Imperial College London

Grantham Institute

Climate Change and the Environment

An Institute of Imperial College London

2015–16

Outlook

Looking up
Meet the three new lecturers broadening horizons at the Grantham Institute

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Foreword

We live in an ever-changing world, driving the need to adapt to new challenges as we face them. Universities like Imperial College London have a vital role to play in helping society understand and mitigate the effects of climate and environmental change.

The Grantham Institute exemplifies how Imperial's research and education deliver societal benefit. In 2014–15, the Institute's work commanded the attention of the scientific community, the media and policymakers alike.

Research highlights included: a prize-winning computer model to optimise the arrangement of underwater tidal turbines; insights into the effects of fossil fuel emissions on the efficacy of radiocarbon dating; and new evidence about the loss of ice from the Totten Glacier in East Antarctica.

The success of the 2015 Grantham Annual Lecture, delivered by former Irish President, Mary Robinson, demonstrated the Institute's prominence as a forum for debate on key issues in climate change and the environment.

The outlook for 2015–16 is equally strong. The Grantham Institute will seize the opportunity to use its expertise and knowledge to inform, influence and inspire people in the UK and across the world. As future plans come to fruition, the Institute will inspire policy-change and equip students to become leaders in their fields.

The three newly appointed Grantham Lecturers will take the Institute's work to new heights. The launch of a new collaborative postgraduate degree in Climate Change, Management and Finance in 2016 will provide an innovative course for our students, combining scientific insight with economic and business awareness.

The work of the Institute is supported by the Grantham Foundation for the Protection of the Environment; Imperial is indebted to Jeremy and Hanne Grantham for their vision and generosity. The Granthams are also deserving recipients of the 2015 Carnegie Medal of Philanthropy for their dedication of private wealth for the public good.

It gives me great pleasure to see the Grantham Institute continuing to grow and develop. I look forward to its ongoing success. ■

Professor Alice P. Gast is President of Imperial College London

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INTRODUCTION FROM THE CO-DIRECTORS

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PROFESSOR JOANNA HAIGH FRS
Co-Director of the Grantham Institute

Welcome to the Grantham Institute Outlook 2015–16.

One of the most rewarding aspects of my first full year as Co-Director has been learning about and promoting the wide range of high-quality climate and environmental science and engineering underway at Imperial College London. I hope that you enjoy reading about this activity in the following pages.

During the year, we have been busy expanding our community with a core of talented and enthusiastic students, taking on a new generation of climate and environmental researchers, and bringing on board people from a spectrum of organisations around the world who support and enable our work.

We have launched a new NERC-funded Doctoral Training Partnership, currently connecting its first intake of 30 students with 11 departments across Imperial, as well as with six other core research partners (**page 20**).

I'm also proud to introduce you to our cover stars, our new Grantham lecturers (left to right): Dr Erik van Sebille (**page 7**), with the Department of Physics, Dr Mirabelle Muûls (**page 11**), with Imperial College Business School, and Dr Kris Murray (**page 15**), hosted in partnership with the School for Public Health. With their appointment we are developing new educational streams, and enhancing Imperial's strengths in these research fields.

Now heading up our policy and translation work is Alyssa Gilbert (interview, **page 18**), who joined us in April to increase the impact of all our work with policymakers and business leaders at this crucial time for climate science. Our newly established Grantham Affiliates scheme is just one of the ways we are making new links possible between government or business networks and anyone with an interest in climate change and environment at Imperial.

You can find out more about how to get involved with the Grantham Institute on **page 23**. ■

PROFESSOR MARTIN SIEGERT FRSE
Co-Director of the Grantham Institute

The last decade has been the warmest on record across global land and ocean surfaces, Arctic ice is shrinking and glaciers disappearing, extreme weather events, floods and droughts are becoming more common. Against this backdrop, it is vital for policy makers to have an understanding of the options available to mitigate and adapt to our changing world, driven by developments in climate and environmental science and engineering.

