for the more sustainable management of phosphorus. Further focuses of the P-Campus, in addition to the sufficient and efficient use and recycling and recovery of phosphorus, are phosphorus cycles and fluxes in the environment and the environmental problems, in particular in aquatic systems, caused by inefficient phosphorus use or a lack of phosphorus recycling. Expertise in various aspects of research into the essential and

irreplaceable element phosphorus, diverse phosphorus-containing chemical compounds, and specific modes of action of phosphorus in agricultural and environmental systems as well as in technical and industrial processes are brought together at the P-Campus. Cooperation and research are intensified and strong national and international networks established.

The following institutes are partners of the P-Campus:

- Leibniz Institute for Catalysis (LIKAT) at the University of Rostock
- Leibniz Institute for Farm Animal Biology (FBN), Dummerstorf
- Leibniz Institute for Baltic Sea Research Warnemünde (IOW)
- Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Satellite Collections North, Groß Lüsewitz
- Leibniz Institute for Plasma Science and Technology (INP), Greifswald
- University of Rostock (Faculty of Agricultural and Environmental Sciences, Interdisciplinary Faculty, Faculty of Law, Faculty of Mathematics and Natural Sciences, Rostock University Medical Centre)

3 Research

3.1 Research Foci

The research foci of the P-Campus are:

- Cluster I: P in the Environment
- Cluster II: Sufficiency and Efficiency of P Utilization, P Recycling
- Cluster III: P in Synthesis and Catalysis
- Cluster IV: Molecular Biology of P
- Cluster V (cross-topic): P Governance

3.1.1 Cluster I: P in the Environment

Phosphorus ends up in the environment through open-ended industrial cycles and along river flows, reaching the sea. The aim is a better understanding of P fluxes and cycles in the environment in order, on the one hand, to analyze the effects of high P inputs and, on the other, to enable discussion of protection and/or rehabilitation measures. This starts at the "sources", for example with the application of fertilizer on agricultural land and the effects of artificial drainage (drain systems), but also at the river outlets of small and large wastewater treatment plants. And it continues through phosphorus fluxes in different ecosystems, from special soil crusts to coastal waters and into the large Baltic Sea basin. Methodological approaches in Cluster I include measurements on the smallest scale up to the Baltic Sea ecosystem modelling over a wide range of scales and instrumentation.

3.1.2 Cluster II: Sufficiency and Efficiency of P Utilization, P Recycling

The goal is to formulate a scientific basis with which to derive the necessary legal framework and policy recommendations for the sustainable management of regional and global closed P-fluxes in accordance with the principles of sufficiency and efficiency. Sufficiency

means to limit the application rates of P for the production of plant and animal foods to the level actually required. This requires critical evaluations of existing P-fertilization and feed recommendations with the aim of reducing P-use in agriculture. Research to improve P-efficiency includes:
(1) Elucidation of the genetic basis of P-efficiency (uptake and utilization efficiency)
(2) Unlocking the accumulated but not available or not used P-stores in topsoil and the subsoil
(3) Utilization of alternative P sources and development / refinement of practice-relevant P-recovery technologies including research into the properties and potential of alternative P sources and technically recovered phosphates and extending to recommendations for practical applications.
The interdisciplinary nature of the Cluster, which covers all sub-areas of the agricultural P cycle (soil, plant, animal, water, process engineering ...), enables a realistic assessment of the portion of the P application rates that in the future are replaceable with renewable P sources.

3.1.3 Cluster III: P in Synthesis and Catalysis

This cluster is primarily concerned with research into underlying structural and reactive properties as well as theoretical issues in phosphorus chemistry. This reflects the formally possible oxidation states, which for phosphorus range from -3 to +5, the extraordinarily high structural diversity of phosphorus compounds. As a central element in achiral and chiral ligands for organometallic and coordination chemistry catalytic processes, phosphorus plays a unique role in catalysis research and as a reagent in organic synthesis. This is also true for some areas of industrial chemistry, mainly in the manufacture of fine chemicals, which often have a high added value. In addition, phosphorus-based organocatalysts are gaining increasing importance.

3.1.4 Cluster IV: Molecular Biology of P

The overarching goal is to unravel the central role of P as a metabolic, signaling and regulatory molecule from molecular to ecosystem levels. In fact, P acquisition, mobilization and assimilation involve various molecular mechanisms in microorganisms, plants and animals. Moreover, P plays a key role in signaling at the level of ecosystems, organisms and cells. Projects in this Cluster aim to analyze the molecular mechanisms related to the uptake of P from the environment into the organism, the distribution, storage and mobilization of P within the organisms and its essential roles in the cellular metabolism as well as in the crosstalk of microorganisms, cells and tissues.

3.1.5 Cluster V (cross-topic): P Governance

Cluster V of the P-Campus aims at possible policy instruments to strengthen P-recycling (consistency), efficiency and sufficiency in the use of P-fertilizers and deals with their implementation in society and agricultural practice through effective legal frameworks. The aim of the subproject is to deepen the analysis and further development of agricultural, fertilizer, water, soil protection, waste and recycling legislation and to develop concrete governance options for closed P cycles at different legal levels. Natural scientific findings generated within the framework of the P-Campus will be included as well as current political and legal developments. A current priority is the monitoring and further development of the EU Common Agricultural Policy for the 2021-2027 funding phase.

3.2 Research Projects

Within the research clusters, 27 disciplinary and interdisciplinary, externally funded projects were thematically assigned to the P-Campus in 2019 (table 1). Six of these projects started newly in 2019. The Graduate School I, funded by the Leibniz Association, conducts research in 11 thematically affiliated individual projects, which are listed in table 2a. The Graduate School II consists of 15 projects, which are listed in table 2b. Additionally, six seed projects from the first funding period run in 2019 and six new seed projects were granted (five started in 2019), which partly run until 2020 (table 3).

Table 1. Research projects thematically assigned to the P-Campus (status as of December 2019; *italics: phosphorus not a subject of the total project or members of the P-Campus only active in parts of the project*)

Project Name	Term	Sponsor	Participating Partners of the P-Campus	Cluster
AC/DC-weeds: Applying and combining disturbance and competition for an agro-ecological management of creeping perennial weeds	*04/2019-03/2022*	*DFG*	*University of Rostock (AUF)*	*I*
BACOSA II: Baltic Coastal System Analysis and Status Evaluation	*04/2016 - 03/2019*	*BMBF*	*University of Rostock (MNF, AUF)*	*I*
Baltic Transcoast	*01/2016-06/2020*	*DFG*	*University of Rostock (AUF, MNF), IOW*	*I*
Biomasse-Asche-Monitoring (BAM) Teilvorhaben 2: Agronomische Bewertung	11/2016-10/2019	BMELV	University of Rostock (AUF)	II
CLIMARCTIC: Einfluss des Klimawandels auf arktische Boden- und See-Mikrobiome	*03/2017 - 02/2020*	*DFG*	*University of Rostock (MNF)*	*I*
CRUSTFUNCTION II: Biodiversität und funktionelle Rolle von biologischen Bodenkrusten II	*07/2017-06/2020*	*DFG*	*University of Rostock (AUF, MNF)*	*I*
DachKüNO II: Wissens- und Datentransfer in der Küstenmeerforschung	*01/2017-12/2019*	*BMBF*	*IOW*	*I*
DiveCropS: Diversifying cropping systems - Traditional knowledge and innovative approaches	01/2019-12/2022	DAAD	University of Rostock	II
Glyphosat: Untersuchungen der Eigenschaften und Wirkungsweisen von Glyphosat im Boden	02/2016-01/2019	Landesgraduiertenstipendium MV	University of Rostock	I, II, Q
Graduate School I: Leibniz ScienceCampus Phosphorus Research Rostock	04/2015-06/2019	WGL	FBN, IOW, INP, IPK, LIKAT, University of Rostock	I, II, III, Q
Graduate School II: Leibniz ScienceCampus Phosphorus Research Rostock	07/2019-06/2023	WGL	FBN, IOW, INP, IPK, LIKAT, University of Rostock	I, II, III, IV, V
InFertRes: Innovative Fertilizers and Resource Efficiency in Agriculture	03/2018–02/2021	BMBF	University of Rostock (AUF)	II
InnoAquaTech: Cross-border development and transfer of innovative and sustainable aquaculture technologies in the South Baltic area	*07/2016-06/2019*	*Interreg South Baltic*	*University of Rostock (AUF)*	*II*

