Wimek update

2018-2020 | Final report

WAGENINGEN
UNIVERSITY & RESEARCH

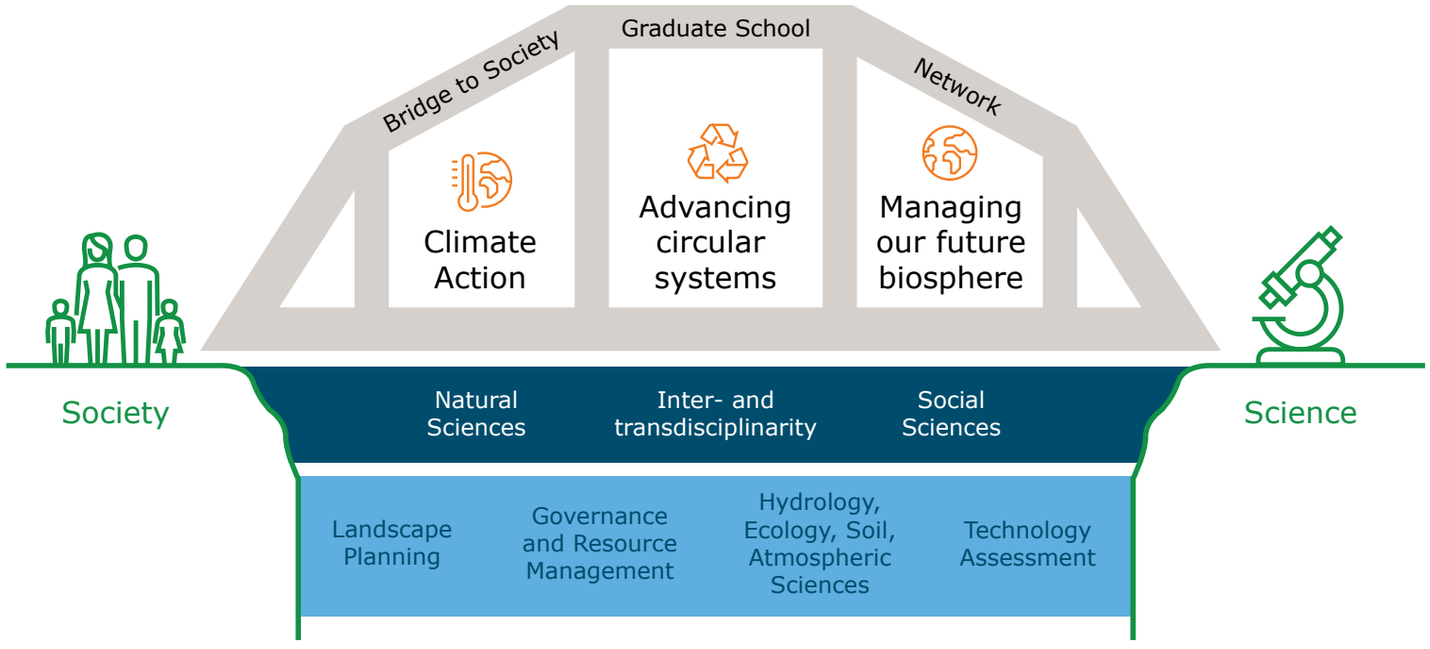
Our Position

The Wageningen Institute for Environment and Climate Research (WIMEK) is one of the six Graduate Schools at Wageningen University. Founded in 1993, WIMEK aims to boost and safeguard the quality of environmental research, provide an attractive training programme for PhD candidates and postdocs, and encourage interdisciplinary and transdisciplinary collaboration. The ultimate goal is to help our global society achieve sustainable development by promoting outstanding scientific research with impact and educating a new generation of experts on the environment and climate.

WIMEK has three main functions: it is a **school** for PhD candidates, postdocs and academic staff more generally; it functions as a **network** linking researchers at Wageningen who are working on climate and the environment; and it acts as a **bridge** between the scientists and society at large.

At present, nineteen chair groups participate in WIMEK, twelve in their entirety and the remainder in varying degrees. These groups have scientific expertise in the domains of soil, water, atmosphere, landscape, spatial planning, environmental governance, economics, policy, technology, microbiology and toxicology. About 370 PhD candidates are currently enrolled through these groups in the WIMEK Graduate School. WIMEK is also a co-founder and member of the inter-university network of Dutch environmental research groups, SENSE (the Netherlands Research School for the Socio-Economic and Natural Sciences of the Environment).

This Update introduces WIMEK, giving an overview of the organisation, the research priorities and the educational activities. It also presents some highlights from the period 2018-2020, with examples of outstanding research that give an idea of the full range of WIMEK's scientific expertise, plus notable conferences, awards and other scientific achievements during this three-year period.



Our Research

WIMEK's research focuses on finding sustainable solutions to pressing environmental problems, ranging from local to global significance. It combines fundamental, strategic, applied and participatory research in the environmental, climate and sustainability sciences. WIMEK believes that fundamental disciplinary research efforts and innovative interdisciplinary and transdisciplinary research (including with stakeholders) are all needed to arrive at results that have an impact.

WIMEK's research focuses on three Grand Challenges:

- Climate Action. Working towards fair and effective solutions for climate change mitigation and adaptation.
- Managing our Future Biosphere. Developing strategies for the sustainable use of soil, water, atmosphere, biodiversity, ecosystems and landscapes.
- Advancing Circular Systems. Innovation aimed at closed water, nutrient and material flows.

The three Grand Challenges are explained in more detail below. For each Grand Challenge, some cases from 2018-2020 are highlighted to illustrate the range of research carried out by WIMEK.

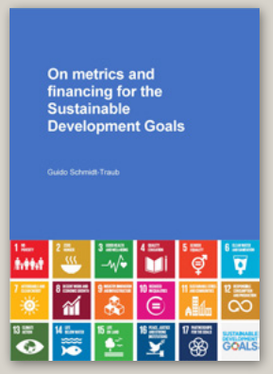
Research Highlights

Grand Challenge: Climate Action

Grand Challenge:
Managing our Future Biosphere

Grand Challenge:
Advancing Circular Systems

All theses 2018-2020



Guido Schmidt-Traub
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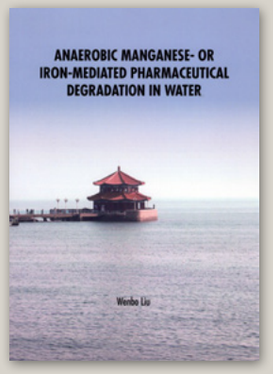
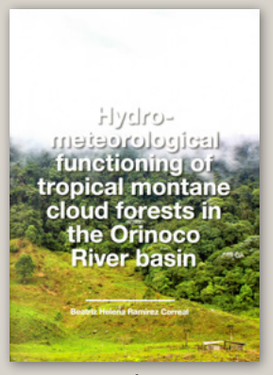
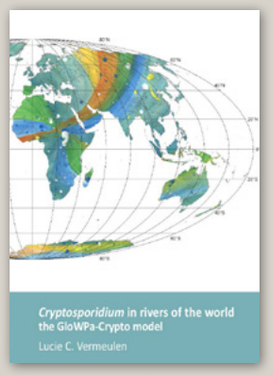


Wenbo Liu 2
6/01/2018



Beatriz Ramírez Correal
30/01/2018

Arnoud de Wilt
02/02/2018



Lucie Vermeulen
16/02/2018

Paul Roncken
14/03/2018

Research Highlights

Grand Challenge: Climate Action

Combatting climate change is one of the most pressing global challenges. Greenhouse gas emissions are increasing, weather patterns are changing, and sea levels are rising. Urgent action is needed to reduce greenhouse gas emissions (mitigation) and increase the resilience and adaptive capacity of socio-economic systems (adaptation).

WIMEK's research combines the natural and social sciences to find workable solutions for the challenges of climate change. It contributes by: gaining a better understanding of the climate system; identifying emission reduction strategies; developing nature-based climate solutions; creating climate information services; supporting the design and implementation of climate-resilient pathways; and studying new governance arrangements for adaptation and mitigation.

Case 1: Climate Information Services

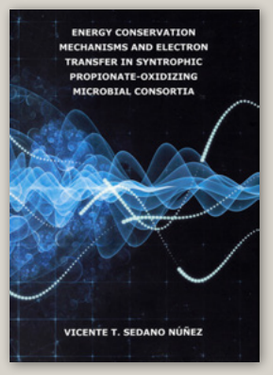
Case 2: Weather Extremes

Case 3: Longitudinal Dams

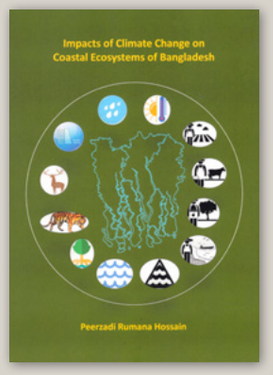
Case 4: Really Cooling Water Bodies in Cities (REALCOOL)

Case 5: Global Environmental Governance

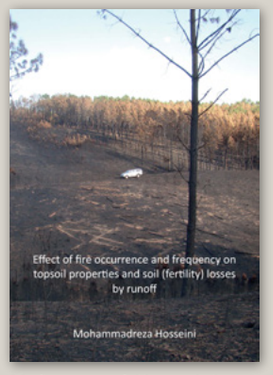
All theses 2018-2020



Vicente Sedano Núñez
03/04/2018

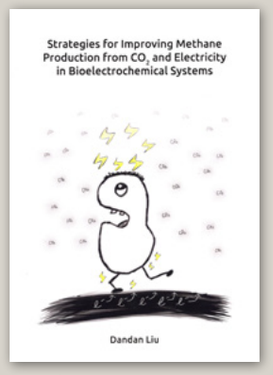


Rumana Hossain
04/04/2018



Mohammad Hosseini
09/04/2018

Jan Willem van Egmond
11/04/2018



Dandan Liu
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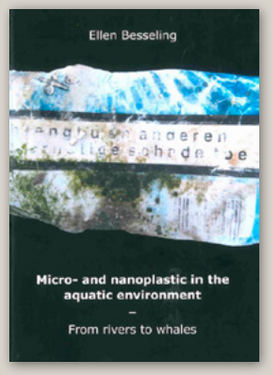


Ellen Besseling
16/04/2018

Case 1

Climate Information Services

In order to adapt to climate change, stakeholders such as farmers and water boards need actionable climate data. But such data is often not available, or it is difficult to access and to interpret. WIMEK researchers are tackling this problem with its Climate Information Services: the effects of climate change are quantified and this information is made available to a wide range of users.

The approach stands out for the central role given to users. A co-development process, in which biophysical scientists work together with social scientists and stakeholders, is used for information products. As a result, the users trust the product and are more likely to use it appropriately. This also ensures that the information is at the right spatial scale, makes projections in the right time frame and is sufficiently reliable to act upon.

