UNIVERSITY OF LEEDS

water@leeds

Annual Report 2018

Established in 2009, water@leeds draws together over 500 academics and postgraduates from across the University of Leeds to deliver excellent, internationally leading water science, technology and policy research.

The diversity of our membership means water@leeds is a focus for delivering interdisciplinary water research and innovation, whilst maximising the effectiveness of water sector research funding.

water@leeds works with business, local and national governments and governmental organisations, charities and NGOs. We engage locally, nationally and internationally.

The University of Leeds is a QS World top 100 university and a UK top 10 research institution. It is part of the prestigious, research-intensive Russell Group and is a member of the Worldwide Universities Network.

http://water.leeds.ac.uk/
https://twitter.com/wateratleeds

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Front and content photo: Shutterstock

Introduction from the Directors

The need for interdisciplinary research to tackle the world's grand challenges has never been more urgent.

Recently, climate scientists warned we must make substantial and immediate changes to the way in which we live our lives and the amount of carbon we produce if we are to avoid the irreversible and catastrophic 3°C rise in mean global temperature the world is currently heading for.

Of course, the world is already experiencing the impacts of global warming be it in terms of extremes in temperature, as experienced across the UK and mainland Europe during 2018, coastal flooding such as Hurricane Florence on the Florida Coast, or the separation of iceberg A-68 as further evidence of the destabilisation of the Antarctica Larsen C Ice Shelf. Whatever the event, it is clear the impacts of global warming and its impacts on the world around us are becoming more evident, more devastating, and more frequent.

water@leeds was created in 2009 in response to emerging global water issues, recognising that we have to take an interdisciplinary approach to tackle the grand challenges around water. water@leeds has expanded its expertise and interdisciplinary approach across arts and humanities, social sciences and law, environmental sciences, business studies, engineering, mathematics and physical sciences, biological and health studies. We are proud to be able to say we are one of the world's largest interdisciplinary water research centres. Our members work with a huge variety of similarly concerned organisations in the UK, Europe, and throughout the world.

During the last 12 months our members have worked on projects with, amongst others, Bill & Melinda Gates Foundation, National Natural Science Foundation of China, Moors for the Future, Natural England and Network Rail to secure strategic funding, and we look forward to developing these relationships in the coming years. We're also delighted to have strengthened our leadership team through the appointment of four excellent Associate Directors, who will work closely with us to develop and deliver our strategic objectives.

Looking forwards, water@leeds celebrates its 10th birthday in 2019. Coinciding with the opening of the new Nexus on-campus innovation centre, we are planning a series of exciting activities and events which will allow us to both look back at our achievements over the past decade, and forwards to the challenges of the coming decades. More information will be forthcoming on our plans, and we very much hope you will be part of them.

Finally, we hope you will enjoy reading our annual report and update on what has been achieved during 2018.

With best wishes,
Prof Joseph Holden and Prof Martin Tillotson
Directors of water@leeds
November 2018

Professor Joseph Holden
(School of Geography)

Professor Martin Tillotson
(School of Civil Engineering)

Candyfloss Waterslide (Photo: Sami Tarsuslugill)

Our vision

water@leeds was established in 2009. Its purpose is to tackle the global research challenges associated with water and to generate a step-change in terms of interdisciplinary research, scientific solutions, outcomes and their impact on the water environment.

Mission 1 - Research
Provide excellent internationally recognised water science, technology and policy research.

Mission 2 - Partnerships
Maximise the effectiveness of research funding in the water sector by becoming the focus for interdisciplinary water research.

Mission 3 - Impact
Generate world-leading research which has major impacts on society, environment and the economy.

Mission 4 - Next generation
Train new innovative, excellent and interdisciplinary water experts to work at the cutting edge of water research, management and policy.

Breathing Underwater (Photo: Sophie Anna Bellin)

Our year in review

Outputs

44 Conference presentations

35 Book / chapters

428 Peer-reviewed articles

Membership

500+ Members

162 Academic staff

434 Postgraduates

Media

250+ Media references
(online, radio, newspapers & TV)

2,331 Twitter followers

Partnership

23 New projects (worth £15+ million)

£40+ million live grants portfolio

1,000+ Partners

143 Countries

Associate Directors

Dr Anna Mdee (School of Politics and International Studies) Associate Professor in International Development

Mission 1 - Research

I'm excited to be working with the membership of water@leeds to raise the profile of the extraordinary diversity of water related research going on in Leeds. This year we will be working on enhancing the profile of water@leeds both internally and externally. As water@leeds marks its 10 year anniversary, we will be showcasing our work at high profile events such as Stockholm Water Week in August 2019, and working with our members and wider networks on producing an article on 'the most significant questions for international water research'.

Dr James Stark (School of Philosophy, Religion and History of Science) Associate Professor of Medical Humanities

Mission 3 - Impact

The researchers of the water@leeds community have a long-standing commitment to impact-rich investigation, responding to and inspired by real-world challenges and problems. By supporting the development of new partnerships, and maximising our existing relationships, my ambition is to facilitate a step-change in our capacity to meet the needs of industry, consumers, and the changing environment. If you are developing a programme of impact-related research, whether short- or long-term, or if you believe you have more to offer the sector, we are here to offer the support and connections to help make those ambitions a reality.

Dr Julia Martin-Ortega (School of Earth and Environment) Professor of Ecological Economics

Mission 2 - Partnerships

As part of our partnerships mission, we aim to maximize effectiveness of research funding by becoming the focus of interdisciplinary research worldwide. Our aspiration is to become a model for inspiration and empowerment, in which early career researchers take the lead in developing major cross-school interdisciplinary funding bids and enhanced network activity. For that, we facilitate leadership development, intelligence and success sharing and we seek to increase the diversity of funding sources from which our researchers can develop their full potential. Join us in this exciting journey!

Dr Miller Alonso Camargo-Valero (School of Civil Engineering) Associate Professor of BioResource Systems

Mission 4 - Next Generation

As an international, research-led University, we provide training in all aspects of water, with the unique aim of helping develop innovative, excellent and interdisciplinary water experts capable of delivering cutting edge solutions to water research, practice, management and policy challenges. We continue to attract the most talented candidates from the UK and across the world to our training courses and postgraduate academic programmes, where we provide an environment that supports development of technical and transferable skills. Our alumni, who are now living and working worldwide, are our best ambassadors and a testament to our commitment to academic excellence.

Photo: Dr Jonathan Carrivick

Research

The water@leeds research community are inspired by the global and regional grand challenges for water.