Project Name	Term	Sponsor	Participating Partners of the P-Campus	Cluster
InnoSoilPhos II: Innovative solutions to sustainable soil phosphorus management	03/2018 – 02/2021	BMBF	University of Rostock (AUF)	I, II, Q
INTEGRAL: Integrated carbon and trace gas monitoring for the Baltic Sea	*07/2017-06/2020*	*BONUS*	*IOW*	*I*
KataPlasma: Hydroformylierung mit homogenen Katalysatoren geträgert auf Plasma funktionalisierten Materialien	*06/2016 – 05/2019*	*BMBF*	*LIKAT, INP*	*III*
Kombination von Biokatalyse und Kristallisation für die Synthese chiraler Amine	*04/2019-03/2022*	*BMWi*	*University of Rostock (MNF)*	*III*
MitoBOX: The mitochondrial basis of hypoxia tolerance in marine mollusks	*02/2019-01/2022*	*DFG*	*University of Rostock (MNF)*	*IV*
MOSSCO II: Modular System for Shelves and Coasts	*04/2016-03/2019*	*BMBF*	*IOW*	*I*
NuReDrain: Innovative Nutrient Catching Reactive Barrier and Controlled Drainage Technologies for Sustainable Growth of the Agriculture Sector	*2017-2020*	*North Sea Region Programme (EU)*	*University of Rostock (AUF)*	*I, II*
OPTIMUS: Optimierung von Muschelfarmen zur Eutrophierungsvermeidung und zur Fischfutterproduktion in der Ostsee	*04/2017-03/2020*	*BONUS*	*IOW*	*I*
P FOWL: Inositolphosphate und Myo-Inositol beim Geflügel	*09/2017-08/2020*	*DFG*	*FBN*	*II*
PEGaSus: Phosphorus efficiency in Gallus and Sus scrofa: Bridging the gaps in the phosphorus value chain	*09/2017-08/2020*	*ERA-NET SUSAN*	*FBN*	*I, II*

Table 2a. Subprojects of the Graduate School Phosphorus Research Rostock (financed by the Leibniz Association and partners of the P-Campus): 2015–2019

Project	Participating Partners	Research Focus
Quality, quantity and transformation of P losses from diffuse sources to the Baltic Sea	IOW, UR	I
Phosphatases – Development of new quantitative assays along terrestrial-aquatic gradients	UR, IOW	I
Natural and anthropogenic organic P compounds – inositolphosphates, phospholipids and glyphosate	IOW, UR	I, II, Q
Mechanisms of P mobilization in the rhizosphere involving weeds and crop plants	UR, IPK	II
Genetic regulation of phosphatase production and activity to increase P uptake from deficient soils	UR, IPK	II
Genetic and nutritional effects on the efficiency of P use of monogastric animals	FBN, UR	II
The P cycle and its application in land-based integrated aquaculture systems	UR, FBN	II
Political-legal P governance by means of certificate markets and charges	UR, IOW	II
Processing of alternative P sources for fertilization in agriculture	INP, UR	II, III
Synthesis of new heterocyclic ring systems containing P	LIKAT, UR	III
Large scale application of P based organocatalysts in batch and flow for the synthesis of fatty acid derived cyclic carbonates	LIKAT, UR	III

Table 2b. Subprojects of the Graduate School Phosphorus Research Rostock (financed by the Leibniz Association and partners of the P-Campus): 2019–2023

Project	Participating Partners	Research Focus
I.1 Risks and benefits of rewetting coastal wetlands after agricultural use	UR, IOW	I
I.2 P Pools and mobilization potential in lowlands and coastal regions	UR, LIKAT	I
I.3 Analysis of glyphosate and glufosinate in sea water and as indicator compounds for industrial cropping	IOW, UR	I
II.1 P recycling in animal husbandry	UR, IOW, FBN	II
II.2 Efficiency of recovered phosphorus for monogastric animals	UR, FBN	II
II.3 P efficiency of forage legumes and their capacity to utilize P from recycling products	IPK, UR	II
III.1 Synthesis of novel P-based ligands for complexes to activate small molecules	LIKAT, UR	III
III.2 Application of P-based organocatalysts and biocatalysts for the resolution of racemic carbonates	UR, LIKAT	III
III.3 Synthesis of potential anti-tumor and adhesion-promoting agents by P-based organocatalysis for oncology and biomedical engineering	LIKAT, UMR, INP	III
IV.1 Gene expression in biogeochemical cycling of phosphorus in biological soil crusts of sand dunes of the Baltic Sea	UR, IOW	IV
IV.2 Sustainability of potatoe production: Cloning ans squencing of candidate genes improving P aquisition efficiency to reduce fertilizer inputs	UR, IPK	IV
IV.3 The role of inorganic phosphate supply on the development of cyanobacterial summer blooms in the Baltic Sea	UR, IOW	IV
IV.4 Phosphorus as a metabolic regulator during environmental stress in animals	UR, IOW, FBN	IV
IV.5 Molecular mechanisms of phosphate homeostasis and osteoimmunological processes and their consequence for health and welfare	FBN, UMR	IV
V. Governance options for closed P cycles - the GAP 2020 revision	UR, IOW	V

Table 3. In 2019, 12 seed projects started in cooperation between partners of the P-Campus, financed by the Leibniz Association (condensed reports of the projects can be provided on request).

Project	Participating Partners
Funding Period 1	
Novel mechanisms of P-dependent energy transductions in an animal extremophile (01/2019-06/2019)	IOW, UR
Cyclovoltammometrische Messungen an Phosphorliganden (P-Redox) (03/2019-06/2019)	UR, LIKAT
Glyphosate „Beeinflussung der Biodiversität & biologischen Aktivität in terrestrischen und aquatischen Systemen durch Glyphosat und AMPA" (03/2019-06/2019)	UR, IOW
Shifted excitation Raman difference spectroscopy testing for analysis of inorganic phosphorus, inositol phosphates (InsPx) and myo-inositol in environmental and animal samples (SERAIP) (03/2019-06/2019)	FBN, FBH, UR
Synthese von isotopenmarkiertem AMPA für die qualitative und quantitative Analyse des Glyphosatabbaus im Boden (AMPA) (03/2019-06/2019)	IOW, LIKAT, UR
Zusammenstellung von Langzeitdaten und Ringversuchsdaten zum P-Aufschluss aus unterschiedlichen Naturmaterialien innerhalb des P-Campus für das eBook P analytics (P-Digest) (03/2019-06/2019)	UR, IOW, INP

Project	Participating Partners
Funding Period 2	
Die Rolle von Protisten im Phosphorkreislauf biologischer Bodenkrusten (ProCycle) (07/2019-04/2020)	UR, IOW
Dietary effects on DNA methylation in porcine parathyroid glands (EpiPTG) (07/2019-03/2020)	FBN, UR, UMR
Phosphorus as a cue regulating microbial N2O production (PQ4N) (07/2019-12/2019)	UR, IOW
Plasmainduzierte Abbaureaktionen in Glyphosat-haltigen Substraten (PIAG) (08/2019-12/2019)	INP, UR
Phosphor - Protein - Interaktionen in der Quervernetzung (P-ChemBind) (10/2019-12/2019)	UR, LIKAT

Abbreviations: AUF = Faculty of Agricultural and Environmental Sciences, FBN= Leibniz Institute for Farm Animal Biology, IOW = Leibniz Institute for Baltic Sea Research Warnemünde, LIKAT = Leibniz Institute for Catalysis, MNF = Faculty of Mathematics and Natural Sciences, UR = University of Rostock

3.3 Graduate Concept/Graduate School Phosphorus Research

The structured training concept of the P-Campus (see figure 1) is realized by graduate studies at the Graduate School of Phosphorus Research and the involvement of other young scientists (BSc and MSc students, doctoral students, and postdocs) whose thesis or project concerns phosphorus research. All relevant information are provided to young scientific members of the P-Campus. In addition to their inclusion in events involving the P-Campus and in scientific and thematic networks, for example, those of the DPP and ESPP, they can apply to the P-Campus for grants and for financial support for internationalization (travels, publications and visiting scientists, including longer stays).

Figure 1. Graduate Concept of the Leibniz ScienceCampus Phosphorus Research Rostock

The Graduate School of Phosphorus Research is the core of the graduate concept of the P-Campus. Its overall objective is to provide excellent graduate education, to encourage new and innovative phosphorus research topics, and to foster networking among partners. The 11 doctoral projects of the first period and the 15 doctoral projects of the second period cover important areas of knowledge and research (table 2a + 2b). BSc and MSc thesis topics in phosphorus research have also been developed during the first period.

All doctoral students are supervised by a committee of scientists from at least two partner organizations of the P-Campus (e.g. the Leibniz Institute for Baltic Sea Research and

the University of Rostock). The students present their work at the annual P-Campus Symposium, held in November. Lively exchanges of information between doctoral students are promoted through various events, such as workshops and the regularly held P-Breakfast (see Section 5). Positive support for these activities has come from opening up the events to other doctoral students with thesis topics in phosphorus-related research.

Until the end of 2019, three PhD students of the first graduate school completed their doctoral thesis (green letters in table 2a) and another PhD student submitted his doctoral thesis (orange letters in table 2a). Five more dissertations shall be submitted in the course of 2020. Two PhD students dropped out due to personal reasons, the respective supervisors finished the projects. Seven new PhD students started in 2019, being part of the second graduate school (green letters in table 2b). The other eight PhD students will be employed until summer 2020.