Climate Information Services at the regional and global levels have allowed businesses such as Heineken and Thomas Cook, water boards, NGOs and other stakeholders to better manage their climate risks and adapt to future climate change. The research has also led to highly cited papers in leading journals. At the local level, WIMEK researchers have produced information products in collaboration with farmers in Ghana and Bangladesh. The seven-day cyclone warning system in Bangladesh, for example, lets farmers prepare for incoming cyclones by bringing in livestock from exposed fields, and taking other measures. This has substantially reduced the physical damage and financial losses from such events.

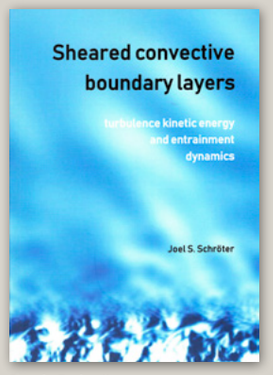
For more information | Contact Prof. Fulco Ludwig

All theses 2018-2020

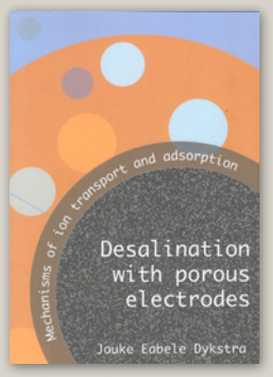
Pepijn de Vries
16/04/2018

Debora de Block
07/05/2018

Lisette Bakker
30/05/2018



Joel Schröter
05/06/2018



Jouke Dykstra
15/06/2018

Arie Staal
22/06/2018

Case 2

Weather Extremes

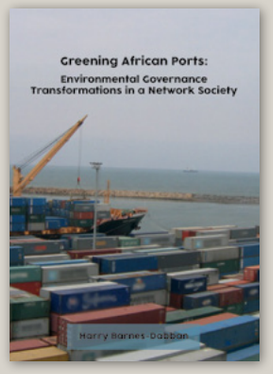
Extreme weather brings with it risks of fire, floods and air pollution. Climate change is affecting the incidence and intensity of extreme weather. There is therefore a need for a better understanding of the underlying processes and more reliable predictions of weather extremes in climate models.

WIMEK staff are tackling this challenge, focusing specifically on heatwaves and on clouds and extreme precipitation. The research is noted for the inclusion of coupled processes in the models and for the interdisciplinary approach, with meteorologists working with hydrologists and ecologists. The research on clouds and extreme precipitation examines cloud organisation over a time scale of days. The aim is to see whether there are multiple states of cloud organisation and whether critical transitions can be expected between these states with rising temperatures; this information will give a better understanding of the sensitivity of the climate. The research on heatwaves examines land-atmosphere interactions over a time scale of weeks. The aim is to understand how heatwaves are intensified by processes at the local scale and to comprehend the role played by large-scale atmospheric circulation. Studies seeking to quantify the links between heatwaves and droughts have shown that mid-latitude heatwaves in early spring impact summer droughts, while tropical wet-season droughts affect the heat in the following dry season.

This research is leading to more accurate representations of extreme weather in climate and hydrological models and more reliable weather forecasts. The WIMEK researchers are actively collaborating with meteorological organisations such as the European Centre for Medium-range Weather Forecasts, the Max Planck Institute for Meteorology and the Royal Dutch Meteorological Institute. Other potential beneficiaries are water boards, insurance companies and renewable energy companies.

For more information | Contact Dr Chiel van Heerwaarden

All theses 2018-2020



Harry Barnes-Dabban
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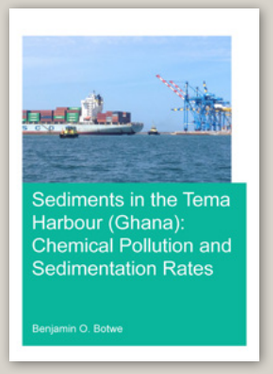

Benjamin Botwe
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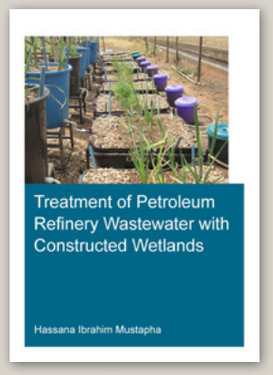

Hassana Mustapha
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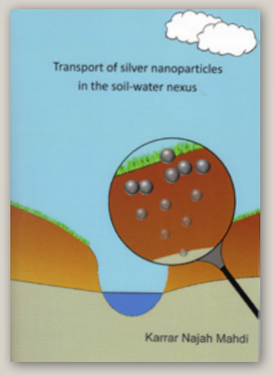

Karrar Mahdi
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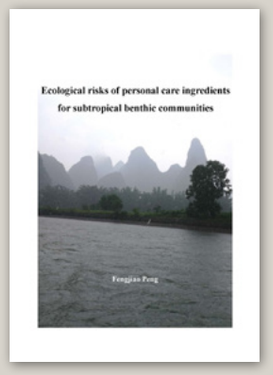

Fenjiao Peng
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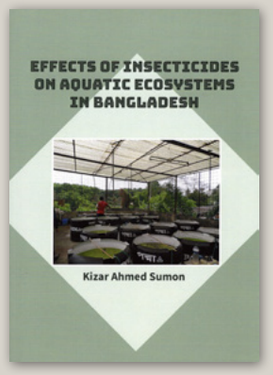


Kizar Sumon
27/08/2018

Case 3

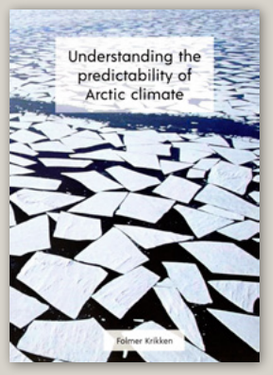
Longitudinal Dams

Dutch rivers are used intensively for commercial shipping, recreation and angling, and the river banks are an important site of biodiversity. Bank erosion and sand accretion present a constant threat to those services, while high water levels can cause safety problems. Traditionally groynes, placed perpendicular to the river bank, are used to manage water flows but they obstruct the flow during high discharges of river water. WIMEK staff are investigating longitudinal training dams as an innovative alternative.

The longitudinal dams split the river into a fairway for commercial shipping and a side channel for recreation. This approach was tested in a pilot on a ten-kilometre stretch of the River Waal and in a physical scale model in the laboratory. Measurements in the pilot study gave good indications of the flow and sediment dynamics. The model was used to test alternative designs for the inlet geometry, with the aid of a laser line scanner to measure the bed of the laboratory flume. The model showed how the geometrical properties affect the exchange of water and sediment at high and low water, and allowed a solution to be found that minimises maintenance work and avoids dangerous flow situations.

The research shows the longitudinal dam to be a promising approach that increases channel depths during low water periods, which benefits shipping, and reduces peak water levels and the risk of flooding. It also allows biodiversity to flourish along the river bank. The impact of the research is assured by a participatory process called ‘Waal Together’, initiated by the Dutch Directorate-General for Water Management, which includes representatives of the inland shipping industry and recreational users such as anglers.

For more information | Contact Prof. Ton Hoitink



Folmer Krikken
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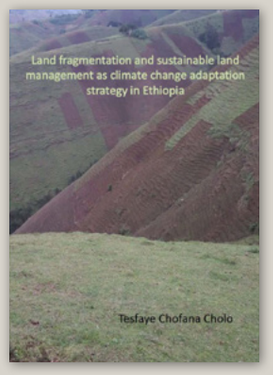

Tesfaye Chofana Cholo
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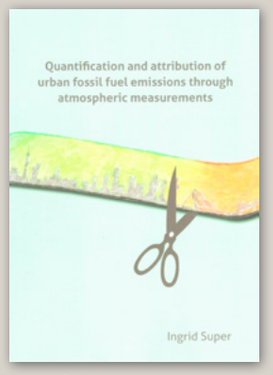
Susakul Palakawong Na Ayudthaya
07/09/2018



Ingrid Super
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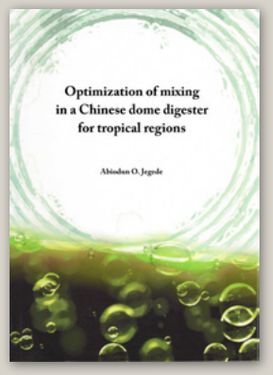

Abiodun Jegede
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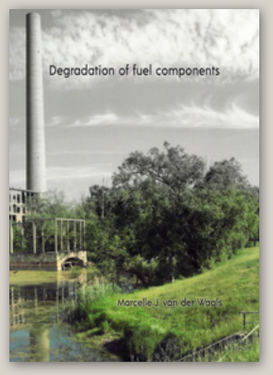


Marcelle van der Waals
18/10/2018

Case 4

Really Cooling Water Bodies in Cities (REALCOOL)

Cities can become particularly hot in summertime and there is a need for cooling elements in the urban environment. It was long thought that small bodies of water, such as canals and ponds, could have a cooling effect but recent research had thrown doubt on this. It was also not clear what effect shade, vaporisation and ventilation have.

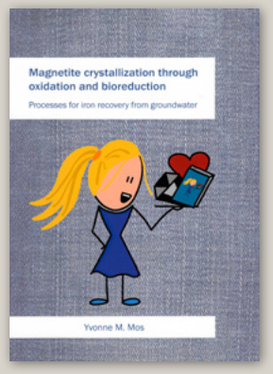
In the REALCOOL project, the cooling effect of small bodies of water was investigated, and optimised water body prototypes were developed using a research-through-design approach. The project stands out as a successful example of the research-through-design approach thanks to the intensive collaboration of different disciplines, the involvement of key stakeholders and rigorous testing of the design options.

The project started with microclimate simulations to determine the cooling effect of small bodies of water (with improved modelling of water evaporation processes). Next, virtual 3D prototypes were designed with variations in shading, vaporisation and ventilation, and their performance tested in terms of microclimate effects, public health, hydrological functionality, combination with other urban functions (such as road traffic) and costs. The general public's aesthetic appreciation of the prototypes was also assessed in an online questionnaire. Based on this information, a final set of prototypes was selected. Animated design guidelines were created to visualise the prototypes and explain them to the target group of urban design specialists.

A key finding of the project was confirmation that small bodies of water do not have a significant cooling effect themselves. However, the prototypes could be effective in cooling people near the body of water and were also able to increase rainwater storage capacity substantially. Moreover, most designs were perceived as more attractive than the current situation. Importantly, practitioners judged the prototypes to be relatively easy to implement and found the visualisations clear and inspiring.