Addressing major research questions through the provision of coordination support, creation of an intellectually stimulating environment, promotion of activities and appointment of outstanding staff to deliver world-leading research, enable us to realise our core aims of delivering scientific, economic, and societal impact from the highest quality research.

Photo: Professor Joseph Holden

Mapping the global impact of shrinking glaciers on river invertebrates

This study found a globally consistent pattern in response of river invertebrates to decreasing glacier cover. **Professor Lee Brown** (School of Geography) and team combined data on river invertebrates collected from over 170 sites in nine mountain ranges, spanning three continents and both hemispheres. By examining invertebrates from glacier-fed rivers, researchers were able to demonstrate that effects on functional traits are due largely to environmental change caused by glacier shrinking.

Professor Brown and co-authors mapped functional traits shared by species, such as body size, movement, life-cycle length and eating habits. Invertebrates account for nearly 95% of the animal species on Earth; they perform important ecological roles such as maintaining soil fertility, carbon cycling, and water purification. Understanding invertebrate functional responses to environmental change is of urgent importance.

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Wastewater treatment plants are key source of river microplastics

In one of the first studies to determine potential sources of microplastic pollution, researchers led by **Dr Paul Kay** (School of Geography) found a link between wastewater treatment plants and contamination in rivers—up to three times higher on average. However, pervasive microplastics were also found in upstream samples. Improving treatment technologies could reduce the amount of microplastics in the environment, but other sources of contamination must also be identified and addressed.

To discern how modern lifestyles contribute to river pollution the team characterised sample material into pellets/beads, fibres and fragments/flakes. Fragment and fibres made up nearly 90% of the material, implicating contributions from clothing and textiles. The amount of plastic microfibres polluting our rivers indicates we need to review the role of synthetic fabrics in causing long-term environmental harm.

Contact: Dr Paul Kay
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Tim Wainwright Chief Executive of WaterAid UK Visit

Mr Tim Wainwright, Chief Executive of WaterAid, spoke to **Professor Barbara Evans** (School of Civil Engineering) about his career, his experiences in development administration, and his views on the challenges and realities of international engagement in 2018. The event was collaboratively organised by water@leeds, the Centre for Global Development (CGD) and the Researchers in Development Network (RiDNet).

Established in 1981 by the UK water industry, WaterAid utilises UK water sector expertise to deliver global improvements. Mr Wainwright invited questions and discussion from the floor and encouraged a rich and diverse discussion from the researchers and students.

Mr Wainwright believes water, sanitation and hygiene underpin all progress in development from civil society, governments and the private sector.

Contact:
Professor Barbara Evans
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Tim Wainwright (right) being interviewed by Professor Barbara Evans
Photo: Dr Celia Way

Cape Town, a city without (enough) water

Professor of Urban Water Management, Neil Armitage, from the Civil Engineering Department at University of Cape Town visited water@leeds to share his professional and personal experience of Day Zero. Cape Town is suffering from the worst drought on record. Reservoirs supplying the region are nearly empty, after three consecutive dry years, including the two driest years on record. Extreme water supply

restrictions, including limiting per capita daily use to 50 litres, were implemented, as were contingency preparations for a complete shut-down of 75% of the water distribution system. Significant reductions to public and industrial consumption combined to help avert Day Zero for the short term, but the dramatic events have left a legacy of private boreholes and plastic storage tanks which harbour future risks. Efforts to ensure equitable distribution of water also revealed populations living in water poverty, unable to access clean water and adequate sanitation.

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New research aims to protect communities at risk from flooding

An innovative project plans to demonstrate that landscape restoration could protect at-risk upland communities from flash flooding. **Professor Joseph Holden** (School of Geography) is co-investigator on the Natural Environment Council (NERC) funded project, which will investigate natural flood management methods for protecting communities at risk from steep upland streams and rivers. Vulnerable rural communities are often small and spread out, and are rarely targeted for expensive traditional flood defences. Previous research has shown that upland restoration can have a substantial impact on the flow of water during storms.

The project will improve understanding of how reintroducing vegetation to bare soils and damming up erosional channels increases the roughness of the land's surface and slows the flow of water entering streams. Evidence of the delayed release of water from uplands and the profile of reduced peak storm flow informs how to optimally invest to reduce the chance of flooding downstream. The project will assess the longer-term evolution of woodland and gully blocking approaches, and determine how newly-planted upland woodlands affect storm flow.

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Professor Joseph Holden
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Congo River users Hydrology and Morphology (CRuHM)

CRuHM is a Royal Society-DFID funded research capacity building project focused on the Congo River (2016-2021). **Dr Mark Trigg** (School of Civil Engineering) is the water@leeds leader in a consortium including the Universities of Bristol, Kinshasa, Rhodes, and Dar es Salaam. The consortium are undertaking large-scale fundamental hydrology, hydraulic and geomorphological science research on the main navigable channels of the Congo River to address the severe lack of basic knowledge and understanding in these water

Hands on river flow measurement with ADCP training on the Nsele River, Aug 2018 (Photo: Dr Mark Trigg)

CRuHM stakeholder training workshop on fieldwork methods at the University of Kinshasa, August 2018 (Photo: Dr Mark Trigg)

research fields for the world's second largest river. **Andy Carr** (School of Civil Engineering), undertook fieldwork focused on in-depth equipment training for stakeholders at the University of Kinshasa and on utilising the nearby rivers. Other activities included a sediment transport workshop in Moshi, Tanzania, and a key role in the prestigious American Geophysical Union Congo Chapman Conference in Washington. water@leeds are a partner in the new regional Congo Basin Water Resources Research Center (CRREBaC) at the University of Kinshasa.

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The Deluge in Romantic poetry

Dr Tess Somervell (School of English) works on the cultural history of the Deluge and representations of flooding in English literature. She is a Research Assistant on the Arts and Humanities Research Council (AHRC) funded project British Romantic Writing and Environmental Catastrophe.

In the eighteenth and nineteenth centuries many geologists believed that the Earth had been formed by a global deluge, or flood, (recorded in the Bible as Noah's Flood), which carved out mountains and continents. When Romantic poets like William Wordsworth, Charlotte Smith, and John Clare wrote about deluge, therefore, they portrayed it as an apocalyptic catastrophe but also as a creative force. For these poets floodwater had shaped the landscape, and had left stories and myths in its wake as well as fossils and erratic boulders.