3.4 Publications

Publications of the members of the P-Campus in 2019:

Acksel, A, Baumann, K, Hu, Y, Leinweber, P (2019) A critical review and evaluation of some P-research methods. Comm Soil Sci Plant Anal 50, 2804-2824, doi 10.1080/00103624.2019.1679165

Acksel, A, Baumann, K, Hu, Y, Leinweber, P (2019) A look into the past: tracing ancient sustainable manuring practices by thorough P speciation of northern European Anthrosols. Soil Systems 3, 72, doi 10.3390/soilsystems3040072

Ahmed, A. A, Gypser, S, Leinweber, P, Freese, D, Kühn, O (2019) Infrared spectroscopic characterization of phosphate binding at the goethite-water interface. Physical Chemistry Chemical Physics 21, 4421, doi 10.1039/C8CP07168C

Andert, S, Mutz, J.-E, Wiese, A, de Mol, F, Steinmann, H.-H, Gerowitt, B (2019) Farmers' statements are reliable – comparing two different data sources about Glyphosate use in Germany. Crop Protect 124, 104876, doi 10.1016/j.cropro.2019.104876

Baumann, K, Siebers, M, Kruse, J, Eckardt, K.-U, Hu, Y, Michalik, D, Siebers, N, Kar, G, Karsten, U, Leinweber, P (2019) Biological soil crusts as key player in biogeochemical P cycling during pedogenesis of sandy substrate. Geoderma 338, 145–158, doi 10.1016/j.geoderma.2018.11.034

Bauwe, A, Eckhardt, K.-U, Lennartz, B (2019) Predicting dissolved reactive phosphorus in tile-drained catchments using a modified SWAT model. Ecohydrol Hydrobiol 19 (2), 198-209, doi 10.1016/j.ecohyd.2019.03.003

Bauwe, A, Neumann, D, Lennartz, B (2019) Einfluss des Klimawandels auf Abfluss und Phosphoraustrag: Eine Fallstudie aus Mecklenburg-Vorpommern. KW Korrespondenz Wasserwirtschaft 3/2019, 166-171

Bauwe, A (2019) Potential der P-Reduktion aus Punktquellen im Einzugsgebiet der Warnow: ein modelltechnischer Ansatz. Schriftenreihe Umweltingenieurwesen 88, 20-28

Berthold, M, Karsten, U, Nausch, G, Schumann, R (2019) Die Darß-Zingster Boddenkette – ein Modellsystem innerer Küstengewässer der südlichen Ostsee: Prozesse der Eutrophierung und Re-Mesotrophierung. Wasser und Abfall 21(3), 24-30

Berthold, M, Wulf, R, Reiff, V, Karsten, U, Nausch, G, Schumann, R (2019) Magnitude and influence of atmospheric phosphorus deposition on the southern Baltic Sea coast over 23 years - Management implications for coastal waters. Environ Sci Euro 31, 27, doi 10.1186/s12302-019-0208-y

Bitschowsky, F., Nausch, M (2019) Spatial and seasonal variations in phosphorus speciation along a river in a lowland catchment (Warnow, Germany). STOTEN 657, 671-685, doi 10.1016/j.scitotenv.2018.12.009

Bitschowsky, F. Felgentreu, L, Nausch, G, Leipe, T, Nausch. M (2019) Phosphortransport und -transformation entlang eines norddeutschen Tieflandflusses im Einzugsgebiet der Ostsee. KW Korrespondenz Wasserwirtschaft 3/2019, 134-139

Borchhardt, N, Baum, C, Thiem, D, Köpcke, T, Karsten, U, Leinweber, P. & Hrynkiewicz, K (2019) Link between soil microbial phosphorus turnover and diversity of algae and fungi in biological soil crusts along a transect in a glacier foreland. Europ J Soil Biol 91, 9-17, doi 10.1016/j.ejsobi.2018.12.006

Buczko, U, Steinfurth, K, van Laak, M (2019) Auswirkungen von unterlassener Phosphor-Düngung auf die Entwicklung der Erträge und Boden- P-Gehalte – Ergebnisse einer Metastudie. VDLUFA Kongressband 2019 Gießen, 74-81

Buczko, U, Steinfurth, K, van Laak, M (2019) Meta-Analysis of the yield response to phosphorus fertilization based on long-term field experiments. Agricul Forest 65, 7-14, doi 10.17707/AgricultForest.65.4.01

Buczko, U, Zicker, T, Eichler-Löbermann, B, Brandt, T (2019) Abschätzung von diffusen Phosphor-Austrägen mit Index-Verfahren - Entwicklung und Anwendung eines PI für Nordost-Deutschland. KW Korrespondenz Wasserwirtschaft 3/2019, 154-158

Büttner, H, Kohrt, C, Wulf, C, Schäffner, B, Groenke, K, Hu, Y, Kruse, D, Werner, T (2019) Life cycle assessment for the organocatalytic synthesis of glycerol carbonate methacrylate. ChemSusChem 12, 2701–2707, doi 10.1002/cssc.201900678

Ekardt, F (2019) Sustainability: Transformation, Governance, Ethics, Law. Springer Books

Friedland, R, Buer, A.-L, Dahlke, S, Schernewski, G (2019) Spatial effects of different zebra mussel farming strategies in an eutrophic Baltic lagoon. Front Environ Sci 6, 158, doi 10.3389/fenvs.2018.00158

Friedland, R, Schernewski, G, Gräwe, U, Greipsland, I, Palazzo, D, Pastuszak, M (2019) Managing eutrophication in the szczecin (Oder) lagoon-development, present state and future perspectives. Front Marine Sci 5, 521, doi 10.3389/fmars.2018.00521

Ganta, P. B, Kühn, O, Ahmed, A. A (2019) QM/MM simulations of organic phosphorus adsorption at the diaspore-water interface. Physical Chemistry Chemical Physics 21, 4421, doi 10.1039/C8CP07168C

Gerlinger, C, Oster, M, Borgelt, L, Reyer, H, Muráni, E, Ponsuksili, S, Polley, S, Vollmar, B, Reichel, M, Wolf, P, Wimmers, K (2019) Physiological and transcriptional responses in weaned piglets fed diets with varying phosphorus and calcium levels. Nutrients, 11, 436, doi 10.3390/nu11020436

Gros, P, Ahmed, A, Kühn, O, Leinweber, P (2019) Influence of metal ions on glyphosate detection by FMOC-Cl. Environ Monitor Assess 191, 244, doi 10.1007/s10661-019-7387-2

Hagemann M, Möke F, Springer A, Westermann L, Frank M, Wasmund N, Bauwe H (2019) Cyanobacterium *Nodularia spumigena* strain CCY9414 accumulates polyphosphate under long-term P-limiting conditions. Aqu Micr Ecol 82:267-276, doi 10.3354/ame01896

Jahanbakhsh, S, Brüser, V, Brandenburg, R (2019) Experimental investigation of single microdischarges in a barrier corona arrangement with a cathodic metal pin. Plasma Sourc Sci Technol, doi 10.1088/1361-6595/ab52e9

Jahanbakhsh, S, Hoder, T, Brandenburg, R (2019) Correlation between electric field, current and photon emission in subsequent barrier corona microdischarges. J App Phys 126, 193305, doi 10.1063/1.5124363

Jung, P, Baumann, K, Lehnert, L. W, Samolov, E, Achilles, S, Schermer, M, Wraase, L. M, Eckhardt, K.-U, Bader, M. Y, Leinweber, P, Karsten, U, Bendix, J, Büdel, B (2019) Desert breath—How fog promotes a novel type of soil biocenosis, forming the coastal Atacama Desert's living skin. Geobiology 18, 113-124, doi 10.1111/gbi.12368

Jung, P, Schermer, M, Briegel-Williams, L, Baumann, K, Leinweber, P, Karsten, U, Lehnert, L, Achilles, S, Bendix, J, Büdel, B (2019) Water availability shapes edaphic and lithic cyanobacterial communities in the Atacama Desert. J Phycol 55, 1306-1318, doi 10.1111/jpy.12908

Kahle, P. Bauwe, A, Lennartz, B (2019) P-Austräge aus dränierten landwirtschaftlichen genutzten Böden und Möglichkeiten zur Minderung. KW Korrespondenz Wasserwirtschaft 3/2019, 148-153

Kiobia, D, Graef, H, Reuben, P, Kahimba, F, Graef, F, Eichler-Löbermann, B. Silayo, V (2019) Combining biochar with low rate of chemical fertiliser boosts maize biomass yield, regardless of tillage system, under humid conditions. J Agric Rural Developm Tropics Subtropics (JARTS) 120 (1), 55-62

Koch, S, Kahle, P, Lennartz, B (2019) Biogas digestate application modifies solute transport conditions in soils and increases the release of phosphorus. Vadose Zone Journal 18:190031, doi 10.2136/vzj2019.03.0031

Koning, L A, de Mol, F, Gerowitt, B (2019) Effects of management by glyphosate or tillage on the weed vegetation in a field experiment. Soil Tillage Res 186, 79-86, doi 10.1016/j.still.2018.10.012

Leinweber, P, Hagemann, P, Kebelmann, L, Kebelmann, K, Morshedizad, M (2019) Bone char as a novel phosphorus fertilizer. In: Ohtake H, Tsuneda S (eds) Phosphorus recovery and recycling. Springer, Singapore: 419-432, doi 10.1007/978-981-10-8031-9_29

Lennartz, B (2019) Phosphor - von der Quelle bis ins Meer (Editorial) KW Korrespondenz Wasserwirtschaft 3/2019, 121

Liu, X, de Vries, J.G, Werner, T (2019) Transfer hydrogenation of cyclic carbonates and polycarbonate to methanol and diols by iron pincer catalysts. Green Chem. 21, 5248-5255, doi 10.1039/C9GC02052G (Part of the themed web collection on the International Symposium on Green Chemistry 2019)

Löffler, N, Fiebig, J, Mulch, A, Tütken, T, Schmidt, B.C, Bajnai, D, Conrad, A.C, Wacker, U, Böttcher, M.E (2019) Refining the temperature dependence of the oxygen and clumped isotope partitioning during formation of carbonate-bearing hydroxy-apatite. Geochim Cosmochim Acta, 253, 19-38, doi 10.1016/j.gca.2019.03.002