For more information | Contact Prof. Sanda Lenzholzer

All theses 2018-2020



Yvonne Mos
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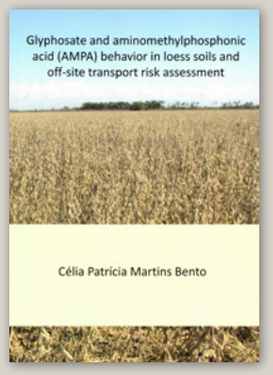

Célia Martins Bento
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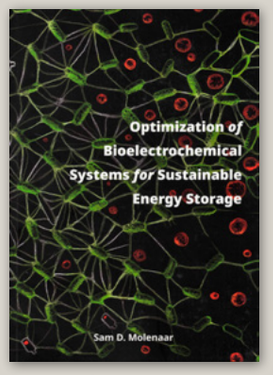
Joop Kroes
25/10/2018

Bastian Hornung
01/11/2018

Ariadna Szczybelski Ciordia
05/11/2018



Sam Molenaar
07/11/2018

Case 5

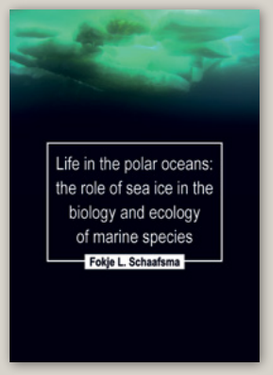
Global Environmental Governance

To tackle environmental challenges, states are making agreements with one another, for example in the 2015 Paris Agreement on Climate Change. But finding the right governance arrangements to ensure compliance is a challenge. Wageningen has set up a Centre for Sustainability Governance to address such questions.

In the past, legal frameworks were often used in an attempt to hold actors formally accountable for their targets. However, now 'learning-based accountability' with transparency mechanisms is increasingly being used as an approach (for example in the Paris Agreement). But this approach is far from straightforward because of the contested political context in which information on sustainability is produced and used. Researchers at WIMEK and the Wageningen School of Social Sciences (WASS) have set up a multidisciplinary incubator programme to investigate this further and develop better accountability mechanisms. A pilot project focused on COP23, the UN Climate Change Conference in Bonn in 2017. To explore accountability processes on the ground, the researchers conducted participant observation of a 'Facilitative Sharing of Views', a process in which developing countries presented their climate actions to the international community. The aim was to analyse the relevance of these novel accountability processes for countries' climate actions. Another aim was to develop appropriate methodologies to assess such state-to-state accountability mechanisms. The project findings were published in a peer-reviewed journal that is also read by climate policymakers and practitioners.

For more information | Contact Prof. Aarti Gupta

All theses 2018-2020



Fokje Schaafsma
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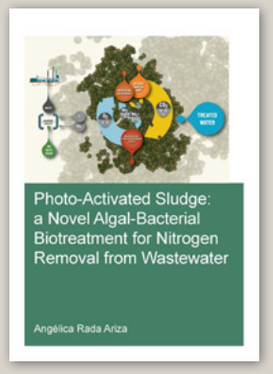

Angélica Rada Ariza
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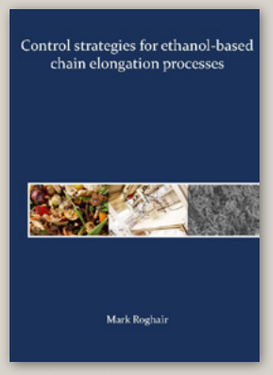

Mark Roghair
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Wiebke Klemm
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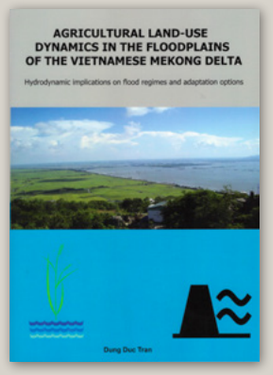

Dung Duc Tran
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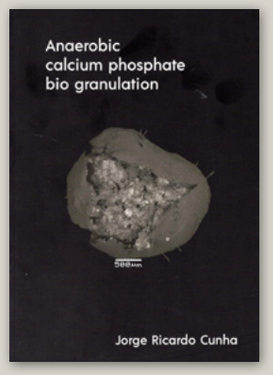


Jorge Ricardo Cunha
30/11/2018

Grand Challenge: Managing our Future Biosphere

Human activities are threatening our planet by disturbing global atmospheric and water cycles and polluting the soil, water and atmosphere. This results in the degradation of biodiversity and ecosystems. Solving these complex problems is challenging because the underlying environmental and socio-economic processes and their systemic interactions are poorly understood.

WIMEK's research aims to develop strategies for the sustainable use of the planet and its resources. An important priority is understanding the interconnections between biophysical and social processes. WIMEK's research focuses on: analysing interactions between the pedosphere, hydrosphere, biosphere and atmosphere; investigating how human activities affect the soil, water and atmosphere; analysing ecosystem services and biodiversity; developing land use planning approaches for urban-rural transformations; and studying the impacts of land use and water management on food security and the availability of clean water.

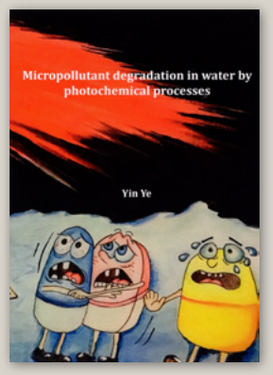
Case 6: Plastic Debris in Nature and Society

Case 7: Sustainable Nutrient Management

Case 8: Micronutrients for Better Yields

Case 9: Impacts of Pesticides on the Environment and Human Health (SPRINT)

All theses 2018-2020



Yin Ye
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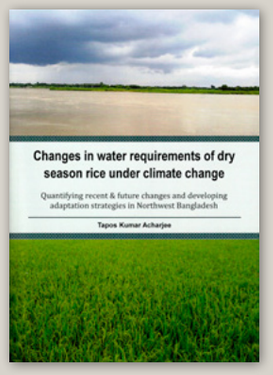

Tapos Acharjee
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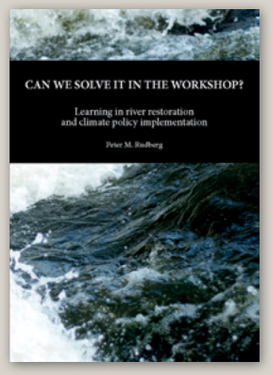

Peter Rudberg
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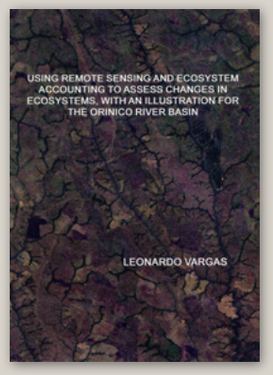
Nikolaos Strepis
16/01/2019



Leonardo Vargas
23/01/2019

Bingzhen Du
30/01/2019

Case 6

Plastic Debris in Nature and Society

Plastic debris pollution is recognised as a major problem, but relatively little is known about the actual risks to human health and the environment. Yet this information is urgently needed in order to develop effective measures to combat the harm from plastic debris.

WIMEK staff are responding to this challenge by developing novel measurement methods and models to assess the fate of plastic debris, and the exposure and effects in humans and the environment. A multidisciplinary approach is used, combining fields such as toxicology, hydrology, ecology and soil science. The researchers work closely with stakeholders including water authorities, environmental agencies and biotech and plastics companies. WIMEK researchers have done groundbreaking work on the detection, fate and effects of microplastics in particular. Examples include biomonitoring using seabirds (fulmars), river transport models, models to assess the role of plastic-associated chemicals in the risk from microplastics, and theoretical approaches to capture the diversity of plastic size, shape and polymer identity as a continuum.

WIMEK's plastics research is highly regarded and has a big impact among academics and policymakers. Its leading scientists were the highest ranked plastics researchers in the Clarivate list of most cited researchers in 2018, 2019, 2020 and 2021. WIMEK staff also authored the UN Environment Programme guidelines on plastic monitoring in freshwater ecosystems and its reports have been influential in determining international policies, for instance EU policy on the restriction of single-use plastics, and microplastic risk management policies in the US.

For more information | Contact Prof. Bart Koelmans

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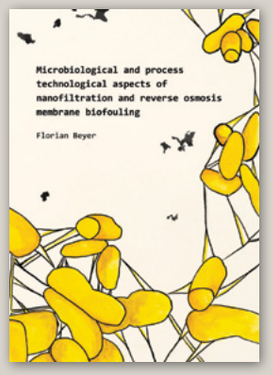
Babak M.S. Arani
05/02/2019

Martijn Diender
08/02/2019

13/02/2019
Florian Beyer



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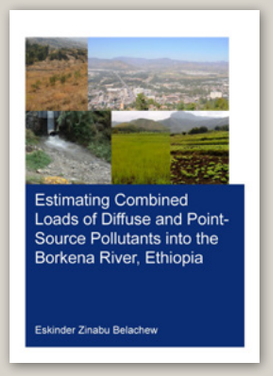

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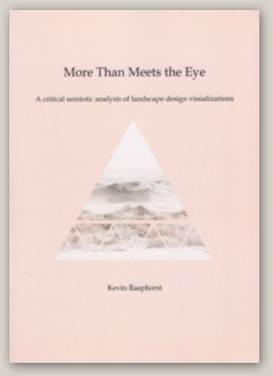
Kevin Raaphorst



09/04/2019

Case 7

Sustainable Nutrient Management

Inputs of nitrogen and phosphorous in agriculture are crucial for crop and livestock production but inefficiencies in both systems mean that large amounts of nutrients are lost to the environment, for example in China and India, but also in developed countries. This causes air and water pollution and affects climate change. WIMEK researchers are developing models to help identify the main causes and impact of nutrient losses, and the effectiveness of interventions.

In an 'integrated nitrogen impact analysis', WIMEK staff study the impact of agricultural nitrogen use on acidification of the soil, and the consequent effect on crop yields, ammonia and nitrous oxide emissions into the air and nitrate leaching into the water. Another integrated set of models considers nutrient flows in aquatic and terrestrial systems. This includes the impact of agricultural and wastewater nutrient management on the export of dissolved and particulate nitrogen and phosphorous to the sea via rivers and the consequent effect on aquatic biodiversity. It further includes the impact of nitrogen deposition on terrestrial biodiversity and forest growth, with the related carbon sequestration. In addition to the Netherlands and the EU, the research focuses on China because of the great potential there for reductions in nutrient inputs. The WIMEK researchers work closely with environmental agencies, fertiliser companies and farmers' organisations to ensure their research leads to more sustainable nutrient management in practice.

The research has produced some key insights. One is on the effects of nitrogen on the climate, where WIMEK studies show that the estimated CO_2 uptake due to nitrogen inputs largely offsets the increase in nitrous oxide emissions. Other studies published in widely cited papers showed that a reduction of 50 per cent is needed in nitrogen losses and related nitrogen inputs at the global scale – a target that is now mentioned in policy documents such as the EU Green Deal.