At the time of writing, the Paris 2015 UN Climate Change Conference – which will be crucial in determining how the nations of the world will start cutting carbon emissions – is yet to take place. The Grantham Institute is gunning for a positive outcome, supporting UK decision makers and providing advice and briefings that translate complex research findings into readily accessible information.

Our mitigation and energy modelling group has been investigating different ways to avoid dangerous climate change by decarbonising the economy, and the role that key low-carbon technologies can play in achieving this goal. We are pleased to formally welcome Professor Jenny Nelson FRS as the head of our mitigation team **(page 12)**. We will also maintain and grow our partnerships with groups such as China's Energy Research Institute in order to meet the challenges ahead.

Looking ahead, we are preparing to launch a unique MSc programme in Climate Change, Management and Finance, together with the Business School. Students studying for this exciting new degree will develop practical business skills, as well as knowledge about the challenges of sustainability and climate change, meeting the needs of Industry. You can read more about the programme on **page 20**.

This has been an exciting year for the Grantham Institute, and we feel well-equipped to contribute positively to action on climate and environmental change at this critical time. We hope to be working with you soon. ■

HIGHLIGHTS

The Grantham Institute's mandate is to drive forward climate and environment related research, translating this into real world impact and communicating our knowledge to help shape decision making. Here are some highlights from the year 2014–2015.

1 Our common future

The 'Our common future under climate change' conference was the largest gathering for the climate science community ahead of the Paris 2015 UN Climate Change Conference. Grantham Institute researchers attended the four-day event in Paris, which brought together 2,200 attendees from over 100 countries to discuss key climate science issues. Institute Co-Director Professor Martin Siegert convened a session on sea level rise, while Grantham Affiliate Professor Colin Prentice engaged in a panel discussion around biodiversity conservation. Grantham Lecturer Dr Mirabelle Muûls' research on the EU Emissions Trading System (ETS) featured at a session about carbon pricing.

2 Climate justice

Delivering the Grantham Annual Lecture 2015, former Irish President Mary Robinson emphasised the pivotal role of upcoming international negotiations for tackling both climate change and humanitarian issues. Robinson, who is known for her advocacy of human rights, called for strong leadership and ambition from developed and developing countries, citing the moral imperative to develop a fair and inclusive response to climate change.

3 The road to Paris

In partnership with the French Embassy, the Grantham Institute hosted a panel discussion focussing on what needs to be done to secure a successful global climate deal at the Paris 2015 UN Climate Change Conference in December. Speakers including former Chief Scientific Adviser to the UK Government, Sir David King, and former French cabinet minister for development, Pascal Canfin, engaged in a lively debate on how diplomatic action can reach the goals of the international negotiations and how academic evidence can inform policy.

5 Carbon dating at risk from fossil fuel emissions

In July 2015, media outlets including *The Times*, BBC News and *The Washington Post* reported that carbon emissions from fossil fuels could soon make it impossible for radiocarbon dating to distinguish new materials from artefacts that are hundreds of years old. According to this Grantham Institute-funded research by physicist Dr Heather Graven, carbon released by burning fossil fuels is diluting radioactive carbon-14 and artificially raising the 'age' of the atmosphere. By 2050, a new T-shirt could have the same radiocarbon date as a robe worn by William the Conqueror, from a thousand years earlier.

4 Imperial Festival

Grantham Institute staff and students took part in the College's annual public festival in May 2015, running energy and environment activities in collaboration with Imperial's Energy Futures Lab. The two-day event attracted more than 15,000 members of the public, Imperial alumni, family and friends, and specially invited guests. Visitors explored the fate of plastic pollution in our oceans, discovered how to produce renewable energy from coffee grounds and took a guess at which London borough's inhabitants use the most energy.

6 Responding to environmental change

Early career environmental scientists from the Institute forged new links with leaders from business, policy and academia at the 'Responding to environmental change' event in March 2015. They explored three key societal challenges, implications of their work for business and policymakers, and ways to address these issues through collaboration. This event was organised by the Natural Environment Research Council (NERC)-funded Doctoral Training Partnerships at Imperial College London, University of Reading, and University of Surrey.