The project team collaborated with The Wordsworth Trust to run poetry workshops, using Romantic poetry to inspire people across Yorkshire and Cumbria to write about their relationships with weather and climate. Many took the opportunity to write about their experiences of the severe local flooding during of 2015/2016. As we face increasing risk of environmental catastrophe, reading and writing poetry reminds us of the importance of preserving communal stories and memories.

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The power of the peat bogs of the Congo

Professor Simon Lewis (School of Geography) is leading a team of interdisciplinary scientists studying the world's largest tropical peatland complex. The CongoPeat Project aims to understand how the peatland was established, how it functions today, and how it will respond to human-induced climate change and differing future development pathways. The researchers will use the results to inform critical policy decisions about the Congo region.

The CongoPeat team, which includes **Professor Andy Baird** (School of Geography) and **Dr Paul Morris** (School of Geography), will produce the first comprehensive assessment of the genesis, development, and future of the world's largest tropical peatland, enabling the UK to retain world-leading expertise in understanding how the Earth functions as an integrated system, and how humans are changing it.

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On Thin Ice

Hundreds of icy ponds on Himalayan glaciers could hold the key for the region's future water security. Icy ponds on debris-covered glaciers have been found to retain and release waters, regulating flow to downstream rivers that serve as lifelines to millions of people. **Dr Duncan Quincey** (School of Geography) is part of an interdisciplinary team investigating formation of these ponds and how changes to meltwater impacts downstream supplies both seasonally and in response to climate change.

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Photo: Dr Duncan Quincey

Partnerships

water@leeds projects bring together faculty from across the University including engineers, physical and natural scientists, biologists, economists and social scientists to find solutions to global water issues.

Our projects often include partnerships with a wide range of NGOs and businesses that help both to shape research for all parties, as well as providing the necessary outputs to inform, change practice and train the next generation of researchers.

The Terrace (Photo: Harewood House Trust and Lee Beel)

Economic value of trees at the Harewood House Estate

Dr Julie Peacock (School of Geography), **Dr Karen Bacon** (School of Geography) and Joey Ting, University of Alberta, recently published an article in PeerJ detailing how the trees of stately homes such as the Harewood House could provide value in terms of carbon storage, runoff prevention, and pollution removal along with additional benefits to biodiversity and human health.

Previous research has shown the economic and ecosystem service value of trees in urban environments. However, one land-use type that has been missing in ecosystem service literature is the estates of stately homes. Considering the ecosystem services of stately homes and their estates has multiple potential benefits, including raising the profile of the ecosystem service benefits of trees to the visiting public.

The 400-hectare estate of Harewood House in North Yorkshire represents an ideal example of such a stately home, with a mixture of parkland and more formally planted gardens.

This is the first research of its kind in exploring the economic and ecosystem benefits of the trees in stately homes.

In total, the trees on the Harewood House estate are estimated to provide approximately £29 million in ecosystem service benefits each year. The value of both individual trees and garden types should be considered in future planning and management of such estates.

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Irrigating Africa Conference

Studying African Farmer-led Irrigation (SAFI) is a collaborative project uniting African and European-based researchers. Funded by the UK's DFID and Economic and Social Research Council (ESRC) Growth Research Programme (DEGRP), the project assesses the contribution of farmer-led irrigation development on economic growth.

Dr Anna Mdee, (School of Politics and International Studies), participated in "Irrigating Africa - Reframing Agricultural Investment". This conference brought together key researchers and policy makers working in sub-Saharan Africa to critically review the findings of SAFI and other recent research on 'farmer-led' irrigation initiatives, and to assess their significance for policies of irrigation investment in Africa. Dr Mdee specialises in governance challenges of managing competing demands on water in Eastern and Southern Africa.

Improvements in understanding of irrigation, and better data on those practices are transforming our understanding of irrigation on the continent. At the same time multiple farmer initiatives are transforming the extent and activity of irrigation works.

Dr Anna Mdee together with the participants at the conference held at the Rockefeller Foundation (Photo: Dr Anna Mdee)

African governments are making ambitious commitments to increasing the area of land being irrigated, and are looking for policy advice. Discussions at this conference made clear the necessity of working across disciplines in order to address the critical capacity, institutional and resources issues that are escalating the potentially negative impacts of increasing irrigation under current conditions—most significantly: marginalisation of the poorest, and depletion of water sources.

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Partnership agreement with James Cook University

Professor Julia Martin-Ortega (School of Earth & Environment) visited James Cook University in Australia to develop research collaborations with the Division of Tropical Environments and Societies.

Professor Martin-Ortega was invited by Professor Iain Gordon, Deputy Vice-Chancellor of James Cook University to input in the development of their work on ecosystem services.

As part of her visit, Professor Martin-Ortega visited the Townsville and Cairns campuses, meeting colleagues from the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Areas of collaboration between the two universities include research on the insurance value of ecosystem services (for which a joint paper is being prepared) and furthering understanding of the value-base of environmental governance.

Professor Martin-Ortega is co-developing a research proposal with James Cook University researchers to test new value conceptual frameworks in ‘contested spaces’ with indigenous and aboriginal communities in Mexico and Northern Australia.

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Scottish peatlands
(Photo: Dr Catherine S Moody)

DOM and its impact on water treatment in a changing climate

At least 11.4 million people in the UK rely on peatlands for their drinking water. Rivers fed by significant peatland contributions have high concentrations of dissolved organic matter (DOM) and highly coloured water. Deterioration in water colour breaches EU drinking water standards and requires increasingly intensive treatment solutions, raising costs and climate impacts.

It also has health implications as the treatment of highly coloured water can result in the production of carcinogenic disinfection by-products which are strictly regulated. When water colour increases become too severe, water companies have to invest tens of millions of pounds in new treatment plants, plus the additional expense of running those plants.

Dr Catherine Moody (School of Geography) is working with Northumbrian Water, Scottish Water, United Utilities, Welsh Water, Yorkshire Water and

others on a Natural Environment Research Council (NERC) funded Industrial Innovation Fellowship to investigate factors that influence and control the composition of DOM. The research explores natural variation across different catchments, land uses and at different scales, using sites from across the UK.