For more information | Contact Prof. Wim de Vries

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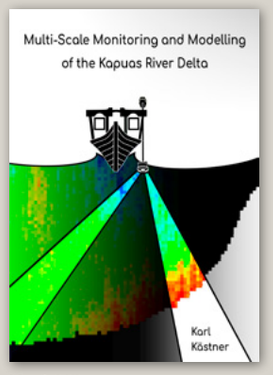

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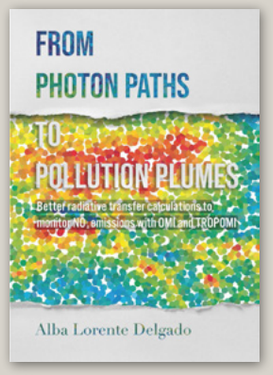

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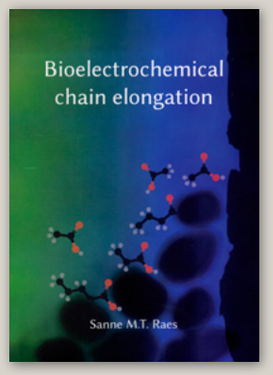

Sanne Raes
29/05/2019

Case 8

Micronutrients for Better Yields

Crop yields in East and Southern Africa are limited by macronutrient and micronutrient deficiencies, which also lead to reduced food quality and micronutrient malnutrition ('hidden hunger'). Effective fertilisation strategies to overcome these problems require a better understanding of the processes above ground and below ground that control the bioavailability of plant nutrients. Therefore, WIMEK staff and staff at the Production Ecology & Resource Conservation (PE&RC) Graduate School conduct highly technical research to develop practical information, in collaboration with the International Soil Reference and Information Centre (ISRIC) and local partners in Africa. The resulting information can be of direct value to fertiliser industries, decision-makers and farmers.

To understand the soil chemical processes that control the chemical speciation and availability of micronutrients (i.e. zinc, copper and boron) in soils from various countries in sub-Saharan Africa, soil samples were collected and characterised extensively. These soil measurements were used as input in mechanistic geochemical models, and translated into more accessible tools for the prediction of nutrient availability and to develop soil maps showing the spatial distribution of nutrient availability. Moving above ground, nutrient omission field trials were set up in which grain yields and nutrient concentrations were compared between treatments with complete fertilisation and treatments in which zinc and or boron fertilisers were left out, to examine when and where micronutrient fertilisation could increase maize yields and nutritional quality. In addition, pot experiments were carried out to better understand the soil properties that affect zinc and boron availability in a controlled environment. Using the knowledge derived from field and greenhouse experiments, micronutrient modules can be added to fertiliser recommendation schemes, such as the QUEFTS model used to analyse the effect of nitrogen, phosphorus and potassium limitations on crops growing in soils.

The research has led in particular to significant advances in the understanding of boron and zinc speciation, and the surface reactivity in general, of soils from the tropics with the help of state-of-the-art surface complexation modelling. More generally, the tools developed in the project will help to identify regions in sub-Saharan Africa at risk of micronutrient-induced growth limitations and human health issues, and will help to develop appropriate fertilisation recommendations.

For more information | Contact Prof. Rob Comans

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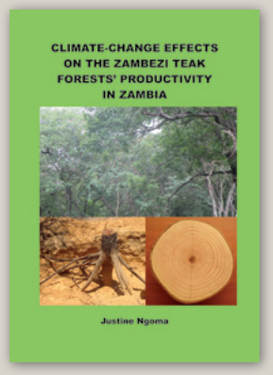

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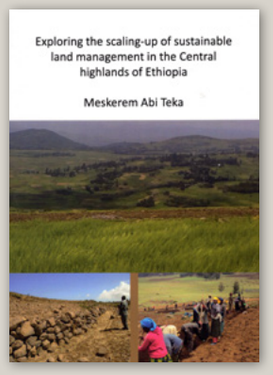

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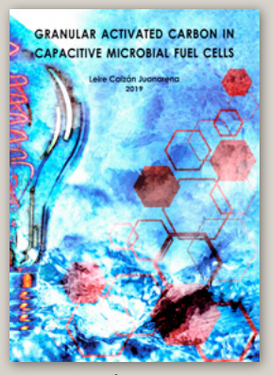

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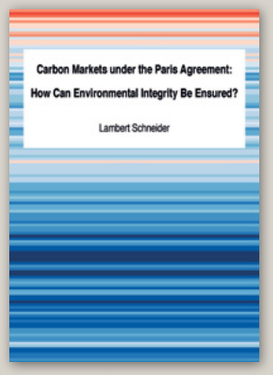

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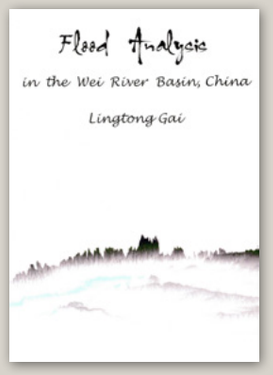

Lingtong Gai
03/07/2019

Case 9

Impacts of Pesticides on the Environment and Human Health (SPRINT)

Farmers use pesticides to protect crops and increase yields, but some pesticides can harm the environment, livestock or human health. However, at present data on the risks is fragmented and incomplete. The EU SPRINT project, which WIMEK staff are coordinating, aims to address this through an integrated assessment of the impacts of pesticides. This should ultimately help reduce pesticide use, reverse biodiversity loss and keep food safe. The project takes a transdisciplinary approach, with the soil scientists of WIMEK working alongside medical researchers and toxicologists.

The project focuses on eleven case-study sites across Europe with contrasting farming systems (conventional, integrated and organic). At these sites, the distribution is studied of the pesticides in the environment (soil, water and air), in crops and livestock, and in humans, along with the direct and indirect uptake. Laboratory tests are being used to determine the health effects. The findings will be incorporated in a toolbox for the risk and impact assessment of pesticide residue mixtures. This will enable an evaluation of the risks, costs and benefits of pesticides in the various farming systems and recommendations for transition pathways to more sustainable plant protection.

Stakeholder involvement is a key element of the project. This is being achieved for example through stakeholder networks at the case-study sites and by engaging farmers, consumers and rural residents in crowd-sourced research. The intention is that the project should increase awareness among stakeholders of integrated risk assessments of pesticides and engender trust in these assessments.

For more information | Contact Prof. Violette Geissen

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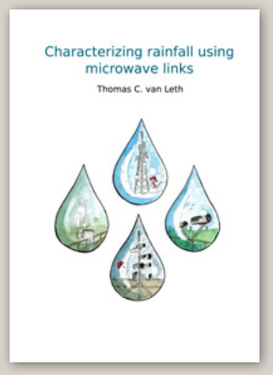

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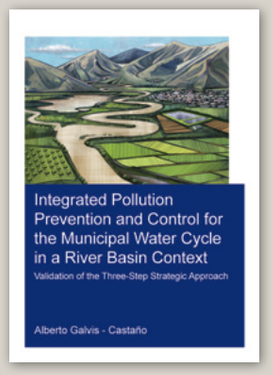

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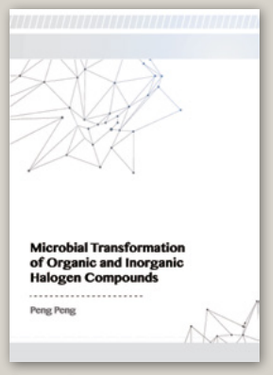

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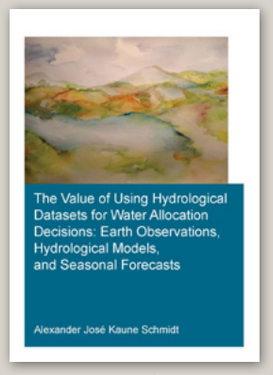

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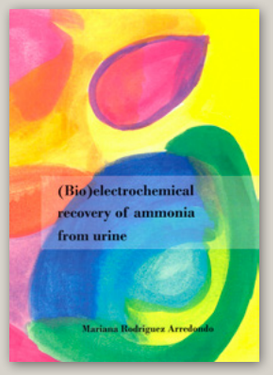

Mariana Rodriguez Arredondo
04/10/2019

Grand Challenge: Advancing Circular Systems

Human activities are threatening our planet by disturbing global atmospheric and water cycles and polluting the soil, water and atmosphere. This results in the degradation of biodiversity and ecosystems. Solving these complex problems is challenging because the underlying environmental and socio-economic processes and their systemic interactions are poorly understood.

WIMEK's research aims to develop strategies for the sustainable use of the planet and its resources. An important priority is understanding the interconnections between biophysical and social processes. WIMEK's research focuses on: analysing interactions between the pedosphere, hydrosphere, biosphere and atmosphere; investigating how human activities affect the soil, water and atmosphere; analysing ecosystem services and biodiversity; developing land use planning approaches for urban-rural transformations; and studying the impacts of land use and water management on food security and the availability of clean water.

Case 10: Circular Water Systems

Case 11: Salt and Urban Water as a Resource

Case 12: Spatial Planning for Environmentally Diverse Circular Development (SPLENDID)

Case 13: Renewable Resources for a Circular Economy

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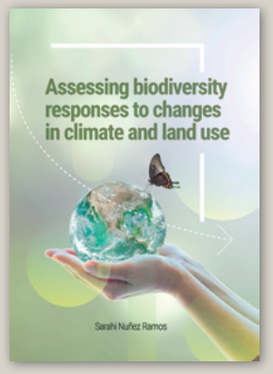

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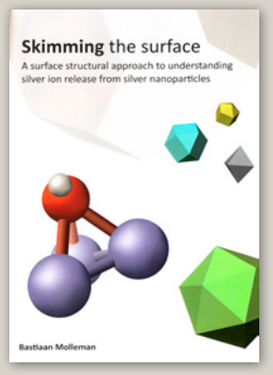

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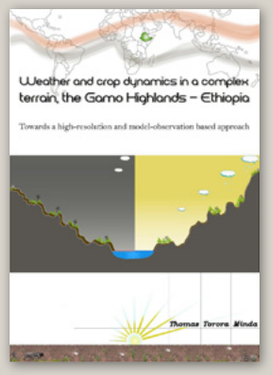

Thomas Minda
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Anna Deppenmeier
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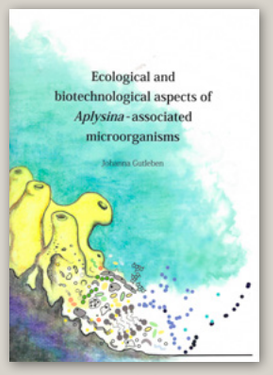

Johanna Gutleben
21/11/2019

Case 10

Circular Water Systems

Water scarcity is rooted in a scarcity of water of sufficient quality. Contamination of water with pollutants results in global water scarcity problems. Circular water systems are urgently needed to allow safe reuse of water and combat water scarcity. WIMEK staff are helping achieve this by modelling water quality, developing strategies for wastewater reuse in agriculture and designing technologies to produce clean water.

Water quality models are useful in parts of the world where measurement data is scarce. The models allow pollutant sources to be identified and potential interventions to be evaluated. In contrast to the usual single-pollutant approach, these models cover multiple pollutants and their interactions, and therefore provide a better prediction of intervention effectiveness. To give an example, a model was developed for Uganda that estimates the number of pathogens reaching the surface water. Sanitation officials now use it to prioritise areas for interventions such as making latrines watertight.

The research on wastewater reuse in agriculture considers the politics and practices of using wastewater in peri-urban agriculture in rapidly urbanising areas of Africa and Asia. This research covers both technical and institutional interventions.