Longwitz, L, Jopp, S, Werner, T (2019) Organocatalytic chlorination of alcohols by P(III)/P(V) redox cycling. J Org Chem 84, 7863–7870, doi 10.1021/acs.joc.9b00741

Longwitz, L, Spannenberg, A, Werner, T (2019) Phosphetane oxides as redox cycling catalysts in the catalytic Wittig reaction at room temperature. ACS Catal 9, 10, 9237-9244, doi 10.1021/acscatal.9b02456

Longwitz, L, Werner, T (2019) Recent advances in catalytic Wittig-type reactions based on P(III)/P(V) redox cycling. Pure Appl Chem 91, 95–102, doi 10.1515/pac-2018-0920

Longwitz, L, Werner, T (2019) The Mitsunobu reaction, reimagined. Science Vol. 365, Issue 6456, 866-867, doi 10.1126/science.aay6635

López Sánchez, R.C, Eichler-Löbermann, B, Campos Posada, R, Campos-Posada, G. and Gomez Padilla, E (2019) Selection of effectiveness of rhizobia nodulating *Macroptillium atropurpureum* under salt stress. Livestock Research for Rural Development. 31, Article #26, from http://www.lrrd.org/lrrd31/2/rlope31026.html

Meyer, L.-E, Gummesson, A, Kragl, U, von Langermann, J (2019) Development of ionic liquid-water-based thermomorphic solvent (TMS)-Systems for biocatalytic reactions. Biotechnology Journal 14, 1900215, doi 10.1002/biot.201900215

Neumann, D (2019) Abschätzung der biogeochemischen Umsetzung, Sedimentation und Resuspension von Phosphorverbindungen in der Unterwarnow für Flusseinträge in der Ostsee – PhosWaM Technical Report AP1.1b. Leibniz-Institut für Ostseeforschung Warnemünde, doi 10.12754/misc-2019-0002

Palm, H. W, Knaus, U, Appelbaum, S, Strauch, S. M, Kotzen, B (2019) Coupled aquaponics systems. Aquapon Food Produc Syst 163-199, doi 10.1007/978-3-030-15943-6

Peine, M, Vitow, N, Graf, M, Baum, C, Zicker, T, Eichler-Löbermann, B, Schulz, S, Schloter, M, Leinweber, P (2019) Effect of triple superphosphate and biowaste compost on mycorrhizal colonization and enzymatic P mobilization under maize in a long-term field experiment, JPNSS 182, 167-174, doi 10.1002/jpln.201800499

Prüter, J, Leipe, T, Michalik, D, Klysubun, W., Leinweber, P (2019) Phosphorus speciation in sediments from the Baltic Sea, evaluated by a multi-method approach. J Soils Sedim doi 10.1007/s11368-019-02518-w

Reyer, H, Oster, M, Wittenburg, D, Muráni, E, Ponsuksili, S, Wimmers, K (2019) genetic contribution to variation in blood calcium, phosphorus, and alkaline phosphatase activity in pigs. Front Gen 10, 590, doi 10.3389/fgene.2019.00590

Saki, H, Alemayehu, E, Schomburg, J, Lennartz, B (2019) Halloysite nanotubes as adsorptive material for phosphate removal from aqueous solution. Water 11, 203, doi 10.3390/w11020203

Schaub, I, Baum, C, Schumann, R., Karsten, U (2019) Effects of an early successional biological soil crust from a temperate coastal sand dune (NE Germany) on soil elemental stoichiometry and phosphatase activity. Microb Ecol 77, 217-229, doi 10.1007/s00248-018-1220-2

Schaub, I, Zimmer, D, Strauch, S (2019) Nachwuchsförderung und Forschung am Leibniz-WissenschaftsCampus Phosphorforschung Rostock. Wasser und Abfall 10/2019, 40-46, doi 10.1007/s35152-019-0142-8

Schumann, A, Reiß, F, Siewert, J.-E, Jiao, H, Rabeah, J, Krummenacher, I, Braunschweig, H, Hering-Junghans, C (2019) A selective route to aryl-triphosphiranes and their titanocene-induced fragmentation. Chem. Sci. 10, 7859-7867, doi 10.1039/C9SC02322D

Sokolov, EP, Markert, S, Hinzke, T, Hirschfeld, C, Becher, D, Ponsuksili, S, Sokolova, I.M (2019) Effects of hypoxia-reoxygenation stress on mitochondrial proteome and bioenergetics of the hypoxia-tolerant marine bivalve *Crassostrea gigas*. J Proteomics 194, 99-111, doi 10.1016/j.jprot.2018.12.009

Sokolov, EP, Sokolova, IM (2019) Compatible osmolytes modulate mitochondrial function in a marine osmoconformer crassostrea gigas (Thunberg, 1793). Mitochondrion 45, 29-37, doi 10.1016/j.mito.2018.02.002

Steinfurth, K, Buczko, U (2019) Ertragswirkung von Phosphordüngung: Eine paneuropäische Metastudie. VDLUFA Kongressband 2019 Gießen, 169-175

Strauch, S.M, Bahr, J, Baßmann, B, Bischoff, A.A, Oster, M, Wasenitz, B, Palm. H.W (2019) Effects of ortho-phosphate on growth performance, welfare and product quality of juvenile african catfish (*Clarias gariepinus*). Fishes 4, 3, doi 10.3390/fishes4010003

Tonn, C, Buczko, U, Jurasinski, G (2019) Schilfröhricht als Schnittstelle zwischen Land und Wasser. Rostocker Meeresbiologische Beiträge 29, 75–84

Tränckner, J (2019) Niederschlagswasser auf landwirtschaftlichen Betriebshöfen und Biogasanlagen. Schriftenreihe Umweltingenieurwesen 88, 86-103

Tränckner, S, Stapel, C, Cramer, M, Tränckner, J (2019) Einfluss kleiner Kläranlagen auf die Gewässerbeschaffenheit hinsichtlich Phosphat im norddeutschen ländlichen Raum. KW Korrespondenz Wasserwirtschaft, 03/2019, 159-165

Tränckner, S, Niendorf, J (2019) Phosphorelimination in kleinen Kläranlagen durch nachgeschaltete alkalische Fällungsfiltration. Schriftenreihe Umweltingenieurwesen 88, 29-38

Vortmeyer-Kley, R, Lünsmann, B, Berthold, M, Gräwe, U, Feudel, U (2019) Eddies: fluid dynamical niches or transporters? - A case study in the Western Baltic Sea. Front. Mar. Sci. 6, 118, doi 10.3389/fmars.2019.00118

Wacker-Fester, K, Uptmoor, R, Pfahler, V, Dehmer, K.J, Bachmann-Pfabe, S, Kavka, M (2019) Genotype-specific differences in phosphorus efficiency of potato (*Solanum tuberosum* L.). Front Plant Sci 10, 1029, doi 10.3389/fpls.2019.01029

Wirth, M.A, Sievers, M, Habedank, F, Kragl, U, Schulz-Bull, D.E, Kanwischer, M (2019) Electrodialysis as a sample processing tool for bulk organic matter and target pollutant analysis of seawater. Marine Chemistry 217, doi 10.1016/j.marchem.2019.103719

Wubuli, A, Reyer, H, Muráni, E, Ponsuksili, S, Wolf, P, Oster, M, Wimmers, K (2019) Tissue-Wide gene expression analysis of sodium/phosphate co-transporters in pigs. Int. J Mol Sci 20, 5576, doi 10.3390/ijms20225576

Zimmer, D, Panten, K, Frank, M, Springer, A, Leinweber, P (2019) Sulfur-enriched bone char as alternative P fertilizer: spectroscopic, wet chemical, and yield response evaluation. Agriculture 9, 21, doi 10.3390/agriculture9010021

3.5 Theses

Thesis	Institution
Dissertations	
Braun, P (2019) Phosphatakkumulation in diazotrophen, filamentösen Cyanobakterien der Ostsee	MNF, UR
Garske, B (2019) Ordnungsrechtliche und ökonomische Instrumente der Phosphor-Governance. Unter Berücksichtigung der Wirkungen auf Böden, Gewässer, Biodiversität und Klima	AUF, UR
Parra-Londono, S (2019) Characterization of the phenotypic and genomic diversity in sorghum: traits and genetic components involved in the adaptation to abiotic stress conditions	AUF, UR
Strauch, S (2019) Nutrient fluxes in commercial African catfish (*Clarias gariepinus* Burchell) recirculating aquaculture systems (RAS): Implications for aquaponics	AUF, UR
Stubenrauch, J (2019) Phosphor-Governance in ländervergleichender Perspektive: Deutschland, Costa Rica und Nicaragua. Ein Beitrag zur Nachhaltigkeits- und Bodenschutzpolitik	AUF, UR
Master Theses	
Allaf, M (2019) Einfluss von Zwischenfrüchten auf die pflanzenverfügbaren P-Gehalte im Boden in Abhängigkeit von neun Düngungsvarianten in einem Dauerfeldversuch	AUF, UR
Bickel, U (2019) Uso de plagicidas por productores familiares en Bolivia	AUF, UR

Thesis	Institution
Master Theses	
Kaminski, J (2019) Bodenökologische Bewertung von Zwischenfrüchten auf einem P-defizienten Standort	AUF, UR
Lange, C (2019) Aktivität von Bodenenzymen in unterschiedlichen Tiefen und Jahreszeiten in Abhängigkeit verschiedener Anbausysteme und Phosphor-düngung	AUF, UR
Bachelor Theses	
Kaufmann, F (2019) Einsatz von Phosphordüngern auf landwirtschaftlichen Betrieben in der Region Rostock	AUF, UR
Mielack, M (2019) Düngeversuch von Gärresten und deren Auswirkung auf Pflanzen- und Bodenparameter bei Raps	AUF, UR
Rüsch, M (2019) Beurteilung der P-Düngewirkung von Biomasseaschen an-hand der P-Aufnahme verschiedener Fruchtarten und der P-Verfügbarkeit des Bodens in einem Gefäßversuch	AUF, UR
von Wedel-Parlow, C (2019) Saatgutpillierung von Ackerfuttermischungen mit Gesteinsmehlen	AUF, UR

Abbreviations: AUF = Faculty of Agricultural and Environmental Sciences, MNF = Faculty of Mathematics and Natural Sciences, UR = University of Rostock

4 Networking

Besides interactions among its individual scientists and research groups, the P-Campus is a member of the ESPP and DPP. In addition, the P-Campus is connected with other Leibniz ScienceCampi as well as through its scientists and their thematic networks.