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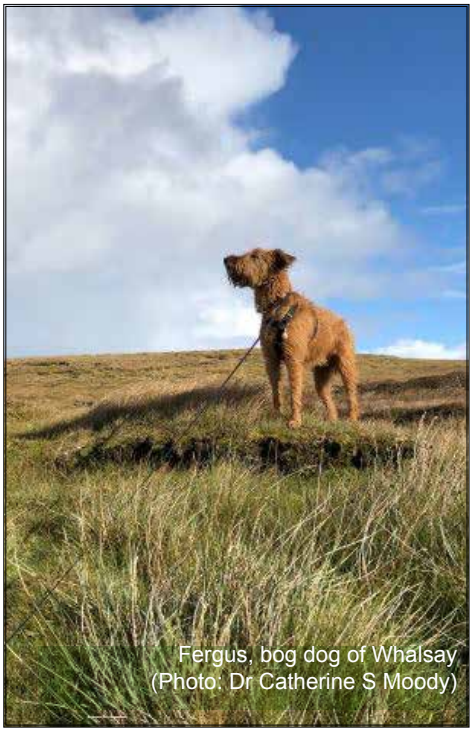

Fergus, bog dog of Whalsay
(Photo: Dr Catherine S Moody)

Pioneering filtration

G_2O Water Technologies has teamed up with **Professor Martin Tillotson** (School of Civil Engineering) as it aims to address the world's drinking water crisis through pioneering graphene-based technology. Working with the Public Health Laboratories within the School of Civil Engineering, G_2O aims to address issues relating to removal of molecules or ions including salts, oil, nuclear waste, dyes, pesticides and other chemicals.

G_2O's technology reduces the amount of energy needed to filter the water passing through a membrane by up to 50%, increasing throughput while combating contamination and lowering the overall cost.

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Impact

water@leeds leads in the development of innovative approaches to water-related issues. Tools and models, new scientific and engineering discovery, health, environmental, and policy informing outcomes can be developed in conjunction with partners in industry or academia. These often lead to joint commercialisation opportunities.

We work with national and international industrial, government, charity and academic bodies.

Water Networked (Photo: Lawrie Phipps)

Solid waste solutions for creating a sustainable marine future

Dr Costas Velis (School of Civil Engineering), Lecturer in Resource Efficiency Systems, played a key role at the recent KfW Development Finance Forum in his capacity as Chair of the International Solid Waste Association (ISWA) Marine Litter Task Force, addressing the conference attendees on the marine litter global challenge.

The Forum, entitled Oceans 21 – Solutions for a Sustainable Marine Future, welcomed close to 150 high-level experts from around the world from academia, civic society, and the financial sector working on ocean conservation. The event aimed to create a place for the exchange of ideas to collectively find solutions for establishing a sustainable marine future.

Delegates discussed ways to protect the world´s oceans and identified any potential challenges. The focal points were marine protection, marine economy and marine litter.

Dr Velis believes that solving the solid waste management crisis in the Global South can prevent marine litter.

There is a strong proponent of improving recyclability by design, and a need to combine this with suitable infrastructure to capture and process the waste items for the 2 billion citizens who live without waste collection services in the Global South. The conclusions of the Forum endorse and reinforce the messages of the ISWA Marine Litter Task Force, which Dr Velis put forward.

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Global water and forest in an era of climate change

Led by the International Union of Forest Research Organizations (IUFRO), the Collaborative Partnership on Forests' Global Forest Expert Panels (GFEP) initiative undertook a comprehensive scientific assessment of the state of knowledge on the forest-water relationship. The panel's report was formally launched in July at the UN Headquarters in New York. **Professor Julia Martin-Ortega** (School of Earth and Environment) was one of the authors and panel members. water@leeds, University of Cambridge and Food and Agriculture Organization of the United Nations (Rome, Italy) hosted the expert meetings.

The resulting publication, entitled "Forest and Water on a Changing Planet: Vulnerability, Adaptation and Governance Opportunities" is a Global Assessment Report which constitutes the most comprehensive, systematic scientific syntheses on the interactions between forests and water on a global level.

The report concludes that international governance can play a key role in optimizing climate- forest-water relations by creating norms such as the Sustainable Development Goals (SDGs), by providing forums in which norms can be discussed, negotiated and agreed upon, and by providing opportunities for assessing progress. Similarly, new levels of collective action especially across sectors and across spatial scales, as well as stronger participatory approaches are needed to shift policy goals away from profit-oriented toward more sustainability-oriented strategies.

Contact: Professor Julia Martin-Ortega
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Low-carbon solution for faecal sludge management in the developing world

Dr Celia Way (School of Civil Engineering), together with a team of experts from the University of Bath are developing artificial poo in order to improve sanitation in developing countries. Across the world, 2.7 billion people do not have access to a flushing toilet and instead rely on static sanitation systems like pit latrines to deal with their waste.

A lack of suitable places to dispose of faecal waste as well as poor understanding of the risks involved means it is often disposed of in fields and rivers. The negative health impact of this cannot be understated. Germs found in faecal sludge cause illnesses, such as diarrhoea, which results in the deaths of more than 750,000 children under five every year. A key way of addressing this problem and improving sanitation is to research and develop safer, more efficient ways of treating faecal waste for the parts of the world where people do not have basic sewerage and centralised waste water treatment. This research addresses the issue of safely disposing human waste by developing and investigating 'fake poo' in order to test and understand the drying process of faecal sludge. The resulting simulant sludge will be tested in drying beds exposed to a variety of humidity, temperature and solar radiation conditions. By testing the sludge in a range of conditions the researchers intend to provide best-practice guidelines to inform the deployment and development of solar-based faecal sludge treatment technologies in a range of developing countries and climates.

The researchers hope this project will have a significant impact in reducing illness and death associated with the unregulated disposal of faecal sludge, and provide a regulatory 'design chart' to inform governments and NGOs about correct faecal sludge drying times using low-cost, low-energy solutions.

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Role play with the Theatre Forum participants (Photo: Prof Julia Martin-Ortega)

Trying new (fun!) participatory research approaches: Theatre Forum

As part of the Usumacinta Roc Project, **Professor Julia Martin-Ortega** (School of Earth and Environment) and colleagues from El Colegio de la Frontera Sur (ECOSUR) and Scotland Rural College tested an innovative participatory research method. Using Theatre Forum, they presented project results, which focused on understanding the risks that using an ecosystem services framing of environmental problems might bring in terms of commodifying nature, to an audience of environmental professionals in Mexico.

This entailed a short representation of a local community assembly using a script based on project results and an interactive phase in which the public could get involved in the play. Using improvisation theatre techniques, this allowed participants to take the findings of the research further, moving the dialogue forward and opening new avenues of thinking about how communities interact with the environment.