WIMEK staff are also developing sustainable water treatment technologies for the removal of micro-contaminants, such as trace concentrations of pharmaceuticals and hormones. Innovative bioreactors and nature-based solutions are designed in combination with advanced chemical and physical techniques to produce clean water for reuse. Another focus area is treatment technologies for emerging economies and dense urban spaces that take account of the limitations of the existing infrastructure. The solutions are not only technically feasible but also economically viable, extracting useful products such as biogas and nutrients for agriculture. A notable example in India is the Vital Urban Filter, where a compact wetland system is used to treat wastewater for reuse in irrigation while ornamental plants are grown on the filter.

For more information

Contact Dr Nora Sutton

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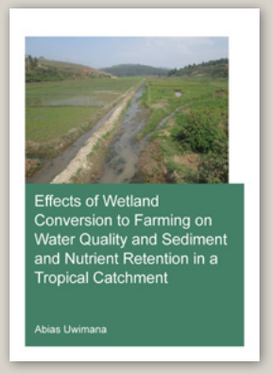

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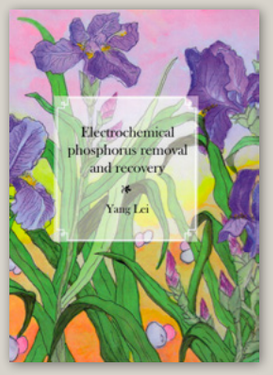

Yang Lei
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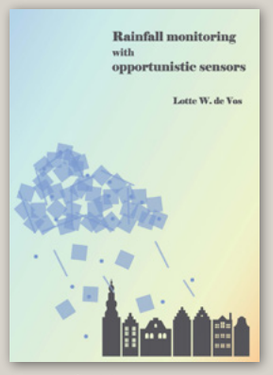

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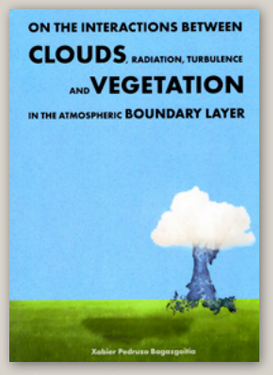

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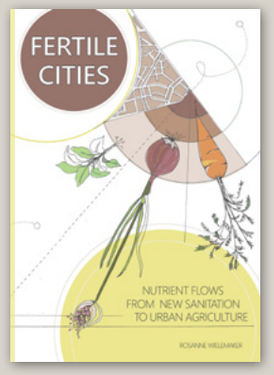

Rosanne Wielemaker
19/12/2019

Case 11

Salt and Urban Water as a Resource

Urbanised deltas (for example in the Netherlands, Vietnam and Bangladesh) suffer from a scarcity of fresh water due to drought, salt water intrusion and increased water consumption. Industrial companies are particularly big consumers of water. WIMEK researchers are tackling this problem through a paradigm shift that sees salt water as an alternative resource rather than a threat. Salty water, combined with urban water, such as harvested rainwater and reclaimed and cleaned wastewater, can be used for industry instead of precious fresh water. Much of the research takes the practical situations in industry as a starting point. These industries are represented in the Water Nexus and other research projects in which various universities, research institutes, government bodies and engineering consultancies are participating.

In this research, modelling tools were created to help manage industrial water provision based on the use of salty water, harvested rainwater and reclaimed wastewater. The Dutch delta region of Zeeuws-Vlaanderen was used as a case study. A smart water grid was developed that matches the demand of users with the supply obtained from urban water and brackish groundwater resources. Transport, treatment to meet specific quality requirements, prevention of damage to nature and limitation of salt water intrusion from the sea were all taken into account.

Another area of research is the development of treatment technology trains (series of processes) for treating saline wastewater from industrial processes. In agro-industrial sectors the wastewater often has high concentrations of both salt and organic materials. Conventional treatment processes require large amounts of energy and chemicals. WIMEK staff have developed an alternative, energy-efficient treatment train with a set of anaerobic-aerobic granular sludge reactors. A different treatment is required for making saline wastewater from cooling towers reusable. In a pilot at DOW Terneuzen in the Netherlands, a constructed wetland was used to remove conditioning chemicals. Further treatment steps were designed, using nanofiltration membranes among other techniques, to further clean and desalinate the water so that it can be reused in the cooling tower. These technology studies provided essential insights into the treatment process parameters, helping consultants and technology providers to scale up these appro aches for market application. Similar treatment solutions are now being designed for wider application in the Netherlands and in Vietnam, India, Bangladesh and the Middle East through the follow-up research programme AquaConnect.

For more information | Contact Prof. Huub Rijnaarts

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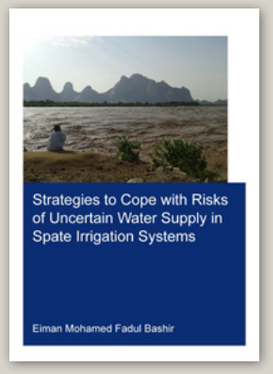

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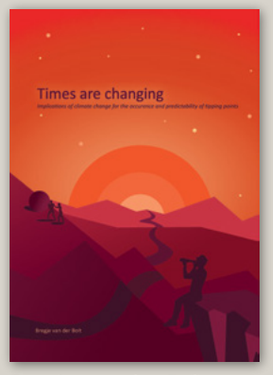

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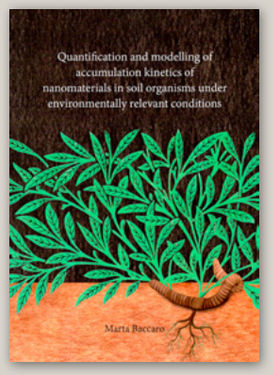

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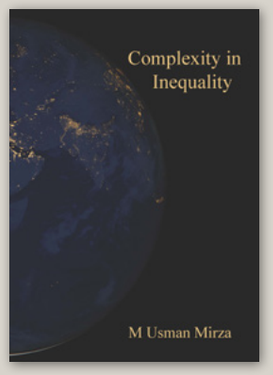

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04/02/2020

Case 12

Spatial Planning for Environmentally Diverse Circular Development (SPLENDID)

Circular agriculture is increasingly seen as a way of making agriculture more sustainable, but actual implementation is proving hard. That is in part because policymakers and researchers overlook the importance of spatial organisation. The right spatial organisation can enhance synergies with other ecosystems, generate economies of scale and improve the overall landscape quality.

In the SPLENDID project, staff from WASS and WIMEK seek to give policymakers a methodology that will let them find a spatial organisation suited to circular agriculture. The approach assumes three circularity archetypes: nature-based implementation, aimed at restoring natural cycles; technology-based implementation, with complementary types of farms in closed systems for the maximum reuse of waste streams; and transport-based implementation, where farmers upgrade their own waste for use by other farmers. Models are used to explore spatial organisations of variants of these three archetypes and their effect on ecosystem services. The researchers also consider what policy instruments could be used to achieve the desired spatial organisation, for example land consolidation or payment for ecosystem services. The project uses a research-through-design approach, taking the Dutch province of Noord-Brabant as an example. Stakeholders are involved in the process through a series of workshops. SPLENDID started relatively recently but has already resulted in a map of the Netherlands showing potential locations for the three circularity archetypes.

For more information | Contact Prof. Martha Bakker

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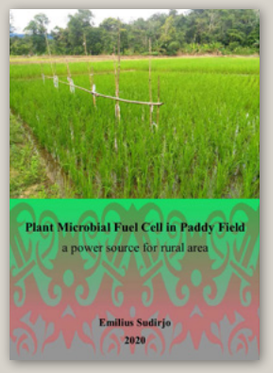

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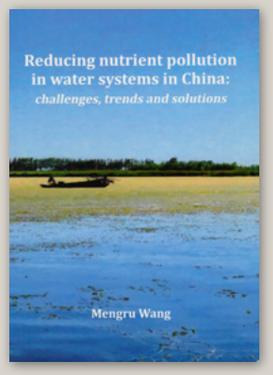

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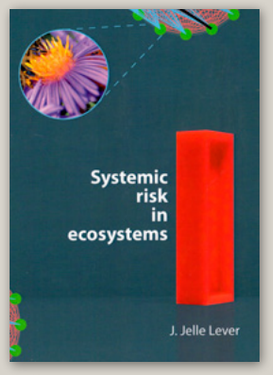

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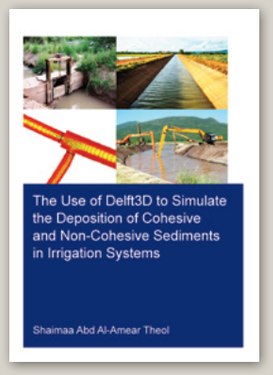


Shaimaa Theol
19/02/2020

Case 13

Renewable Resources for a Circular Economy

There is increasing awareness of the need for a more circular society, requiring the effective recycling of carbon (e.g. from waste), nutrients (nitrogen, phosphorus), and metals (copper, zinc). But current practices in waste systems are not yet geared to the recovery of resources. For example, domestic sewage systems were designed to protect public health and the environment, and the carbon and nitrogen abundant in these streams are simply viewed as pollutants to be removed. WIMEK researchers are investigating new strategies and technologies for the recovery of resources.

Carbon in industrial waste and wastewaters, as well as in flue gases, can be recovered to produce platform chemicals, which currently come from fossil sources or from environmentally damaging sectors such as the palm oil industry. WIMEK has used microbial chain elongation as an alternative method to produce these chemicals from organic waste and, more recently, from syngas (a gaseous stream that can be generated from the gasification of all types of carbon waste). The method using organic waste is being implemented at a demonstration factory in Amsterdam. In addition to carbon recovery, biological methods are being used for metal recovery. In a Dutch zinc smelter plant, a microbial process has successfully been applied to prevent zinc pollution and minimise zinc losses.

In the case of domestic wastewater, WIMEK staff apply the Novel Sanitation concept. This involves the separation at source of blackwater (human excreta, which contains most of the valuable resources) from greywater (wastewater from domestic activities such as showering). Materials can be recovered more efficiently from the concentrated blackwater, and it has the advantage of not being contaminated with pollutants from other streams such as personal care products. WIMEK researchers have also developed a breakthrough method for high-temperature anaerobic digestion of blackwater, which could allow it to be reused as an organic fertiliser product. Novel Sanitation systems are currently implemented in a number of residential districts across Europe, in part through the EU Run4Life project.

For more information | Contact Dr Annemiek ter Heijne | Contact Prof. Diana Machado de Sousa

Our Graduate Training Programme

The WIMEK Graduate School aims to help talented young researchers develop into independent scientists operating to the highest international standards. The WIMEK training programme is geared to developing 'T-shaped skills', combining topical, in-depth training in the environmental and climate sciences on the one hand (the vertical bar of the T) with training in how to put the research into a wider scientific and societal context plus development of the professional and personal skills required for a future career in or outside academia on the other hand (the horizontal bar of the T). At the start of their research, each PhD candidate draws up a Training and Supervision Plan, which identifies competencies to be developed further in the areas of: (1) research skills and techniques; (2) project management; (3) science communication; and (4) career paths.