Deutsche Phosphor Plattform (DPP) – Participation in general assembly (25.09.2019, Dr. D. Zimmer) and annual forum (26.09.2019, Dr. D. Zimmer) in Frankfurt/Main.

Networking meeting of the coordinators of the Leibniz ScienceCampi, Berlin, 26.11.2019 (Dr. M. Oster).

Meeting with representatives of the new Leibniz ScienceCampus ComBioCat (20.08.2019: Dr. D. Zimmer; 19.11.2019: Prof. U. Bathmann, PD Dr. T. Werner, Dr. D. Zimmer).

5 Events

Different kind of events were held, e.g. to promote networking and interdisciplinary co-operation within the P-Campus but also with external scientists, authorities, and the general public. Events are listed in the following.

5.1 Public Events

Symposium of the Leibniz ScienceCampus Phosphorus Research Rostock, 26.04.2019 at the Leibniz Institute for Catalysis (LIKAT)

Meeting of scientists of the P-Campus with journalists of the German Science Journalists' Association within the scope of the research trip "Phosphorus – and future of agriculture" at FBN, University of Rostock (AUF) and IOW, 24.-25.09.2019

International Symposium of the Leibniz ScienceCampus Phosphorus Research Rostock, 12.-13.11.2019, at the Leibniz Institute for Baltic Sea Research (IOW), Warnemünde

5.2 Internal Meetings and Workshops

Internal meetings and workshops facilitate intensive networking and thematic exchanges between scientists of the P-Campus. In addition to various events for graduate/doctoral students, an annual campus-symposium is held in which all scientists introduce their new projects, present their work, and discuss the results. The Steering Group of the P-Campus meets roughly every 3 months to discuss overarching issues as well as the strategic orientation and further development of the P-Campus.

Meetings of the steering group of the P-Campus: 10.01.19, 01.04.19, 09.05.19, 28.06.19, 03.09.19, 28.10.19

"P Breakfast" to promote exchanges among PhD students of the P-Campus, taking place at the various partner institutes including presentation of the P research on-site: 22.03.2019 (University of Rostock, AUF), 17.12.2019 (University of Rostock, MNF)

Start-Workshop "P Analytics" for the new PhD students of the P-Campus, 26.-29.11.2019 at the Biological Station Zingst

6 Public Relations

The P-Campus and the research of its members have been introduced to external research groups, politicians, government and the general public. A selection of the related events is provided below.

6.1 Oral Presentations (Selection)

IPW9, 8 – 12 July 2019, Zurich, Switzerland

B. Eichler-Löbermann et al. Phosphorus pools in the soil profil – results of different fertilizer practices over 20 years

F. Ekardt et al. Animal food, land use governance, and P governance

M. Oster et al. Molecular determinants of phosphorus utilization in pigs

M. Pallentin et al. Determination of athmospheric phosphorus deposition in the German part of the Baltic Sea

J. Stubenrauch et al. P governance from a cross-national perspective

PhosWaM Final Workshop, 17 – 18 September 2019, Rostock, Germany

U. Buczko et al. Evaluation of the impact of agronomic measures on agricultural P-discharge with a P index approach

M. Nausch et al. Phosphorus concentrations along the river Warnow discharching to the Baltic Sea

D. Neumann et al. Modelling processing and transport of phosphorus compounds from the Warnow river in the bay of Mecklenburg

L. Rönspieß et al. Estuarine phosphorus transformation, retention and bioavailability: an example from the southern Baltic Sea

J. Tränckner et al. Determination of P-discharge and optimization possibilities for P retention in small sewage treatment plants

Annual Meeting of the German Soil Science Society (DBG), 24 – 29 August 2019, Bern, Switzerland

K. Baumann et al. Biocrusts - The Atacama Desert‘s unexpected living skin

A. Zacher et al. Einfluss des Anbaus von Serradella als Zwischenfrucht auf die P-Mobilisierung im Boden

12th Rostocker Abwassertagung: Emissionsminderung von Punktquellen im ländlichen Raum, **10 September 2019, Rostock, Germany**

J. Tränckner et al. Niederschlagswasser auf landwirtschaftlichen Betriebshöfen und Biogasanlagen

S. Tränckner et al. Phosphorelimination in kleinen Kläranlagen durch nachgeschaltete alkalische Fällungsfiltration

Conference of the Umbrella Association Agricultural Research, 10 October 2019, Berlin, Germany

C. Baum. Perspektiven für die verbesserte Nutzung der Mykorrhizierung: Chancen und Grenzen

U. Buczko. Düngewirkung von Phosphat auf Basis einer Metastudie über langjährige P-Düngungsversuche

F. Ekardt. Phosphor als Problem von Politik und Recht

P. Leinweber. Phosphor im System „Boden Pflanze Gewässer: Grundlagen und aktuelle Forschungsprobleme“

B. Lennartz. P-Verlagerung in Böden und Landschaften des Norddeutschen Tieflands

Other Events

B. Eichler-Löbermann. Wirkungen von Kompost – Ergebnisse eines Dauerversuchs. 21st Fachtagung of the VHE-Nord e.V., 05.06.2019, Rostock, Germany

M. Nelles et al. Optionen für die künftige Entsorgung von Klärschlamm in Mecklenburg-Vorpommern. DGAW Regionalveranstaltung, 19.06.2019, Neuruppin, Germany

H. Reyer, M. Oster, D. Wittenburg, E. Murani, S. Ponsuksili, K. Wimmers. Molecular drivers of the phosphorus homeostasis in pigs. EAAP - 70th annual meeting, 26.-30.08.2019, Ghent, Belgium

J. Stubenrauch, F. Ekardt. Agriculture-related Climate Policies – Law and Governance Issues on European and Global Level. European Environmental Law Forum conference: Environmental Law for Transitions to Sustainability, 28. - 30.08.19, Utrecht, Netherlands

B. Eichler-Löbermann et al. Yield development and soil fertility – results of different phosphorus fertilizer practices over 20 years. DOK-Monte Verità, 6. – 11.10.2019, Ascona, Switzerland

K. Wimmers. Tiere verstehen - Was unsere Nutztiere können, wollen und brauchen. Urania Berlin, 15.10.2019, Berlin, Germany

U. Bathmann (as spokesperson of the P-Campus) as well as H. Jarvie and C. Müller (members of the scientific advisory council of the P-Campus) held a presentation at the event "Die Zukunft der interdisziplinären Forschung" (Engl. the future of the interdisciplinary research) on the subject of "Begrenzte Ressourcen und wie wir mit ihnen umgehen sollten" (Engl. limited resources and how we should handle them) and participated in the panel discussion, 11.11.2019, within the scope of the 600 years anniversary of the University of Rostock

M. Oster, H. Reyer, C. Gerlinger, A. Wubuli, B. Vollmar, P. Wolf, K. Wimmers. Effekte einer differentiellen Phosphorversorgung bei Monogastriern. 15. Tagung Schweine- und Geflügelernährung, 19. - 21.11.2019, Lutherstadt Wittenberg, Germany

D. Zimmer, T. Werner, M. Kanwischer, M. Wirth. presentations about the current status of research in the P-Campus in front of representatives of the Ministry of Education and the Ministry of Agriculture MV, 11.12.2019

6.2 Posters (Selection)

IPW9, 8 – 12 July 2019, Zurich, Switzerland

A. Ahmed et al. New insights into IR spectroscopic characterization of phosphate binding at the goethite-water interface

B. Garske et al. Regulatory and Economic Instruments of Phosphorus Governance

M. Kavka et al. Root system architecture of potato after cultivation in different phosphorus fertilizer treatments

P. Koal et al. Replacing conventional phosphorus fertilisers with biomass ashes: fertilisation effect of straw ashes on different crops

P. Leinweber et al. Weathering of bone char particles and P-release in a perennial pot experiment sowie InnoSoilPhos: advances in the understanding and managing of agricultural phosphorus use

M. Nausch et al. Phosphorus concentrations and composition along a lowland river in northeast German catchment discharching to the Baltic Sea