Contact: Prof Julia Martin-Ortega
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The Yorkshire Integrated Catchment Solutions Programme (iCASP)

iCASP is a flagship water@leeds programme. Funded by the Natural Environment Research Council under the Regional Impact from Science of the Environment initiative, its aim is to generate impacts worth more than £50M to the regional economy.

It's on the way to achieving this. In just over a year, iCASP has generated more than £4 million of economic/financial benefits, contributed to the success of business cases with an investment value of more than £118 million, created 9 jobs and involved at least 75 organisations.

Core to iCASP's success is project co-design. This enables practitioners to clarify their needs, and academics to showcase relevant research and innovation for addressing a specific catchment challenge. Seven projects are now active with more on the pipeline. Most involve translating research into accessible tools and resources. DigiBog_Hydro is a good example. A user-friendly version of this model, developed by water@leeds, is being created to help peatland restoration practitioners simulate the effect on the water table of different interventions. This reduces their costs by optimising restoration strategies.

Another example is the iCASP Natural Flood Management (NFM) Project which has also achieved substantial cost savings for many iCASP partner organisations by providing monitoring and modelling expertise to a suite of pilot NFM projects across Yorkshire.

However, the remit doesn't stop there. iCASP is also helping to inform policy. An iCASP evidence review of agricultural interventions to improve soil health, for example, is being tailored to make it of use to Defra and other relevant audiences.

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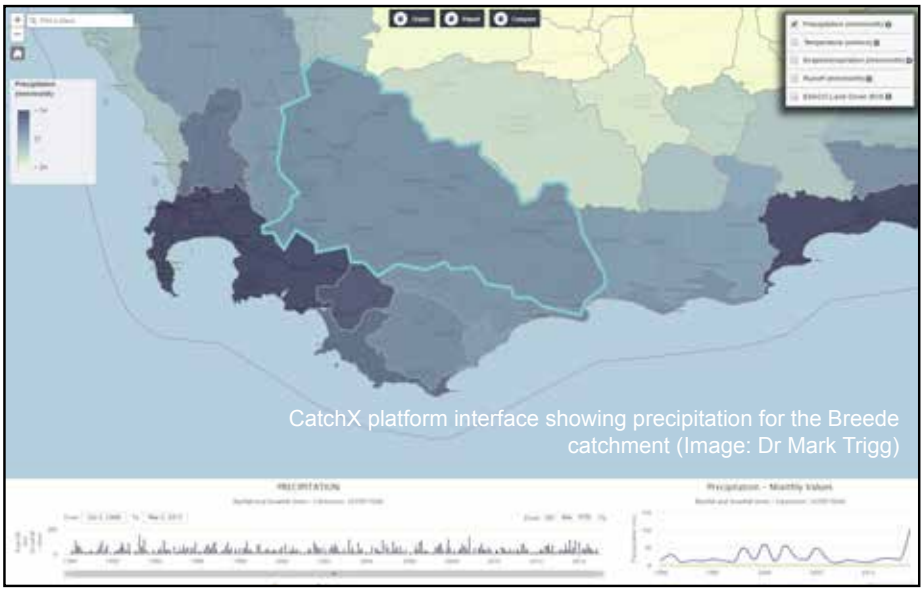
CatchX – Launch of new global hydrology data platform

Lack of data in many parts of the world makes good water resources management particularly challenging, especially in the face of population growth, increasing consumption and climate change. The CatchX web-platform has been designed by Earthwatch Europe to allow universal access to cutting-edge scientific data in any river catchment globally. The most appropriate datasets have been selected and processed into more than 50,000 catchments.

The platform allows non-specialists access to datasets in their catchment— for example, to visualise water balance information, explore trends and compare with other catchments. The platform launches in December 2018.

A successful workshop was held with water professionals in drought hit Cape Town, South Africa to better understand needs of users. Thorough testing of the datasets was undertaken by Rhodes University against national



CatchX platform interface showing precipitation for the Breede catchment (Image: Dr Mark Trigg)

Breede River in June 2018 during a stakeholder workshop (Photo: Dr Mark Trigg)

data available in South Africa. Testing revealed that the global datasets are usable for most water balance parameters, although runoff suffers from more uncertainty and should be used with caution.

This NERC Innovation project is led by **Dr Mark Trigg** (School of Civil Engineering) in partnership with Earthwatch Europe, Rhodes University, World Wildlife Fund (UK & South Africa), Marks & Spencer, Fathom Global, Richard Carter & Associates and others.

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Blackcurrants could help end bad (for the planet) hair days

Natural dyes extracted from blackcurrant waste created during Ribena manufacture have been used in an effective new hair dyeing technology developed by **Dr Richard Blackburn** (School of Design) and **Professor Chris Rayner** (School of Chemistry). The team collaborated to identify and isolate naturally-occurring alternatives and a sustainable process to produce them. The colour is extracted using a water-based process and special filters to collect the anthocyanins that the researchers wanted. They developed a patented sustainable hair dyeing technology that provides intense reds, purples and blues on hair that, when combined with a natural yellow, could provide a wide range of colours including browns. Colours produced were stable for at least 12 washes. Researchers are commercialising their technology through a University of Leeds spinout company, Keracol Limited under the brand Dr Craft. The blackcurrant-based dyes should be on sale in 2019.

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Next generation

water@leeds Doctoral Research and Training Centre (DRTC) is the world's largest interdisciplinary centre for postgraduate students. The primary aim of the DRTC is to maximise opportunities for new researchers to conduct high-quality research and obtain skills necessary to become experts in interdisciplinary water research.

EUROFLOW Summer School (Photo: Dr Megan Klaar)

water@leeds Doctoral Research and Training Centre (DRTC)

The water@leeds DRTC brings together over 187 PhD students from across the University of Leeds to create one of the world's largest interdisciplinary training centres for water related research. Our PhD students come from all over the world, representing multidisciplinary and international water challenges. The DRTC is providing PhD students with a platform to network and share news and expertise, generate collaborations that enrich both the science and student experience at the University of Leeds. Being a member of the water@leeds DRTC requires an active approach which benefits our graduates when it comes to developing their future career. We have a growing group of alumni members, who represent water@leeds globally, promote our research activities and generate overseas partnerships.