Generic skills training applicable to all PhD candidates is provided by the Wageningen Graduate Schools jointly. This programme consists of about 50 courses on topics such as scientific writing, didactic skills and time management. WIMEK itself offers specialised courses specific to the field of environmental research. Examples include topical, in-depth PhD courses (e.g. Principles of Ecological and Evolutionary Genomics, given in 2018), courses on enhancing the social impact of sustainability research (e.g. Grasping Sustainability, given annually) and courses on statistical analysis (e.g. annual courses on Basic Statistics, annual courses on R and Big Data, and a course every two years on Statistical Uncertainty of Dynamic Models, co-organised with other Wageningen Graduate Schools) and modelling (e.g. River Transport of Nutrients from Land to Sea, in 2018; Bioinformatics in Python and Linux, in 2020). The national environmental research network SENSE organises an introductory PhD course and a research impact incubator assignment that are mandatory for all WIMEK PhD candidates.

Because of the COVID pandemic, fewer in-depth PhD courses were offered in 2020, but most statistical, modelling and generic skills courses were continued online, as was the SENSE introduction course.

PhD candidates also receive guidance and support from their supervisors, from the PhD advisor and from fellow, more experienced PhD candidates through the buddy system set up by the WIMEK PhD Council.
The approximately 370 PhD candidates enrolled with WIMEK come from all over the world: 33 per cent are from the Netherlands, 16 per cent from other European countries, 31 per cent from Asia, 10 per cent from Africa, 7 per cent from Latin America and 3 per cent from other parts of the world. Some 43 per cent of PhD candidates have an employment contract with Wageningen University as PhD research assistants. A further 35 per cent have grants from their local institute and are based at WIMEK for all or part of their PhD research (as guest or sandwich PhD students). The remainder are external candidates and Wageningen University staff.

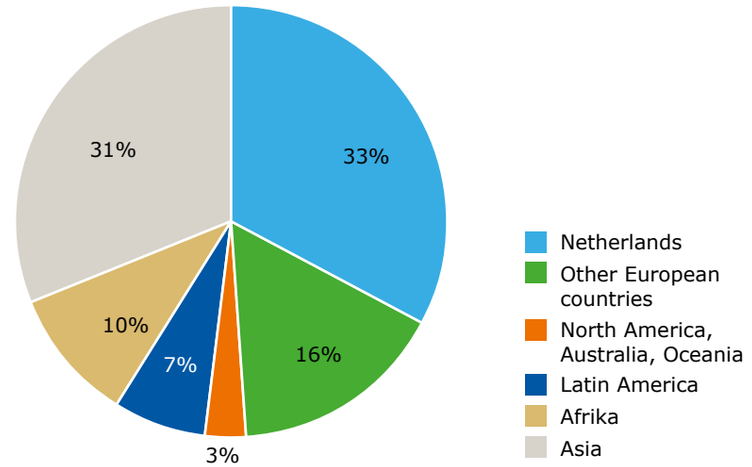


Figure 1: Nationalities of the 370 PhD candidates enrolled in WIMEK

WIMEK conferences

WIMEK organises national and international conferences, workshops and symposia. These events enable the exchange of knowledge with fellow scientists. They also increase the impact of WIMEK's research as they provide a forum for the transfer of knowledge to policymakers and practitioners from government bodies, NGOs and industry. Some key examples in 2018-2020 are given below.

Water Science for Impact Conference
16 – 18 October 2018, Wageningen.
This international conference focused on the interaction between science and society in developing solutions for pressing water-related problems. About 400 participants attended. Inspiring keynote talks were given by Cora van Nieuwenhuizen (Dutch Minister of Infrastructure and Water Management), Josan Meijers (member of Gelderland Provincial Council), Dr Simon Langan (director of IIASA's Water Programme), Charles Iceland (director of Global and National Water Initiatives at World Resources Institute) and Prof. Rob Hamer (Vice President, Agrifood External Affairs at Unilever).

8th International Symposium on Non-CO_2 Greenhouse Gases (NCGG8): Global Challenges and Local Solutions
12-14 June 2019, Amsterdam.
This conference brought together scientists, engineers and decision-makers in the public and private sectors. Its aim was to actively support the implementation of policies and technologies to reduce emissions of non-CO_2 greenhouse gases.

WIMEK-SENSE conference Our Future Energy Landscape
20 June 2019, Wageningen.
This Dutch-language conference focused on the energy transition, how this will lead to competing claims for land in the medium to long term (up to 2050) and how to develop integral solutions that enjoy broad support. The conference was attended by about 120 participants from many different sectors, including local and provincial governments, water authorities, architecture firms, solar and wind energy companies, and research institutions.
Environmental Technology for Impact Conference,
3–5 June 2020, online.

In this international online conference, more than 50 speakers covered innovative developments in the field of treating and valorising waste and wastewater. The conference provided a state-of-the-art overview of technologies to tackle environmental challenges in the coming decades, including resource recovery, micro-pollutants removal, and fuel cells. The keynote speakers were Prof. Francisco J. Cervantes (National Autonomous University of Mexico) and Dr Ghada Kassab (University of Jordan).

Recognition Of Academic Excellence

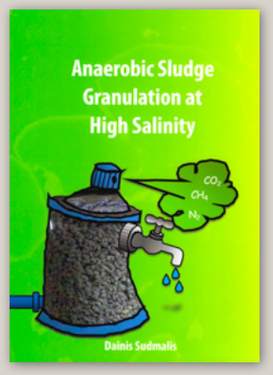
The academic excellence of WIMEK's research is fully recognised in the wider scientific community. This is evident from international rankings: in 2020, Wageningen University was ranked **8th** in the world for Environmental Science in the QS World University Rankings, and **2nd** in the field of Environment & Ecology in the National Taiwan University Rankings. Other signs of recognition are the research grants and prizes awarded to WIMEK scientists. Top WIMEK scientists are also invited to sit on advisory bodies and act as editors-in-chief for journals. This chapter lists the main achievements in the period 2018-2020.

Grants and Awards

Scientific and advisory positions

Editors-in-chief

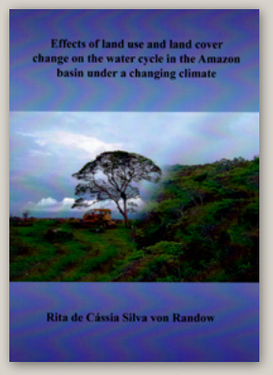
All theses 2018-2020



Dainis Sudmalis
06/03/2020

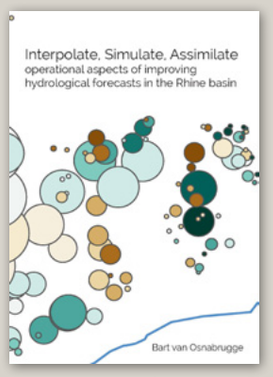
Jillian Student
27/03/2020

Karine Kiragosyan
08/04/2020



Rita De Cassia Silva Von Randow
14/04/2020

Julia Krug
24/04/2020



Bart van Osnabrugge
12/05/2020

Grants and awards

VENI grants

Veni grants of up to EUR 250,000 are awarded by the Dutch Research Council (NWO) to outstanding young postdocs to let them develop their research ideas further.

Dr F. (Franziska) Glassmeier (Meteorology & Air Quality): Clouds as complex systems (2018)
The amount of clouds and their brightness are key sources of uncertainty in the prediction of climate change. The grant was to allow the researcher to apply complex-systems theory to investigate this challenging behaviour.

Dr M. (Maryna) Strokal (Water Systems & Global Change): Optimal solutions for river pollution (2018)
River pollution is a challenge because the causes of pollution and their interactions in the environment are poorly understood. The aim of this research was to search for optimal solutions for river pollution with these interactions in mind, by developing a new river pollution model with spatial optimisation.

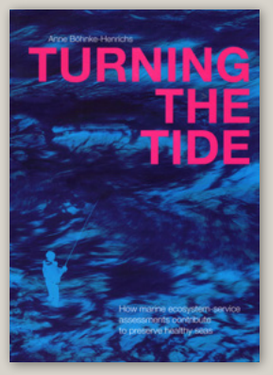
Dr N.J.H.P. (Nico) Claassens (Environmental Microbiology): Building sustainable C1-routes in a bacterium (2019)
Methanol and other one-carbon compounds are ideal sources for the production of biochemicals and biofuels. Unfortunately, microorganisms suitable for biotechnological production, such as Escherichia coli, cannot grow on these sources. The grant was for engineering possible genetic mutations in E. coli for eating one-carbon substrates, and learning which mutations are important.

Dr A.B.G. (Annette) Janssen (Water Systems & Global Change): Booming or blooming? The future of lakes in a changing world (2019)
Algal blooms turn lakes into toxic soups. This research was aimed at finding new solutions to prevent algal blooms by studying a feedback loop that combines economic optimisation with the ecological responses of algae in lakes.

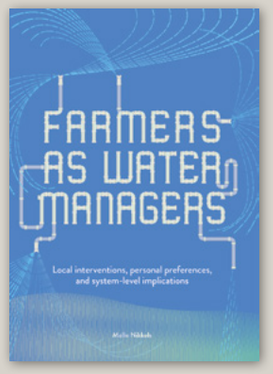
Dr L.A. (Lieke) Melsen (Hydrology and Quantitative Water Management): The human side of environmental computer modelling (2019)
If different people cook the same recipe, the final dish will taste different. This is also true for computer models used for environmental predictions, like river discharges in response to climate change — different modellers will obtain different results. The research was aimed at quantifying the effect of the human factor in environmental modelling.

Dr T.H.M. (Tim) van Emmerik (Hydrology and Quantitative Water Management): The River Plastic Monitoring Project (2020)
Riverine macroplastics (>0.5 cm) cause harm to humans and the environment, are a major source of microplastics and contribute to the plastic soup. Reliable observations are crucial to prevention, mitigation and clean-up strategies. The grant was for developing a universal monitoring framework that would enable macroplastics to be measured consistently in any river.

All theses 2018-2020

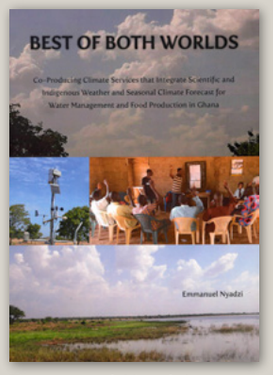


Anne Böhnke-Henrichs
19/05/2020

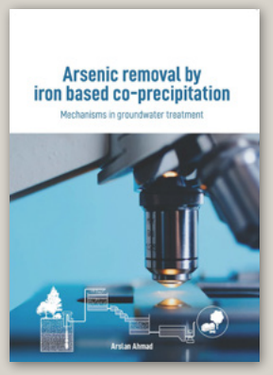


Melle Nikkels
20/05/2020

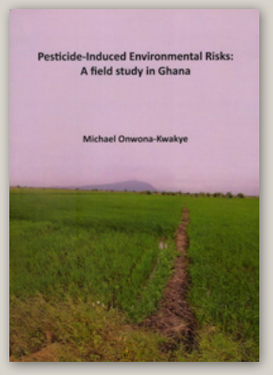
Marta Antonelli
25/05/2020



Emmanuel Nyadzi
27/05/2020



Arslan Ahmad
05/06/2020



Michael Onwona-Kwakye
11/06/2020

Dr A.L. (Annah) Zhu (Environmental Policy): Combating climate change through Great Green Walls (2020)
China plants more trees than the rest of the world combined. The grant was for investigating China's investments in large-scale reforestation, using case studies and a global inventory. The results will show how China's approach to the environment is shaping the world's forests and the future of climate change.