RESEARCH THEME

EARTH SYSTEMS

UNDERSTANDING THE COMPLEXITIES OF THE EARTH'S CLIMATE SYSTEM

At Imperial College London, researchers are pushing the boundaries of knowledge on many aspects of the Earth's complex system, helping to answer fundamental and urgent questions concerning the atmosphere and oceans, ice and land surfaces, and the living things that they host.

Scientists study individual components of the Earth system and how they interact, improving the relationship between humans and our environment. For example, looking at patterns in ocean currents helps scientists to track plastic pollution; researching the ways that different gases and particles move around the atmosphere provides insight into how the environment is changing; glaciers, often a poster child for climate change, are being studied closely for clues to the causes of changes in sea level; and scientists are analysing satellite data to understand the variability in clouds and dust storms, and what this means for the understanding of climate change.

The Grantham Institute aims to build on fundamental scientific findings, using them to anticipate and respond to climate change. Scientists are, for example, building and improving models of the climate and other systems.

The recent appointment of Dr Erik van Sebille, a physical oceanographer, is one way the Institute continues to expand its research on Earth systems. ■

DR ERIK VAN SEBILLE

PROFILE

Grantham Lecturer in Oceanography and Climate Change

Erik van Sebille has been a Lecturer at the Grantham Institute since March 2015. His interest, he says, is in "how currents in the ocean move stuff around."

The "stuff" might be natural or artificial. But he has a special interest in plastic waste. Every year, millions of tons of plastic get into rivers, seas and ultimately our oceans, but little is known about where it goes.

Van Sebille explains: "Plastic in seawater itself is not *per se* a problem. Plastic becomes a problem when it interacts with an ecosystem. We need to know more about where this happens. If you see a plastic bottle on the beach, should you be worried that it is damaging the sandy environment, or happy that it is not in the sea?"

His position at the Institute affords him the opportunity to collaborate with many people, including Imperial computer scientists. He says: "Existing software cannot analyse the complex climate system on a single machine. We are developing better models for use on supercomputers that show how moving water carries plastic and other stuff around the oceans." ■

SUN'S INFLUENCE ON CLIMATE

Professor Joanna Haigh

Physicist Joanna Haigh (pictured) is Co-Director of the Grantham Institute and Professor of Atmospheric Physics at Imperial. She looks at variations in solar radiation, which heats the stratosphere, the upper region of the atmosphere, and influences winds and weather all the way down to sea level. Her research has confirmed the Sun's changing energy output has only a small effect on the Earth's major climate change trend, compared with the effect of human activities.

However, in some areas of the world, such as north western Europe and the north Pacific, the regional climate is especially affected by changes in solar radiation, says Haigh. Her research is revealing this may be the case because the weather in these areas is more strongly influenced than other regions by changing winds and ocean currents.

She says: "At the moment we are investigating new data from the SORCE [Solar Radiation and Climate Experiment] satellite. It is giving us readings of solar ultraviolet radiation that are telling us so much more than we ever used to know about the possible effects of solar radiation on the stratosphere and the lower atmosphere." ■

THE SUN AND CLIMATE
Professor Haigh's new book, *The Sun's Influence on Climate*, is the latest addition to the Princeton Primers in Climate series, aimed at students, researchers and the general public.

UNDERSTANDING HOW ICE SHEETS MELT

Professor Martin Siegert

Martin Siegert is Co-Director of the Grantham Institute and Professor of Geosciences at Imperial. His research is on the link between climate change, melting ice sheets in the polar regions, and the resulting rise in sea levels.

He says: "Antarctic ice does not sit on a flat surface. The hills and valleys of the continent below affect the way it melts and flows. Although we can map this hidden landscape with radar, there are areas of the Antarctic that we know less about than the surface of Pluto." In western Antarctica, ice resting on the shallow sea floor is less stable than ice on land since warm sea water melts sea ice at its edge.