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EUROFLOW ITN Zernez Summer School (Photo: Dr Christopher Robinson)

Reforming water abstraction management in the UK

Dr Megan Klaar (School of Geography) was one of three academics invited to the Water Framework Directive UK Technical Advisory Group (UKTAG) meeting on environmental flow standards. The event sought to ascertain the level of scientific evidence currently underpinning the Government's water abstraction licensing system. Dr Klaar's work on flow-ecology relationships and statistical modelling was used in the workshop to outline the need for revised environmental flow standards, and the possibility of using a more refined approach. Leeds based EuroFLOW early stage researchers **Cordi Wittekind, Saman Hashemi** and **Tapiwa Zimunya** (School of Geography) are further developing this evidence-based environmental flow work as part of their PhDs. Ongoing research will focus on future water availability and economic appraisal of water licensing options and designing water releases from reservoirs to maximise ecological benefits to downstream biota.

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Water consumption practices in Brazil and England

Access to drinking water is not just a global concern but considered as a fundamental right. Not everyone consumes water responsibly, which offers the opportunity to explore the implications of people's actions towards the environment. Research by **Gabriel Isboli** (School of Earth & Environment), aims to understand how the concept of sustainability impacts household water consumption practices in Brazil and England. He intends to use a practical approach allied to a cross-cultural discussion, the Oral History, both for data construction and analysis. His discussion intends to bring together cultural and practice approaches, noting that the cultural environment can result in a particular understanding of a concept. Gabriel is a visiting PhD student from the State University of Maringá with a Brazilian scholarship.

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Peatland contributions to global water security

Jiren Xu (School of Geography) joined the University of Leeds in 2015 to study the role of peatland in global drinking water provision. Although water provision is a commonly stated ecosystem service of peatlands, it is unclear how much peatland-delivered water is readily available as a global potable resource.

In Jiren's study, a meta-analysis of geospatial information collated from a variety of sources at global, regional and national levels was used to produce an improved global peatland map, PEATMAP. Jiren then produced the Peat Population Index (PPI) and Peat Reservoir Index (PRI), combined global-scale peatland, population, surface hydrology, topography and land use datasets to identify hotspots where peatlands are crucial for potable water supply. Results show that peat-rich catchments deliver water to 71.4 million people; however, globally, only 28% of water-supply peatlands are pristine or protected.

Approximately 85% of all drinking water delivered directly from peatlands is consumed in the British Isles, demonstrating the crucial role peatlands play in the water security of some countries, as well as the urgent requirements of peatland restoration in these countries.

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Ecohydrological controls in the Mekong delta mangrove

Mangroves are amongst the most carbon-dense ecosystems in the world. The major input of organic carbon into mangrove soil seems likely to come from fine roots. However, our knowledge of fine root production in mangroves is severely limited, due in large part to the inherent difficulty of measuring such subterranean processes. Measurement techniques for fine root production are time consuming, expensive, and often destructive.

Marie Arnaud (School of Geography, 2017 SPRING competition winner) developed Enroot minirhizotron, an inexpensive, easy to build and partially 3D printable minirhizotron that offers a non-destructive alternative to quantify fine root production and enable high-frequency in situ monitoring with little disturbance after an initial settling period. The cost of the new minirhizotron is around ten times less than the commercial minirhizotron. Enroot is light, waterproof and utilises a narrow minirhizotron tube that can fit between stilt-roots of mangrove.

Monitoring root production using Enroot (Photo: Marie Arnaud)

With the help of Enroot, Marie collected the first detailed data on patterns of root production in the world's second largest rehabilitated mangrove forest, in the Mekong Delta, Vietnam. The results will provide valuable data to inform projections of the response of mangrove carbon stocks to climate change, and will guide mangrove restoration and protection efforts both in the Mekong and beyond.

Contact: Marie Arnaud
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Marie presenting PhD results at Ho Chi Minh University (Photo: Marie Arnaud)

Installing 60 minirhizotrons in the Mekong (Photo: Marie Arnaud)

Biofilters: a sustainable multifunctional solution to stormwater runoff pollutants

Human induced climate change is affecting global average temperatures, resulting in rising sea levels and more extreme weather events. The expansion of cities has worsened the effects of runoff due to lack of permeable surface area with consequent increase in floods and poorer water quality.

Biofilters are green infrastructure that manage stormwater runoff while delivering multiple ecosystem services with a compact footprint. However, unclear maintenance requirements, and the treatment of dissolved pollutants is preventing widespread adoption of this technology.

Andrea Aiello (School of Civil Engineering, 2017 SPRING competition winner) has set-up a lab scale biofilter experiment on the effect of Granular Activated Carbon (GAC) and Zeolite on plant and water treatment. The columns are dosed with synthetic storm water for durations simulating local rainfall regimes, and are modelled for water

quality, hydraulic conductivity, moisture and plant growth. The first outcomes, presented during the International Conference on Urban Drainage 2017 and Urban Drainage Modelling 2018, show better treatment for the amended designs.

Contact: Andrea Aiello, Professor Martin Tillotson and Dr Christian Beretta
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24 biofilters in the greenhouse of Bardon Grange Lodge (Photo: Andrea Aiello)

Biofilters up close (Photo: Andrea Aiello)

A first collective validation of global fluvial flood models for major floods in Nigeria and Mozambique

Mark Bernhofen (School of Civil Engineering) led a study validating the flood hazard output of six global flood models. This research was the first to compare the performance of multiple models against historical flood events.

An offshoot of **Dr Mark Trigg**'s (School of Civil Engineering) 2016 paper "The credibility challenge for global fluvial flood risk analysis", this validation work expands on the findings of this initial intercomparison and identifies how different model structures and conditions affect performance. In a field still in its infancy, this research is important in focusing future model development. It also provides a comparable measure of model performance to end users such as the United Nations or the World Bank, who use these flood hazard models for disaster response.

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2017 - 2018 Spring Award winners

The DRTC runs the Supporting Postgraduate Research to Inspire the Next Generation (SPRING) competition scheme: a postgraduate research funding competition open to all DRTC members. SPRING aims to provide additional research funds to research postgraduates to extend the scale and scope of their research projects. There are no disciplinary boundaries for PhD topics.

The winners of the 8th SPRING (June 2018) competition:

Oloyede Adekolurejo (School of Biology) Effects of cyanobacterial toxins on the biodiversity structure and ecosystem functioning in freshwater systems.

Myrna Barjau Pérez Milicua (School of Biology) Impacts of drought and warming on structure and function of invaded and non-invaded freshwater ecosystems.

Sarah Letsinger (School of Geography) Occurrence and effects of pharmaceuticals in estuaries.