VIDI grants

Vidi grants of up to EUR 800,000 are awarded by the Dutch Research Council to researchers with several years of experience. The aim is to let them develop their own lines of research and appoint one or more researchers.

Dr A. (Annemiek) ter Heijne (Environmental Technology): The fate of electrons in biofilms (2018)
The grant was for researching how biological transitions can be made more efficient. Biological transitions form the basis of many processes, such as wastewater treatment and recovery of nutrients from waste streams. The aim of the project is to measure exactly how electrons move through bacteria.

Dr C.C. (Chiel) van Heerwaarden (Meteorology & Air Quality): Shedding light on cloud shadows (2018)
Cloud shadows are responsible for significant local fluctuations in light quantity. In locations where solar energy is harvested, this can lead to variation in the power supply. The objective of this project is to study cloud shadows using innovative measurements and cloud simulations in order to better predict these fluctuations.

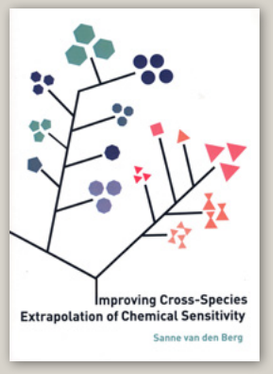
Dr L.E. (Lisa) Becking (Marine Animal Ecology): Marine Time Machine (2019)
In this project, marine lakes — islands of seawater — are studied to see today how marine life will respond in a future with higher temperatures and declining water quality. This approach will provide new insights into the impact of climate change on biodiversity.

VICI grant

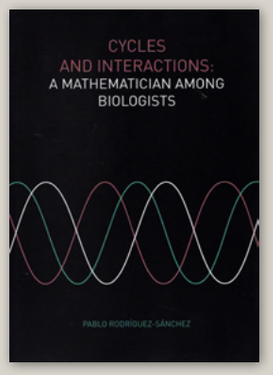
Vici grants of up to EUR 1.5 million are awarded by the Dutch Research Council to outstanding senior researchers.

Prof. A.J.F. (Ton) Hoitink (Hydrology & Quantitative Water Management): Deltas out of shape (2018)
Intertidal areas in river deltas are disappearing because of land reclamation and rising sea levels. This alters the tidal motion in delta channels and changes the pathways of sand, silt and clay. To better understand the physical mechanisms, innovative monitoring approaches are combined with model simulations to unravel the causes of high turbidity, siltation and bank erosion.

All theses 2018-2020



Sanne van den Berg
12/06/2020

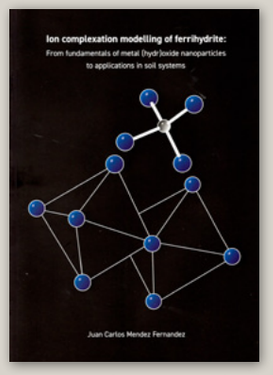


Pablo Rodríguez Sánchez
15/06/2020

Artem Krasnobaev
16/06/2020

Jolijn van Engelenburg
01/07/2020

Delaram Azari
03/07/2020



Juan Mendez Fernandez
27/08/2020

Scientific and advisory positions

WIMEK researchers are recognised as experts in their field, and are regularly invited to serve on scientific and policy boards and committees. Some examples are given below:
o Prof. J. (Jordi) Vila (Meteorology & Air Quality): Science Officer in the Atmospheric Sciences Division of the European Geophysical Union.

- **Prof. C.J.N. (Cees) Buisman** (Environmental Technology) and **Prof. H.H.M. (Huub) Rijnaarts** (Environmental Technology): members of the board and the programme committee respectively, Dutch Top Sector Alliance for Water Technology.

- **Prof. Wim de Vries** (Environmental Systems Analysis) and **Prof. Maarten Krol** (Meteorology and Air Quality): members of the advisory committee on the measurement and calculation of nitrogen emissions and deposition in the Netherlands, set up by the Minister of Agriculture, Nature and Food Quality.

- **Prof. Martha Bakker** (Land Use Planning): member of the Spatial Design study group established by the ministries of Agriculture, Nature & Food Quality and Internal Affairs (to 2020).

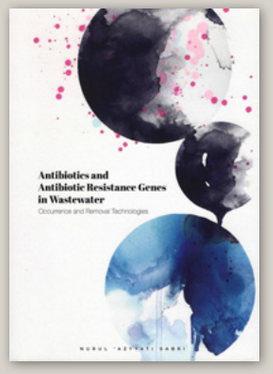
- **Prof. Rob Comans** (Soil Chemistry and Chemical Soil Quality): member of the international standardisation committee ISO/TC 190/SC7 (Soil Quality - Soil and Site Assessment) and convenor of its Working Group 6 ‘Transfer and mobility of components’ (from 2004).

- **Prof. Rob Comans** (Soil Chemistry and Chemical Soil Quality): member of independent advisory bodies on soil protection measures for the Ministry of Infrastructure and Water Management (from 2016).

- **Prof. Carolien Kroeze** (Water Systems & Global Change): member of the Committee of Experts on the Fertilisers Act, which advises the Ministry of Agriculture, Nature and Food Quality (from 2018).

All theses 2018-2020

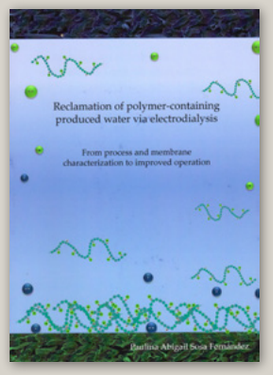
Silvia Vega Hernández
01/09/2020



Azie Sabri
04/09/2020

Victor Ajao
11/09/2020

Louis Legrand
11/09/2020



Paulina Sosa Fernandez
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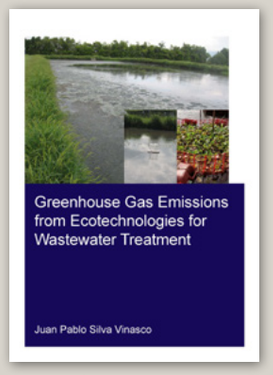


Juan Silva Vinasco
14/09/2020

Editors-in-chief

WIMEK researchers contribute to the wider scientific community by serving on the editorial boards of scientific journals. The following scientists held a position as editor-in-chief during the period 2018-2020:

- **Dr Dolf de Groot** (Environmental Systems Analysis): Editor-in-chief of Ecosystem Services (from 2019).
- **Prof. Bart Koelmans** (Aquatic Ecology & Water Quality Management: Editor-in-chief of the new journal Microplastics and Nanoplastics (from 2020).
- **Prof. Carolien Kroeze** (Water Systems & Global Change): Editor-in-chief of the Journal of Integrative Environmental Sciences.
- **Prof. Rik Leemans** (Environmental Systems Analysis): Founding editor and joint editor-in-chief of Current Opinion in Environmental Sustainability (2008¬2019).

Societal impact

Education: training the next generation

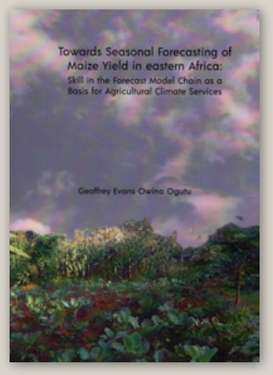
The most important societal impact of WIMEK is in educating the next generation of environmental and sustainability experts (BSc, MSc and PhD). On average, WIMEK staff spend 40 per cent of their time on teaching. Moreover, many MSc students conduct their thesis research on topics related to current PhD projects and they are also often co-supervised by PhD candidates. Almost all WIMEK staff are involved in PhD supervision.

Participatory research

Citizen Science

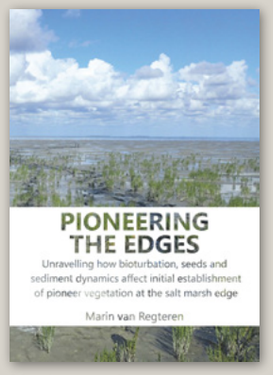
Contributions to assessments and policy reports

All theses 2018-2020

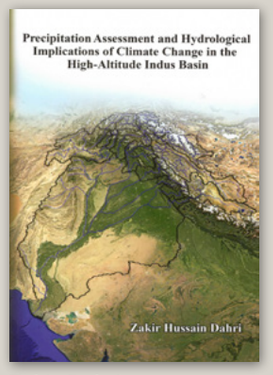


Geoffrey Ogutu
14/09/2020

Gerbrand Koren
18/09/2020

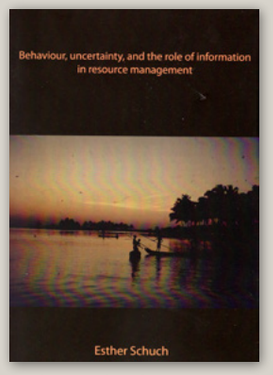


Marin van Regteren
09/10/2020



Zakir Dahri
13/10/2020

Antonello Squintu
16/10/2020



Esther Schuch
20/10/2020

Participatory research

Participatory research is research that actively involves stakeholders, such as farmers or water authorities. This involvement yields research that is aligned with the requirements of stakeholders and increases the likelihood of the results being used in practice.

The work on **climate information services** is a good example of participatory research (see Case 1). This research focuses on how to communicate the information on climate change impact and how to co-create actionable knowledge through the development of climate information services. WIMEK groups co-developed second-generation climate information services focusing on co-production and co-learning approaches together with the users.

Wetsus is another inspiring example of collaboration with stakeholders. WIMEK-WUR is one of the main participants in Wetsus, the European centre of excellence for sustainable water technology. The multidisciplinary collaboration between companies and research institutes from all over Europe in Wetsus results in innovations that contribute significantly to the solution of global water problems.

Another example is **WaterNexus**, an NWO-STW research programme of EUR 6 million, coordinated by Prof. Huub Rijnaarts (Environmental Technology). This programme ran from January 2015 to 2020, with the support of 25 partners consisting of multinational and small/medium-sized companies, consultancy firms, research institutes, water boards, and the Ministry of Infrastructure and Environment (see Case 11). In total 15 PhD candidates and two postdoc researchers worked together to develop new solutions for the water supply in coastal regions in the Netherlands and abroad where fresh water is scarce.

WIMEK researchers are are also heavily involved in the AMS initiative: the **Amsterdam Institute for Advanced Metropolitan Solutions**, with Wageningen UR, Delft University of Technology, MIT and TNO as the scientific partners. In this institute, science, education, government, business partners and societal organisations are working together closely to create solutions for the complex challenges that metropolitan regions like Amsterdam are facing now and in the future.