L. Rönspiess et al. Different phosphorus fractions – how bioavailable are they?

K. Steinfurth et al. Comparibility of the Calcium-Acetate-Lactate and Double-Lactate extraction methods to assess soil phopshorus fertility sowie Yield response to omitted phopshorus fertilization – results of a meta-study

T. Zicker et al. Long-term application of biogas digestates affects phosphorus pools in the soil profile

D. Zimmer et al. Leibniz-ScienceCampus Phosphorus Research Rostock

Annual Meeting of the German Soil Science Society (DBG), 24 – 29 August 2019, Bern, Switzerland

M. Peine et al. Einfluss von Bioporen auf die P-Mobilisierung in Ackerböden

J. Prüter et al. Umsetzungsprozesse und Reaktionen von Phosphorverbindungen entlang verschiedener Transekte von Böden und Sedimenten in der nordostdeutschen Küstenregion

D. Zimmer et al. Forschung im Leibniz-WissenschaftsCampus Phosphorforschung Rostock

6.3 Press

Regionale Schwerpunktsetzung mit internationaler Strahlkraft – Press Release of the Leibniz Association, 02.04.2019

Millionenförderung für Rostocker Phosphorforschung – Article on welt.de, 09.04.2019

Weitere vier Jahre Förderung für Rostocker Leibniz-WissenschaftsCampus Phosphorforschung – Press Release of the Leibniz ScienceCampus Phosphorus Research Rostock, 09.04.2019

Nährstoffbelastung im Blick: Rostocker erforschen Qualität der Küstengewässer - Article on svz.de, 29.07.2019

Nachwuchsförderung und Forschung am Leibniz-WissenschaftsCampus Phosphorforschung Rostock - Article in Wasser und Abfall No. 10/2019, pp. 40-46, October 2019

Phosphorwirkung von Kompost – Article in Humuswirtschaft & Kompost, Q3 2019, pp. 1 – 2, 10.10.2019

Phosphor-Campus-Symposium in Warnemünde – TV report on NDR about the P-Campus Symposium, 15.11.2019

6.4 Websites

Leibniz ScienceCampus Phosphorus Research Rostock: www.wissenschaftscampus-rostock.de (www.sciencecampus-rostock.de | www.p-campus-rostock.de)

Leibniz-Association/ScienceCampi: www.leibniz-gemeinschaft.de/en/research/leibniz-sciencecampi/phosphorous-research

6.5 Others

D. Zimmer, C. Gerlinger, J. Prüter, L. Rönspieß. Information point and presentation of the Leibniz ScienceCampus Phosphorus Research Rostock at the Long Night of Sciences, University of Rostock, 25.04.2019

D. Zimmer. presentation of the Leibniz ScienceCampus Phosphorus Research Rostock (funding period 2) at the Research Camp of the University of Rostock, 21.11.2019

7 Structure and Committees

7.1 Structure

The Leibniz ScienceCampus Phosphorus Research Rostock is assigned to the University of Rostock's Interdisciplinary Faculty (INF), Department of Maritime Systems.

The organisation of the Leibniz ScienceCampus Phosphorus Research Rostock is as follows: The **Directorship** is made up of the Directors of the participating Leibniz Institutes and the Rector of the University of Rostock. They can be represented by members of their institutions. Through the **Steering Committee** representatives of the Leibniz Institutes and the University of Rostock assume direct leadership of the P-Campus. They are represented by a **Spokesperson**. Direct **coordination** is carried out by a staff scientist, supported by a secretary. An international **Scientific Advisory Council** oversees the Leibniz ScienceCampus Phosphorus Research and in addition to advising has the task of

evaluating the scientific work of the P-Campus. Currently, more than 70 scientists and 20 PhD students from 40 Working Groups are **Members** (see Partners and Members) of the P-Campus.

The Institute for Baltic Sea Research Warnemünde acts as beneficiaries and provides the coordination office.

Figure 2. Structure of the Leibniz ScienceCampus Phosphorus Research Rostock

7.2 Committees

7.2.1 Scientific Advisory Council

Prof. Dr. Emmanuel Frossard, ETH Zürich
Prof. Dr. Ellery D. Ingall, Georgia Institute of Technology
Prof. Dr. Helen Jarvie, Centre for Ecology & Hydrology (CEH), UK
Prof. Dr. Christian Müller, FU Berlin
Prof. Dr. Heidrun Steinmetz, TU Kaiserslautern

7.2.2 Directorship

Prof. Dr. Ulrich Bathmann, IOW
Prof. Dr. Matthias Beller, LIKAT
Prof. Dr. Andreas Graner, IPK
Prof. Dr. Wolfgang Schareck, UR
Prof. Dr. Klaus-Dieter Weltmann, INP
Prof. Dr. Klaus Wimmers, FBN

7.2.3 Spokesperson / Deputy

Prof. Dr. Ulrich Bathmann, IOW
Prof. Dr. Peter Leinweber, UR (spokesperson of the university)

7.2.4 Steering Committee

Prof. Dr. Ulrich Bathmann, IOW
Dr. Volker Brüser, INP
Dr. Klaus Dehmer, IPK
Prof. Dr. Bettina Eichler-Löbermann, UR
PD Dr. Dagmar-Christiane Fischer, UniMed Rostock
Dr. Marion Kanwischer, IOW

Prof. Dr. Ulf Karsten, UR
Prof. Dr. Udo Kragl, UR
Prof. Dr. Peter Leinweber, UR
Dr. Carsten Mönnig, P-Campus (until 01/2019)
Prof. Dr. Inna Sokolova, UR
PD Dr. Thomas Werner, LIKAT
Prof. Dr. Klaus Wimmers, FBN
Dr. Dana Zimmer, P-Campus

Substitutes:
Dr. Silvia Bachmann-Pfabe, IPK
PD Dr. Tom Goldammer, FBN
Dr. Christian Hering-Junghans, LIKAT
Dr. Stephan Reuter, INP
Prof. Dr. Axel Schulz, UR/LIKAT

7.2.5 Coordination Office

(Work and tasks 2019: see Appendix)
Dr. Carsten Mönnig (until January 2019), Dr. Dana Zimmer (since 15.10.2018) (Coordinator)
Daniela Derlet-Eichler (until 30.06.2019), Maxi Hoche (since 01.09.2019) (Secretary)

7.2.6 Members

(Status: Updated during 2019)

Leibniz Institute for Catalysis (LIKAT) at the University of Rostock

Prof. Dr. Matthias Beller	Applied Homogeneous Catalysis	Cluster III
Prof. Dr. Armin Börner	Asymmetric Catalysis	Cluster III
Prof. Dr. Marko Hapke	Cycloadditions and Transition Metal Catalysis	Cluster III
Dr. Christian Hering-Junghans	Small Molecule Activation	Cluster III
Yuya Hu	Organocatalysis	Cluster III
Lars Longwitz	Organocatalysis	Cluster III
Dr. Dirk Michalik	Analytical Service	Cluster III
Prof. Dr. Uwe Rosenthal	Coordination Chemistry and Catalysis	Cluster III
PD Dr. Thomas Werner	Organocatalysis	Cluster III

Leibniz Institute for Farm Animal Biology (FBN), Dummerstorf

Christian Gerlinger	Genome Biology	Cluster II
PD Dr. Tom Goldammer	Genome Biology	Cluster II
Franziska Just	Genome Biology	Cluster II
Prof. Dr. Cornelia Metges	Institute of Nutritional Physiology "Oskar Kellner"	Cluster II
Dr. Michael Oster	Genome Biology	Cluster II
Mohammad Seyed Almoosavi	Institute of Nutritional Physiology "Oskar Kellner"	Cluster II
Prof. Dr. Klaus Wimmers	Genome Biology / Director	Cluster II
Dr. Siriluck Wimmers	Functional Genome Analysis	Cluster II

Leibniz-Institute for Baltic Sea Research (IOW)

Directorate

Prof. Dr. Ulrich Bathmann	Director	Cluster I
Dr. Evgeny Sokolov	Directorate	Cluster IV
Dr.Dana Zimmer	Coordination Office	Cluster II

Department Biological Oceanography

Philipp Braun	Microbial Processes and Phosphorus Cycle	Cluster I
Dr. Monika Nausch	Microbial Processes and Phosphorus Cycle	Cluster I
Dr. Angela Vogts	NanoSIMS Lab	Q

Department Marine Geology

Prof. Dr. Michael Böttcher	Geochemistry and Stable Isotope Biogeochemistry	Cluster I, Q
Dr. Thomas Leipe	Microanalysis	Cluster I, Q

Department Marine Chemistry

Dr. Marion Kanwischer	Organic Contaminants	Cluster I, Q
Dr. Günther Nausch	General Marine Chemistry	Cluster I, Q
Constantin Recknagel	Organic Contaminants	Cluster I, Q
Lisa Rönspieß	General Marine Chemistry	Cluster I, Q
Dr. Oliver Schmale	Biogeochemistry Trace Gases	Cluster I, Q
Prof. Dr. Detlef Schulz-Bull	Organic Contaminants	Cluster I, Q
Marisa Wirth	Organic Contaminants	Cluster I, Q

Department Physical Oceanography and Instrumentation

Dr. Daniel Neumann	Marine biogeochemical modeling	Cluster I
Dr. Thomas Neumann	Baltic Sea system dynamics	Cluster I
Dr. Hagen Radtke	Baltic Sea system dynamics	Cluster I

Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Satellite Collections North, Groß Lüsewitz

Dr. Silvia Bachmann-Pfabe	Genebank, Satellite Collections North	Cluster II
Dr. Christine Brandt	Genebank, Satellite Collections North	Cluster II
Dr. Klaus Dehmer	Genebank, Satellite Collections North	Cluster II
Prof. Dr. Andreas Graner	Director	Cluster II
Mousumi Hazarika	Genebank, Satellite Collections North	Cluster II
Yue Hu	Genebank, Satellite Collections North	Cluster II

Leibniz Institute for Plasma Science and Technology (INP), Greifswald

Dr. Volker Brüser	Catalytic Materials	Cluster II
Sina Jahanbakhsh	Catalytic Materials	Cluster II
Prof. Dr. Klaus-Dieter Weltmann	Director	

University of Rostock (UR)

Faculty of Agricultural and Environmental Sciences

PD Dr. Christel Baum	Soil Science	Cluster II
Dr. Karen Baumann	Soil Science	Cluster II
Dr. Adrian Bischoff-Lang	Aquaculture and Sea-Ranching	Cluster I, II
Dr. Uwe Buczko	Landscape Ecology and Site Evaluation	Cluster I
Dr. Jörg Burgstaler	Agricultural Technology and Process Engineering	Cluster II
Michael Cramer	Water Resources Management	Cluster II
Dr. Carsten Croonenbroeck	Agricultural Economics	Cluster II
apl. Prof. Dr. Bettina Eichler-Löbermann	Agronomy	Cluster II
Beatrice Garske	Research Unit Sustainability and Climate Policy	Cluster II
Prof. Dr. Bärbel Gerowitt	Crop Health	Cluster II
Dr. Manuela Görs	Soil Science	Cluster II
Peter Gros	Soil Science	Cluster II
Sebastian Heller	Grassland and Fodder Sciences	Cluster I
Katharina Heyl	Research Unit Sustainability and Climate Policy	Cluster V
Prof. Dr. Florian Jansen	Landscape Ecology and Site Evaluation	Cluster I
Dr. Petra Kahle	Soil Physics	Cluster I, II
Dr. Mareike Kavka	Agronomy	Cluster II
Prof. Dr. Norbert Kanswohl	Agricultural Technology and Process Engineering	Cluster II
Dipl. Agr.-Ing. Ulrich Knaus	Aquaculture and Sea-Ranching	Cluster I, II
Philipp Koal	Agronomy	Cluster II
Dr. Stefan Koch	Soil Physics	Cluster I
Prof. Dr. Peter Leinweber	Soil Science	Cluster II,Q
Prof. Dr. Bernd Lennartz	Soil Physics	Cluster I, II
Dr. Gert Morscheck	Waste Management and Material Flow	Cluster II
Mohsen Morshedizad	Soil Science	Cluster II
Dr. Jürgen Müller	Landscape Ecology and Site Evaluation	Cluster I
Prof. Dr. Michael Nelles	Waste Management and Material Flow	Cluster II
Prof. Dr. Harry Palm	Aquaculture and Sea-Ranching	Cluster I, II
Julia Prüter	Soil Science	Cluster I, Q
Jonathan Schleyken	Water Resources Management	Cluster II
Jessica Stubenrauch	Research Unit Sustainability and Climate Policy	Cluster II
Prof. Dr. Jens Tränckner	Water Resources Management	Cluster II
Prof. Dr. Ralf Uptmoor	Agronomy	Cluster II
Jutta Wieding	Research Unit Sustainability and Climate Policy	Cluster II
Paul Winklhofer	Crop Health	Cluster II
Prof. Dr. Petra Wolf	Nutrient Physiology and Animal Nutrition	Cluster II

Prof. Dr. Nicole Wrage-Mönnig	Grassland and Fodder Sciences	Cluster II
Annika Zacher	Soil Science	Cluster II
Theresa Zicker	Agronomy	Cluster II

Faculty of Law

Prof. Felix Ekardt	Research Unit Sustainability and Climate Policy	Cluster II

Faculty of Mathematics and Natural Sciences

Dr. Ashour Ahmed	Institute of Physics, Molecular Quantum Dynamics	Cluster Q
Martin Albrecht	Institute for Biological Sciences, Applied Ecology & Phycology	Cluster I
Maximilian Berthold	Institute for Biological Sciences, Applied Ecology & Phycology	Cluster I, Q
Dr. Jonas Bresien	Institute for Chemistry, Anorganic Chemistry	Cluster III
PD Dr. Stefan Forster	Institute for Biological Sciences, Marine Biology	Cluster I
Dr. Karin Glaser	Institute for Biological Sciences, Applied Ecology & Phycology	Cluster I
Prof. Dr. Martin Hagemann	Institute for Biological Sciences, Animal Physiol-ogy	Cluster II
Sandra Kammann	Institute for Biological Sciences, Applied Ecology & Phycology	Cluster IV
Prof. Ulf Karsten	Institute for Biological Sciences, Applied Ecology & Phycology	Cluster I, II
Prof. Udo Kragl	Institute for Chemistry, Analytical & Technical Chemistry; Technical Chemistry	Cluster III
Prof. Oliver Kühn	Institute of Physics, Molecular Quantum Dynamics	Q
Iris Schaub	Institute for Biological Sciences, Applied Ecology & Phycology	Cluster I
Prof. Dr. Axel Schulz	Institute for Chemistry, Anorganic Chemistry	Cluster III
PD Dr. Rhena Schumann	Institute for Biological Sciences, Applied Ecology & Phycology, Biological Station Zingst	Cluster I, Q
Prof. Dr. Inna Sokolova	Marine Biology	Cluster II
Dr. Jan von Langermann	Institute for Chemistry, Biocatalysis	Cluster III

Rostock University Medical Center

PD Dr. Hugo Murua Esco-bar	Hematology, oncology and palliative care	Cluster III
PD Dr. Dagmar-Christiane Fischer	Pediatric Clinic, Experimental Pediatrics Group	Cluster II
Prof. Brigitte Vollmar	Institute for Experimental Surgery, University Medicine Rostock	Cluster II

8 Funding

In 2019, the P-Campus was funded by the Ministry of Education Mecklenburg-Vorpommern, by the Leibniz Association and by substantial contributions from the participating Leibniz Institutes and the University of Rostock. External funding by third parties for phosphorus research at the P-Campus was obtained as well (see table 1).

Funds from the Ministry of Education Mecklenburg-Vorpommern (about € 120,000 in 2019) were used mainly to finance the Coordination Office of the P-Campus. Since 2014, the Coordination Office, located at the IOW, has consisted of two employees: a scientist and a secretary.

Since 2015, the P-Campus had an amount of € 1.2 million at his disposal, provided by the Leibniz Association, to be distributed over a period of 4 years to i.a. partially fund 11 interdisciplinary PhD projects. From June 2019 on, the Leibniz Association provides a total amount of € 1.13 million within the scope of the second funding period of the P-Campus.

APPENDIX

Leibniz ScienceCampus Phosphorus Research Rostock

Tasks of the Coordination Office 2019

In the following, the activities and thematic foci of the Coordination Office of the Leibniz ScienceCampus Phosphorus Research Rostock in 2019 are described. The Office is staffed by Dr. Dana Zimmer (scientific coordinator) since mid-October 2018. The position of the administrative assistant was vacant since July 2019 and is staffed by Maxi Hoche since September 2019. The focus of the Coordination Office's work was, as before, the coordination of the partner institutions and its individual members, research foci and projects, but additionally the successful organization of the start of the new funding phase of the Leibniz Association from June 2019 on.

Other tasks included i.a. the external representation of the P-Campus (e.g. Long Night of Sciences on 25 April 2019), the preparation of reports and emails providing information to interested parties, the organization of other events of different formats (e.g. lecture series during summer semester 2019 "Die Wege des Phosphors in der Umwelt und Möglichkeiten der P-Nutzung") and financial management (together with the administration department of the IOW). The work was carried out in close coordination with the spokesperson and the Steering Group of the P-Campus.

In the following, the priorities of the Coordination Office, including its function as a contact point, provider of support in the development of research project proposals, coordinator of the graduate school, event organizer as well as its public relations tasks are described in detail.

Contact point

The Coordination Office of the P-Campus is the linchpin for networking, both within the P-Campus and externally, at national and international levels.

In 2019, the Coordination Office continued to serve as a contact for all members of the P-Campus, new members and external persons and handled external inquiries, and forwarded targeted information to the relevant members/member groups. By mediating both internal and external contacts, the office supported networking among scientists. Moreover, in 2019, the admission of so-called associated members to the P-Campus was organized (i.a. preparing application for admission and contract for associated membership). At the turn of the year 2019/2020, two contracts were prepared, so that one of them is circulating to be signed (University of Copenhagen) and the other one needs final details (Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)). Scientists of other research institutes, which deal with the topic phosphorus and are in close contact with regular members of the P-Campus, can become associated members. The admission of associated members conduces to an increasing external networking of P-Campus scientists and the internationalization of contacts. Contacts with external research institutes, ministries and authorities were regularly maintained (e.g. 11.12.2019 presentation of recent research results of the P-Campus to ministry members).