The winners of the 7th SPRING (Dec 2017) competition:

Benjamin Pile (School of Biology)
Combined impacts of parasites and climate change on the vital freshwater ecosystem process of detritivory.

Daniel Warren (School of Biology) The ecological impact of invasive freshwater predators upon native amphibians.

water@leeds affiliated Masters Programmes

Masters courses at the School of Geography

MSc in River Basin Dynamics and Management with GIS
Masters by Research

Masters courses at the School of Earth and Environment

MSc Environment and Development
MSc Climate Change and Environmental Policy
MSc Sustainability and Consultancy
MSc Sustainability and Business
MSc Ecological Economics

Masters courses at the School of Civil Engineering

MSc Environmental Engineering & Project Management
MSc Water, Sanitation and Health Engineering

Masters courses at the School of Mathematics

MSc Atmosphere-Ocean Dynamics

Masters courses at the School of Philosophy, Religion and History of Science

MA in History of Science, Technology and Medicine

Masters courses at the Faculty of Biological Sciences

MSc/MRes Biodiversity and Conservation (African Field Course optional)
MSc Bioscience
MSc Infection, Immunity and Human Disease
MSc Plant Science and Biotechnology

Testimonials

Craig Clement, Director of G_2O

G_2O Water Technologies (G2O) established a collaboration with water@leeds to support the development of its water filtration coating technology. G_2O produces graphene oxide coatings which improve water filtration processes and reduce the cost of water filtration. Through the collaboration with water@leeds, G_2O have undertaken testing in the University's laboratories and are sponsoring PhD and MSc students to undertake membrane testing. This has enabled G_2O to accelerate and enhance its development programme.

Rob Lamb, Managing Director, JBA Trust

The water@leeds and Yorkshire iCASP teams have been helping us to explore sustainable approaches to managing flooding in upland rivers through PhD research, assess some of the practical implications of new UK climate change projections and plan for advances in high-resolution surface water flood prediction. The water@leeds events we've attended have been a great platform to showcase our physical models. We are looking forward to working with you on new flood risk communication tools in the coming year.

Zora Van Leeuwen, Postgraduate Researcher, School of Geography, University of Leeds

Support and funding from water@leeds allowed me to host a very well received outreach day for interested members of the public from the charity PLACE (People, Landscape, Culture and Environment of Yorkshire). The day started with talks about the management of water in our landscape, both from an academic and practitioners' perspectives. The attendees were then taken to my field site in the Yorkshire Dales, where they were spellbound by the land-owner's revelations about anthropogenic influences on the landscape. The day gave me the opportunity to engage members of the public in this important area of research and would not have been possible without the time, effort and funding provided by water@leeds.

Robert Burnett, Natural England Manager,
Yorkshire and Northern Lincolnshire

water@leeds provide exemplary facilitation and leadership that connects land management organisations together. Their iCASP project is on track to secure significant environmental and economic benefits by supporting partnership collaborations through the dissemination of evidence and research. We are also particularly pleased with the developing relationship we have; around the use of Natural England's National Nature Reserves for research, education and public understanding. Their facilitation has generated exciting, and occasionally surprising, ideas from all sections of the University that will benefit both of our organisations and the people we serve.

Dr Karen Bacon, Lecturer, School of Geography,
University of Leeds

It has been great becoming more involved with water@leeds colleagues this year. Attending meetings and events has provided additional networking opportunities and is facilitating the development of new collaborations. Colleagues in water@leeds have also helped facilitate a conference by providing helpful information and support around the nuts and bolts of organisation. I look forward to further developing our work together.

Dr Faith Chan, Assistant Professor, University of Nottingham Ningbo, China

I was the chair of the water@leeds Postgraduate forum from 2008-2012 and we set up a delta group in 2010 as well. I enjoyed working with water@leeds and I am still actively involved with water@leeds as a visiting research fellow and have to thank water@leeds for support. This year has been great that we won the grant with Dr Paul Kay at Natural Science Foundation China (NSFC) investigating micro plastics, and I will continue working closely with water@leeds, Leeds is my home as always.

Wash the sand off your toes (Photo: Sarah Douglas)

Testimonials

Dr Elena Lopez-Gunn, Director ICATALIST-Spain, water@leeds visiting Cheney Fellow

The collaboration and exchange with water@leeds provides a strong springboard for joint activities. This year in June 2018 we hosted an event at Adaptation Futures in Cape Town, South Africa (https://adaptationfutures2018.capetown/). Together with projects from Africa, Latin-America and Europe (so called “buddy” projects) we did our best collaborative thinking to gather our collective intelligence on the role of nature-based solutions can play in climate change adaptation and DRR. These buddy projects came together to reflect on actionable science. It was exciting to share experiences around what we are learning from transdisciplinary and engaged research processes, how to maximise the uptake of evidence from research and innovations into policy and practice, and how we can “go the last mile” – from good research, good policy, and great ideas to actual implementation that lead to real change. In other words, a kind of voluntary audit on the policy relevance and impact of our own projects. We will now prepare a collective policy brief that summarises the main outcomes from the workshop. Watch this water@leeds space for the main findings!

Dr John Marsham, Associate Professor, School of Earth & Environment and National Centre for Atmospheric Science

water@leeds has been invaluable for my interdisciplinary research, and in providing support for leading large projects. The water@leeds network has introduced me to individuals across campus, who I now work with on major funded activities. The water@leeds team has also supported development of bids for large projects and the resultant administration when successful. Both have given me more time to focus on teaching and research. There are many important problems that can be addressed by a single discipline. There are many others that need teams from across disciplines to work together, and this has added an enjoyable variety to my work, and increased its impact.

Awards & honours

Dr James Stark (School of Philosophy, Religion and History of Science) together with Dr Alinka Greasley (School of Music), were shortlisted for the inaugural Health Humanities Medal, sponsored jointly by the Arts and Humanities Research Council (AHRC) and Wellcome Trust. Dr Stark was nominated for the Best Doctoral or Early Career Research Award.

Professor Caroline Peacock (School of Geography) has recently been awarded a Royal Society Wolfson Individual Research Merit award.

Professor Ken Carslaw , **Dr Gabriela Lopez-Gonzalez**, **Professor Simon Lewis**, **Professor Oliver Phillips and Professor Dominick Spracklen**, won the Clarivate Highly Cited Researchers 2018 .

Professor Bruce Yardley was awarded a Mineralogical Society Collins Medal (2017). The Medal is awarded to scientists who have made outstanding contributions to pure or applied Mineral Sciences and associated studies throughout their career.