There are indications that for every one-degree rise in global temperature, sea levels will increase by one to three metres. "We will almost certainly have to deal with several metres of sea level rise in coming centuries," says Siegert. "However, the ability to predict these changes accurately would mean we could better inform policies to adapt to climate change." ■

PREDICTING TSUNAMIS

Dr Matt Piggott

Ocean warming can increase the frequency of underwater landslides, which displace seawater and can lead to large, destructive tsunami waves around the world. While they are rare, one triggered in 1998 in the Pacific Ocean led to a tsunami that killed 2,200 people in Papua New Guinea.

Matt Piggott is a Grantham Reader in Ocean Modelling in the Department of Earth Science and Engineering. He is part of a project assessing what would happen if climate change in the Arctic led to a greater chance of tsunamis that could flood coastal areas of the UK. The project aims to quantify the risk to UK infrastructure, the potential costs, and ways to minimising the damage.

"This is a large multi-disciplinary consortium funded by the Natural Environment Research Council [NERC] and led by the National Oceanography Centre," says Piggott.

An underwater landslide in 1998 in the Pacific Ocean led to a tsunami that killed 2,200 people in Papua New Guinea

"Our expertise lies in the numerical modelling of hazards, but the project includes the Scottish Government, the Department for Environment, Food and Rural Affairs [Defra], the Environment Agency and representatives from the reinsurance industry." ■

Ones to watch

1

Grantham Institute research on the chemical composition of sediments from the ocean floor is revealing how the Western and Eastern Antarctic ice sheets have expanded and contracted in the past. **Patric Simoes Pereira** and **Rachel Bertram**, whose PhD studentships are funded by the Kristian Gerhard Jebsen Foundation, are trying to predict the likelihood that ice sheets around Antarctica will collapse in a warmer future climate.

2

Very little is known about what lies beneath the ice in Princess Elizabeth Land, the last remaining region of Antarctica yet to be surveyed. This is set to change in 2016, when a collaboration between Imperial College London and colleagues from China, Australia, India and the USA will undertake an airborne geophysical reconnaissance of the region. Grantham Institute Co-Director **Professor Martin Siegert** and his team will then use detailed surveys to build up a better picture of this last frontier of the Antarctic continent.

3

So far over 90% of the heat the Earth has gained through climate change has been absorbed by the planet's oceans. Grantham Affiliate **Dr Jan Zika** is getting to the bottom of where the oceans store this heat, in order to determine how long it will be locked away. Zika combines data from ocean models and scientific observations to explore how heat is transported from the ocean surface to its depths.

RESEARCH THEME

MITIGATION

REDUCING HUMAN IMPACT ON CLIMATE AND THE ENVIRONMENT

Since the first UN Earth Summit in 1992, governments have been trying to encourage sound environmental management in tandem with economic growth and social welfare. There is now a wealth of technology available to reduce the adverse effects that humans have on the environment, in part thanks to a recent research focus into technologies that can reduce global emissions of greenhouse gases. However, a range of low-carbon solutions will be needed in the near future, from energy efficiency and energy storage, through to electric vehicles, renewable energy generation and carbon capture and storage (CCS). Researchers at Imperial College London are working to understand the costs of new low-carbon technologies, what is likely to become available and when, and how their roll-out can be encouraged.

A good governance framework and specific policies are needed to make changes happen, and a more sophisticated understanding of how policies work is required in order to identify what is possible.

Getting mitigation policy right will continue to be an important focus for the Grantham Institute. The mitigation team, led by Professor Jenny Nelson, is investigating which technologies and ideas could really make a difference in practice. ■

DR MIRABELLE MUÛLS

PROFILE

Grantham Lecturer in the Economics of Climate Change

Lecturer Mirabelle Muûls works at the Grantham Institute and with fellow economists at Imperial College Business School. She researches Emissions Trading Schemes (ETSs), such as the European ETS, which has been running since 2005. These market-based policies can reduce greenhouse gas emissions: a cap is enforced on total emissions from participating companies, who can individually buy or trade carbon credits.