Due to the extension of the research clusters and since especially a gender-neutral orientation of the P-Campus should be experienced, as it is established in the guidelines of the Leibniz institutes and the University of Rostock, an extension of the

steering committee with the focus on applications of women was organized and successfully realized. Since April 2019 three more women are members of the steering committee of the P-Campus (Prof. Dr. I. Sokolova, PD Dr. D.-C. Fischer, Prof. Dr. B. Eichler-Löbermann).

Contacts to other networks were intensified, for example to the network Interdisciplinary Faculty (INF) and the DFG Graduate College Baltic Transcoast of the University of Rostock and by membership in the participation in meetings of the DPP. The organized DPP event at the faculty of agricultural and environmental sciences on the 22 August 2019 unfortunately could not take place because of too few participants (due to the long journey to northern Germany).The coordination of the P-Campus participated in the meeting of members and the forum of the DPP on 25-26 September 2019. On the 1 October 2019, the Leibniz ScienceCampus ComBioCat started as cooperation between the University of Rostock (Institute of Chemistry) and the LIKAT. During the fourth quarter, several meetings with representatives of this Campus took place, so that on the one hand, the new ScienceCampus could benefit from the experiences of the P-Campus and, on the other hand, to consider to what extent common events respectively cooperations are possible and sensible.

Research topics and initiatives

The P-Campus thrives on the continuous initiatives of its scientists in developing research themes and ideas and in considering proposals for their realization. A first tender for seed projects for the second funding period of the P-Campus was organized in May 2019. The funding of six new seed projects could be promised by the P-Campus with the official start of the second funding period in June 2019. Three of these projects can (partly) be allocated to the new cluster IV "Molecular Biology of P". This successful concept of the seed projects is also borrowed and extended for the second funding phase from 2019 on. The next call for tender is planned for 2020/21.

To facilitate the application for seed projects, the assumption of travel and publishing costs but also the report of published publications and granted projects for the P-Campus members, old templates were improved respectively new templates were created. Since there are more foreign PhD students in the second funding phase, all forms and so on were translated into English.

Structured graduate support

As young scientists are a significant part of the P-Campus network, a structured framework for their support and encouragement is offered by the P-Campus. Furthermore, feedback from the PhD students of the first graduate school (2015-2018) as well as from other funded PhD students of the P-Campus was requested and evaluated and will be realized as changes in the second graduate school (e.g. extension in the supervision agreement, provision of a guideline for the new PhD students).

The Coordination Office is responsible for the coordination and administration of the new graduate school and will organize several events and other networking opportunities for the PhD students again. Since June 2019, the new PhD students are being gradually employed (last employment planned for June 2020). Since several PhD students were employed just in October respectively November 2019, the start-workshop 'P analytics' was organized for November 2019 (CW 48) and the P Breakfast was organized and supervised by the Coordination Office on the 17 December

2019. Some of the PhD students could already present their concept as poster or speech at the International P-Campus Symposium (12-13 Nov 2019 at IOW). The P-Campus also co-financed the participation in IPW9 (July 2019) and a research stay at the ETH Zurich (Nov 2019) for two new PhD students.

Event organization

The events organized and guided by the Coordination Office are an important basis not only for networking but also for the internal and external representation of the P-Campus.

Among the regular activities that took place in 2019 were the organization of meetings of the Steering Group of the P-Campus (including presentation of current developments, record keeping, etc.) and of breakfast gatherings of PhD students of the P-Campus, which promoted mutual exchanges. For that reason, a "P Breakfast" for (former) PhD students was organized in March and December 2019 to receive feedback and improvement suggestions for the new graduate school (see above). This very well adopted concept, which includes all PhD students (also the ones not being funded), shall be continued during the second funding phase. For the summer semester 2019 the lecture series "Die Wege des Phosphors in der Umwelt und Möglichkeiten der P-Nutzung", consisting of six lectures, was organized and supervised by the Coordination Office. The first P breakfast with the new PhD students (and a few "older" ones) took place in December 2019 (as mentioned above), since around half of the PhD students were employed at this time. Furthermore, the P-Campus Symposium (compiling the program, invitation, catering etc.) took place twice in 2019; the first time in April 2019 including a presentation of the concept und topics of the new graduate school and the second time in November 2019 as international symposium with participation of the international scientific advisory council.

Public relations

The P-Campus is a prominent research network among six partner institutions in Mecklenburg-Vorpommern and is represented not only regionally but also nationally and internationally. The Coordination Office is responsible for the presentation of the P-Campus at various events and in the media (articles, interviews). For this reason, e.g. a former PhD student of the P-Campus Graduate School was employed to write, in close collaboration with the Coordination Office, an article about the first Graduate School for the journal "Wasser und Abfall". The article was published in October 2019.

Moreover, the development of information (handouts, posters, presentations) about the P-Campus is part of the tasks of the Coordination Office. That also means that members of the P-Campus are actively addressed to represent the P-Campus at interesting events (conferences, workshops etc.). Selected workshops and other small events are used to increase the level of awareness of the P-Campus and attract new members by offering P-Campus writing pads and flyers. The Coordination Office offers support related to introducing the P-Campus to external scientific groups, policy makers, authorities, and the general public through visual presentations, such as research posters.

Together with its PhD students, the P-Campus actively participated in the Long Night of Sciences at the University of Rostock. In April 2019, sources and ways of P in the

environment, the impact of P in nutrition on the (bone) health of farm animals and the impact of soil crusts and earthworms on the soil and the P availability were brought nearer to public. The coordination of the P-Campus presented the P-Campus with a poster at the open day of the IPK. The International Phosphorus Workshop (IPW9) took place in in Zurich in July and the annual meeting of the German Soil Science Society (DBG) took place in Bern in August. The coordination of the P-Campus presented the P-Campus (with the new research topics and the second graduate school) with a poster at both events. Moreover, the coordination office organized the visit of partner institutes of the P-Campus (presentations and guided tours at FBN, AUF and IOW) for journalists of the German Science Journalists' Association on 24 and 25 September 2019 within the scope of their research trip "Phosphorus – and the future of agriculture". One of the journalists published an article about the visit at the P-Campus in January 2020 in the journal 'Nachrichten aus der Chemie' (Osterath, B. "Ressourcenmanagement – Ein paar Schippchen weniger"). Prof. U. Bathmann (as spokesperson of the P-Campus) and two members of the scientific advisory council of the P-Campus took part in the event "Die Zukunft der interdisziplinären Forschung" (Engl. 'the future of the interdisciplinary research') within the scope of the 600 years anniversary of the University of Rostock in November. They held a presentation and participated in the panel discussion on the subject of "Begrenzte Ressourcen und wie wir mit ihnen umgehen sollten" (Engl. 'limited resources and how we should handle them'). A journalist of the NDR attended the International P-Campus Symposium on 12 November 2019. A TV report about the symposium and the research of the P-Campus was broadcasted as part of the 'Nordmagazin' on 15 November 2019. The coordination office presented the P-Campus and its new graduate school with a poster at the Research Camp of the University of Rostock on 21 November 2019.

The coordination office also compiles information about the P-Campus (handouts, posters, presentations). Furthermore, members are directly addressed in order to represent the P-Campus at thematically interesting events (conferences, workshops etc.). The P-Campus uses selected workshops and small events to increase the awareness level of the P-Campus and acquire new members by providing P-Campus notepads and leaflets. For example, the Antarctic workshop on 3 and 4 June 2019 (organized by P-Campus members) was provided with ballpoint pens and notepads. The Botanists Meeting (15-19 Sept 2019, also organized by P-Campus members) was also financially supported to increase the awareness level of the P-Campus. In this sense, the coordination office supports the members to present the P-Campus to extern scientist groups, policy, authorities and the general public in the form of presentations (slides) and posters.

Another important task was the design of the website of the Leibniz ScienceCampus Phosphorus Research Rostock, including content development, in coordination with relevant scientists. In 2019, the website had to be comprehensively edited due to the start of the second phase of the P-Campus. The website is updated continuously with new information from the P-Campus (e.g. new publications, P relevant events). The coordination office also compiles texts and information that allow the presentation of the P-Campus on other websites (for example, those of the DPP and the ESPP).

Cooperation Partners:

Leibniz Institute for Baltic Sea Research Warnemünde (IOW)
Prof. Dr. Ulrich Bathmann (Director)
Seestr. 15
18119 Rostock

Leibniz Institute for Catalysis (LIKAT), Rostock
Prof. Dr. Matthias Beller (Director)
Albert-Einstein-Str. 29a
18059 Rostock

Leibniz Institute for Farm Animal Biology (FBN), Dummerstorf
Prof. Dr. Klaus Wimmers (Director)
Wilhelm-Stahl-Allee 2
18196 Dummerstorf

Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Satellite Collections North, Groß Lüsewitz
Prof. Dr. Andreas Graner (Director)
Parkweg 3a
18190 Groß Lüsewitz

Leibniz Institute for Plasma Science and Technology (INP), Greifswald
Prof. Dr. Klaus-Dieter Weltmann (Director)
Felix-Hausdorff-Str. 2
17489 Greifswald

University of Rostock
Prof. Dr. Wolfgang Schareck (Rector)
Universitätsplatz
18055 Rostock

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PHOSPHORUS RESEARCH
ROSTOCK

Imprint

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Seestr. 15

18119 Rostock

Germany

info@sciencecampus-rostock.de, www.sciencecampus-rostock.de

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