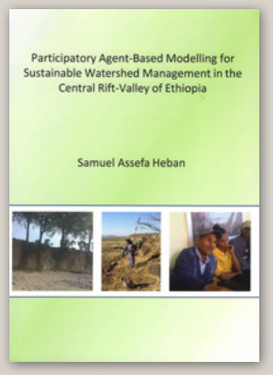
WIMEK was also the coordinator of the WUR-wide **'Metropolitan Solutions' Knowledge Investment Theme** (MetSol, 2016-2018), which is closely connected to the AMS initiative. Within the MetSol theme, five postdocs and two part-time staff members worked on setting up various 'living labs': the Fresh Food City, the Healing Garden, the Ludic City, Green & Blue Urban Design, Urban Heat and Dry Feet and Green Street.

All theses 2018-2020

Carlos Alberto Faundez Urbina
20/10/2020

Susanne Kühn
30/10/2020

Kasper de Leeuw
03/11/2020



Samuel Assefa Heban
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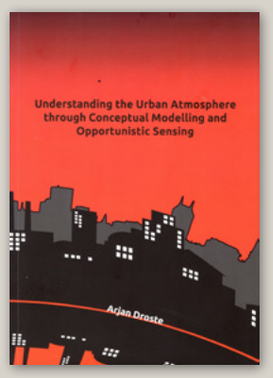
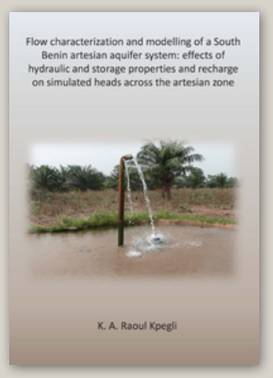


Arjan Droste
04/11/2020



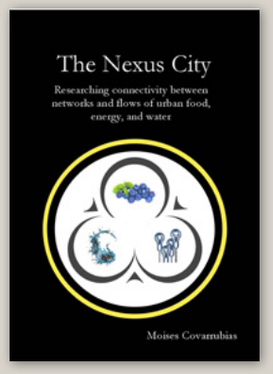
Raoul Kpegli
04/11/2020

Another example of co-design is the **Solutions for Outdoor Climate Adaptation** (SOLOCLIM) programme. This is a European Industrial Doctorate project funded by the European Commission within the Horizon 2020 programme. SOLOCLIM will develop innovative solutions for climate adaptation in cities at different scales, ranging from buildings to larger neighbourhoods and cities. It will also test their effects.

Wageningen University contributes to **capacity building** in developing countries in the **INREF programmes**, funded by the University's Interdisciplinary Research and Education Fund (INREF). INREF aims to respond to the social need for more impact in research for development and to contribute to the development of innovative research approaches. Most of the INREF research is conducted by groups of eight to ten sandwich PhD students working on complex topics concerning developing countries and emerging economies. These interdisciplinary, multi-annual research programmes typically involve multiple Graduate Schools, with WIMEK researchers as active participants, for example in:

- Environmental Virtual Observatories for Connective Action in crop, water, livestock and disease management (EVOCA) (2015-2020);
- Scenario Evaluation for Sustainable Agro-forestry Management (SESAM) (2019-2024).

All theses 2018-2020



Moises Covarrubias Perez
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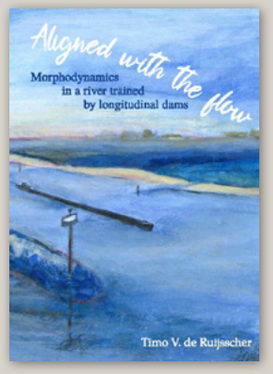
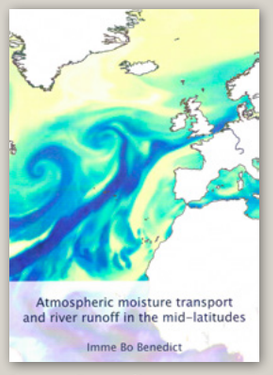


Timo de Ruijsscher
06/11/2020

Diego García Mendoza
13/11/2020



Imme Benedict
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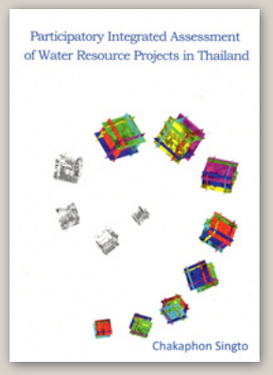


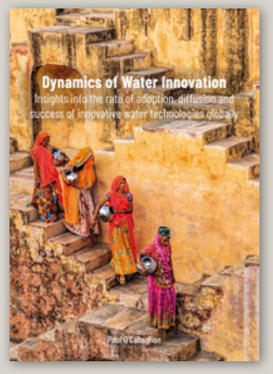
Chakaphon Singto
30/11/2020

Yueling Qi
08/12/2020

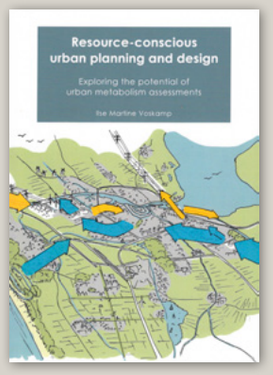
Citizen Science

Citizen science is the practice of science by volunteers in cooperation with professional researchers. It is a way of engaging the general public with science and increasing their scientific literacy. An inspiring example of a citizen science project is **Nature's Calendar,** which was initiated by Dr Arnold van Vliet (Environmental Systems Analysis). Nature's Calendar aims to monitor, analyse, forecast and communicate the timing of annually recurring life-cycle events. It has shown that the growing season is already almost one month longer compared to fifty years ago, due to rising temperatures. Nature's Calendar is coordinated by the WIMEK-ESA group and the Foundation for Sustainable Development and involves over 30 organisations, 8,000 volunteers and hundreds of schoolchildren. Nature's Calendar actively communicates with society via its website, Twitter, presentations, markets, an educational programme and the media.

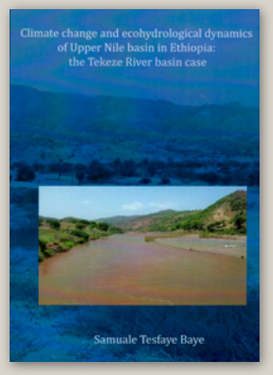
All theses 2018-2020



Paul O'Callaghan
09/12/2020



Ilse Voskamp
11/12/2020



Samuale Baye
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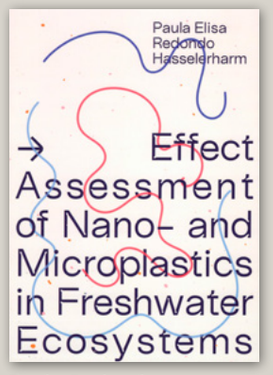

Paula Redondo Hasselerharm
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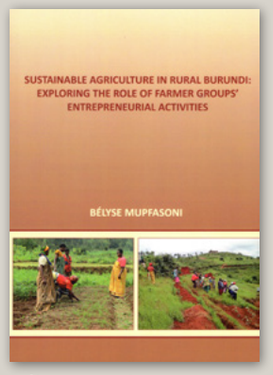

Bélyse Mupfasoni
17/12/2020

Contributions to assessments and policy reports

WIMEK encourages participation in national and international science-policy assessments, such as the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). Moreover, WIMEK researchers contributed to policy reports on the reduction of nitrogen emissions in the Netherlands (Prof. Wim de Vries), the EU report on microplastics in nature and society (Prof. Bart Koelmans), analyses of national strategies regarding the Paris Climate Agreement (Prof. Niklas Hoehne) and future scenarios of climate change and biodiversity policies (Prof. Rik Leemans).

The WIMEK organisation

WIMEK consists of a network of chair groups and research staff in environmental, climate and related sustainability sciences. At Wageningen University, the chair group is the smallest organisational element. Each chair group comprises researchers and lecturers in a particular field, headed by a professor – the chair holder. The chair groups are organised into clusters to mobilise synergies and economies of scale. Individual chair groups and clusters can either operate within a single graduate school or across multiple graduate schools. The main clusters affiliated with WIMEK are:

- Climate, Water and Society
- Environmental Technology & Microbiology
- Landscape Architecture & Spatial Planning
- Soil Science
- Wageningen Centre of Sustainability Governance

See Annex 2 for an overview of all the chair groups and clusters that participate in WIMEK.

WIMEK management

The WIMEK management organisation consists of a General Board, a Scientific Director and executive staff, an Education Committee, a PhD Council and an International Advisory Board. See Annex 1 for more details on the members of these bodies during 2018-2020.

Annex 1

Governance Bodies

WIMEK Board

Prof. Huub Rijnaarts (chair)
Prof. Maarten Krol
Prof. Martha Bakker
Prof. Coen Ritsema
Prof. Diana Machado de Sousa
Prof. Paul van den Brink
Prof. Simon Bush
A member of the WIMEK PhD Council

WIMEK International Advisory Board

Prof. Alex Zehnder
Prof. Petra Döll
Prof. Mathijs van Es
Prof. Lea Kauppi
Prof. Peter Mollinga
Prof. Martin Prominski

WIMEK Staff

Prof. Carolien Kroeze – Scientific Director
Johan Feenstra – Executive Secretary
Peter Vermeulen – PhD education and training coordinator
Elackiya Sithamparanathan – PhD courses and event coordinator
Marjolijn Dannenburg – data management and website
Monique Buijtendorp – secretariat

Annex 2

Chair Groups in WIMEK

The table below shows which chair groups at Wageningen University are involved in WIMEK. In some cases, only part of the chair group participates in WIMEK while the rest of the group is affiliated with another graduate school.

Cluster	Chair group	Acronym	Participation of group members in WIMEK
Climate, Water & Society(CWS)	Aquatic Ecology & Water Quality	AEW	All
	Environmental Systems Analysis	ESA	All
	Hydrology & Quantitative Water Management	HWM	All
	Meteorology & Air Quality	MAQ	All
	Water Resources Management	WRM	Some
	Water Systems and Global Change	WSG	All
Soil Science Cluster (SSC)	Soil Biology	SBL	- (PE&RC)
	Soil Geography & Landscape	SGL	- (PE&RC)
	Soil Physics & Land Management	SLM	Most
	Soil Chemistry & Chemical Soil Quality	SOC	All
Environmental Technology & Microbiology (ETM)	Environmental Technology	ETE	All
	Environmental Microbiology	MIB-ENV	All
Landscape Architecture & Spatial Planning (LSP)	Landscape Architecture	LAR	All
	Land Use Planning	LUP	All
Wageningen Centre of Sustainable Governance	Environmental Policy	ENP	About 50%
	Public Administration & Policy	PAP	Some
Economics Section	Environmental Economics & Natural Resources	ENR	About 50%
Other clusters	Marine Animal Ecology	MAE	About 50%
	Mathematical & Statistical Methods	MAT	Some
	Plant Ecology & Nature Conservation	PEN	Some
	Toxicology	TOX	Some

Information and contact

Information
WIMEK:
www.wimek.wur.nl

WIMEK publications:
https://research.wur.nl/en/organisations/wimek/publications

Contact
e-mail: wimek@wur.nl