Muûls and colleagues recently won the Erik Kempe award, a top environmental economics prize, for work designing ETSs. She says: "Emissions trading can encourage firms to shift emissions-generating activities, and jobs, to a different country rather than stopping them. We call this 'carbon leakage'." Her award-winning paper explores ways of designing ETSs to minimise this risk.

The work at the Institute hopes to build on this past experience to inform new global trading schemes.

But Muûls does not expect ETSs to be central to the 2015 UN Paris Climate Change Conference (COP21). She says: "These systems are mainly national and it would be difficult to establish a global carbon market at this time. I would expect a key element of COP21 to include talks of new climate finance schemes, such as financial support to developing nations." ■

LOW CARBON TECHNOLOGIES AT IMPERIAL

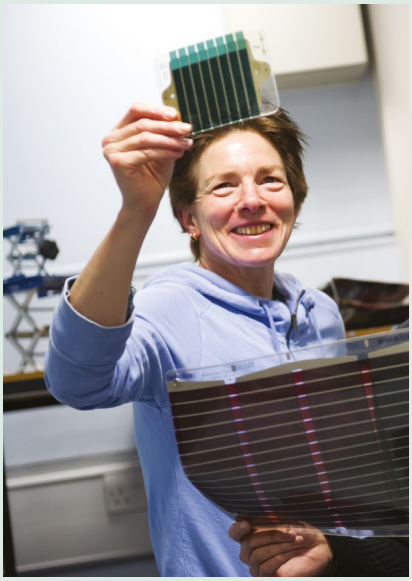
Professor Jenny Nelson FRS

Jenny Nelson (pictured) is Professor of Physics at Imperial College London and leads the mitigation team at the Grantham Institute. "For scientists and engineers like me who research low-carbon technologies, the Institute helps us to evaluate their possible future impact on climate change. It is so important that we take into account all the costs, competing technologies and policy frameworks," she says.

Researchers across Imperial are working on low-carbon technologies, including carbon capture and storage (CCS) to reduce emissions from industry; low-energy electricity generation technologies such as photovoltaics (PV), which converts sunlight into electricity in a solar panel, and solar thermal energy (STE), which concentrates light to produce heat that can be stored or turned into electricity; energy storage; power distribution technologies; fuel cells and electric vehicles.

"In my laboratory, we are focussed on extending the useable life of low-cost solar panel modules, which typically degrade after several months. This year, we completed the first trial of an unsophisticated 'plastic' solar cell in rural Rwanda," says Nelson. "We found that, despite using cheap materials for the packaging, our module still worked after a year. We are also investigating a promising new commercial PV material called a perovskite, and have now identified the main reason it degrades.

"Meanwhile, energy storage is currently too expensive for many users. Scientists at Imperial are now evaluating how to make distribution and storage affordable, and working on new ways to deploy low-energy technologies on a large scale." ■



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RETHINKING GLOBAL ENERGY GOVERNANCE

Neil Hirst

Emerging economies are reshaping the global energy landscape, and the existing international energy governance framework, established in the 1970s, has become outdated.

As the world's largest energy consumer and greenhouse gas emitter, China's involvement in world energy governance is essential to both energy security and climate change mitigation. The Grantham Institute is recommending ways to reform global energy governance and encourage China and other major developing countries to participate in global energy policy.

"Our work has helped to increase China's engagement with the International Energy Agency (IEA) and with the G20 major economies," says Neil Hirst, who leads the Institute's contribution to the project, and is collaborating with China's Energy Research Institute (ERI), part of the National Development and Reform Commission. "The next step will be at the meeting of the IEA's governing board in November, which will hopefully open the way for eventual Chinese membership. We will continue to work with China as it prepares for its presidency of the G20 in 2016." ■

AVOIDING DANGEROUS CLIMATE CHANGE

Ajay Gambhir

Central to the Institute's mitigation research is the AVOID 2 programme, a multidisciplinary consortium led by the Met Office, with Grantham Senior Research Fellow, Ajay Gambhir, leading contributions from across Imperial.