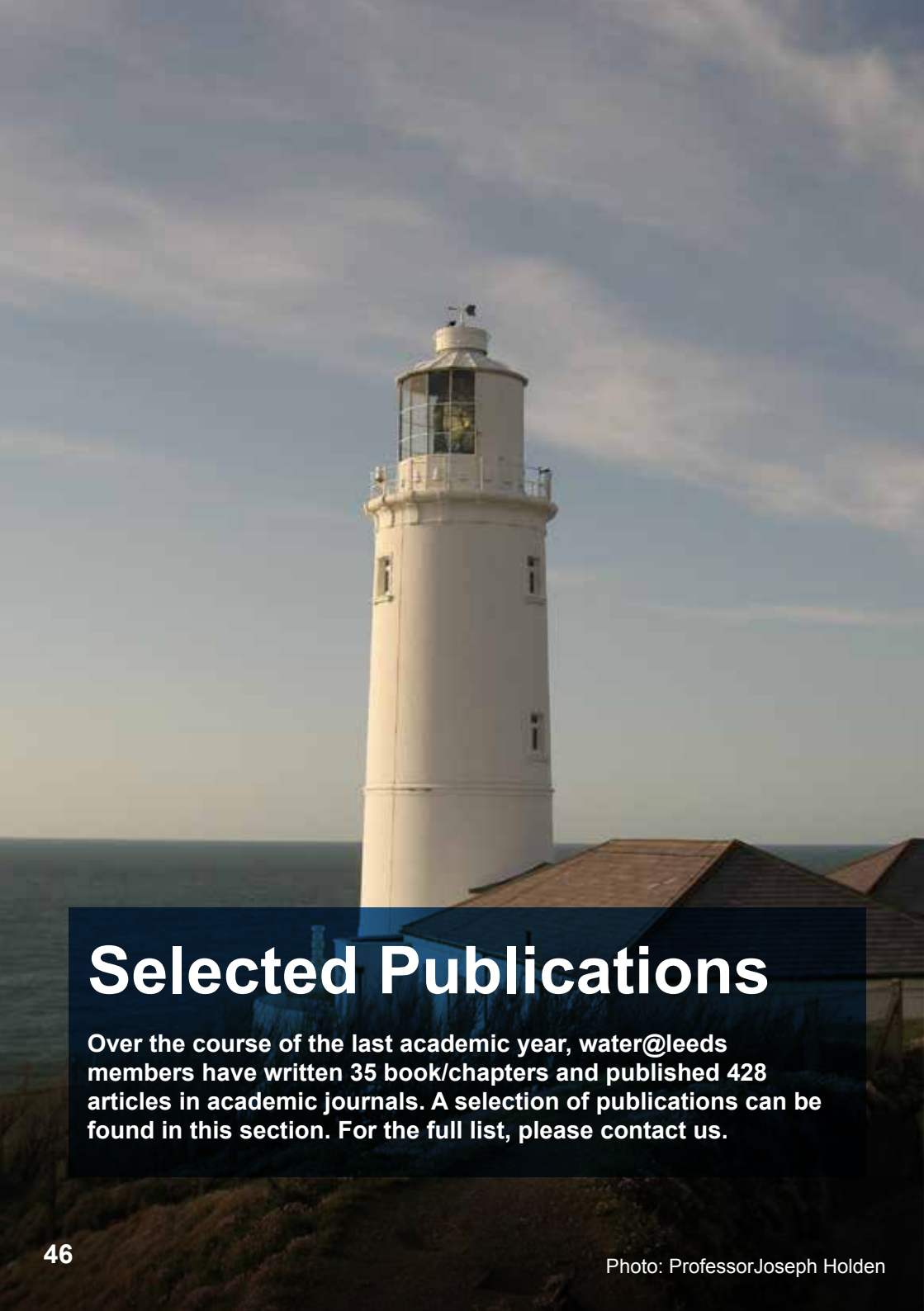
Dr Martin Zebracki has been granted the Researcher Mobility Award from the University of Leeds Research and Innovation Service for conducting his research project CARED: Community Art and Recovery in Environments Disrupted by Disasters in Christchurch, with host collaborator David Conradson, Department of Geography, University of Canterbury, New Zealand.

Dr Paola Sakai was awarded an ESRC Research and Innovation Fellowship for three years. The research will directly inform the Leeds Climate Commission, and Dr Sakai will work closely with Arup, the Environment Agency, Yorkshire Water, as well as businesses of all sizes to ensure strong stakeholder engagement and maximise policy uptake.

Asib Ahmed (supervised by Dr Clare Woulds, Dr Frances Drake, and Dr Rizwan Nawaz) won a prize in the student poster competition at the World Environmental and Water Resources Congress 2018 in Minneapolis, U.S.A. His poster was titled 'Modelling Impacts of Future Climate on Physical Susceptibility to Erosion: A Geospatial Approach Applied for the Coastal Area of Bangladesh'.

PhD researchers **Oliver Grasham** and **Robert White** (both Bioenergy CDT) have won the Institution of Chemical Engineers Water Special Interest Group's Young Process Engineer Prize 2017, for finding a novel way to reduce external electricity demand at wastewater treatment plants by 50% and greenhouse gas emissions by 20%.

PhD researcher **Sarah Fell** received the John Ripley Carter Prize at the British Diatomist Meeting 2017 for her presentation outlining the response of alpine river diatom biodiversity to declining glacier cover.



Selected Publications

Over the course of the last academic year, water@leeds members have written 35 book/chapters and published 428 articles in academic journals. A selection of publications can be found in this section. For the full list, please contact us.

Photo: ProfessorJoseph Holden

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water@leeds coordination team

Dr Gabriela Lopez-Gonzalez: Co-ordinator

Gabriela works closely with the Directors, the Research and Innovation Development Manager and the Doctoral Research & Training Centre Manager to ensure that the water@leeds strategy is delivered to meet the targets of the four strategic objectives.

Kara Hazelgrave: Research and Innovation Development Manager

Kara develops and implements research and innovation strategies with academic teams, engaging with business, to ensure successful external funding applications.

Dr Pazit Ziv: Doctoral Research and Training Centre Manager

Pazit coordinates the postgraduate training funding efforts for water@leeds members and beyond.

She works to recruit industrial collaborators and establishing PhD funding.

Chris Tena: Administrator

Chris provides overarching support to the team and water@leeds membership.

He is responsible for delivering our internal and external communications, including newsletter, website and annual report.

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