AVOID 2 analysis has highlighted how important it is to begin coordinated global decarbonisation by 2020

Members of the consortium are addressing a range of scientific and policy questions posed by the challenge of "preventing 'dangerous' human interference with the climate system", the ultimate goal stated by the UN Framework Convention on Climate Change (UNFCCC). Grantham Institute staff are also responsible for the programme's communications and external engagement, ensuring that AVOID 2 results reach policy makers.

"AVOID 2 analysis has highlighted how important it is to begin coordinated global decarbonisation by 2020," Gambhir says. "We need to use energy more efficiently, increasingly electrify our energy systems and produce electricity without greenhouse gas emissions. We are feeding these messages to policy makers ahead of the UN 2015 Paris Climate Change Conference."

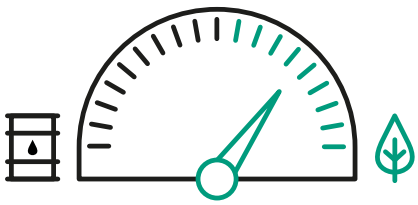
The programme is funded by the UK Government until March 2016, receiving £1.5m for its latest phase. ■

MOVING AWAY FROM FOSSIL FUELS

Dr Adam Hawkes

AVOID 2 analysis has been made possible by *TIAM-Grantham*, a computer model that calculates the most cost-effective ways to change an energy system reliant on fossil fuels, into a low-carbon system, based on a wider variety of technologies. Grantham Affiliate Adam Hawkes from Imperial's Sustainable Gas Institute leads the development of the model.

"We draw on the technological and economic expertise from across the College to create the most robust representation of energy futures for the whole world up to the year 2100," he says. "The insights of the engineering departments and the Business School allow us to investigate the impact of game-changing developments such as solar. The Institute brings all this expertise together to create a tool that can have significant impact on policy." ■



Ones to watch

4

Grantham alumnus **Dr Christoph Mazur** is researching an Institute-funded briefing paper on the future of road transport, providing a snapshot of the latest developments in key low-carbon transport technologies and analysing their costs. Aimed at policy makers at a local and national level, the paper will use case studies to highlight the best policy choices for the UK to support the development of these technologies and the uptake of low-emission vehicles.

5

Engineers are building the world's first power plant with negative emissions, in North Yorkshire, UK. The White Rose CCS Project is an industrial collaboration between Alstom, Drax Power and industrial gas company BOC, with Grantham Affiliate **Dr Niall Mac Dowell** studying the role that flexible CCS can play in the UK's energy system. The plant will be fuelled by both biomass and coal, and include technologies capable of capturing 2 million tonnes, or 90 per cent, of the plant's carbon dioxide emissions, which will be stored beneath the North Sea.

6

Oasis+ is a pan-European project that is developing models, tools and services to assist in the assessment of risk from natural disasters, and provide information for planning climate adaptation. It has developed an award-winning tool, 'Oasis Loss Modelling Framework', that uses multiple climate and environmental models to calculate the property damage and financial costs resulting from catastrophes. Imperial's **Professor Ralf Toumi** leads the project, which is funded by EIT Climate-KIC and supported by 44 global insurers.

RESEARCH THEME

IMPACTS AND ADAPTATION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LIMITING THE EFFECTS OF ENVIRONMENTAL CHANGE

Our environment is changing and we must understand how these changes affect the world around us so that human civilisation can adapt to them.

Climate change could be the biggest opportunity for improving human health today, but changes to our physical environment can also have negative social impacts. There is increasing evidence that environmental change will exacerbate conflicts the most in regions of the world that are least resilient to change. Water management, food production and distribution, deforestation, air pollution and increased urbanisation all add stress to ecosystems and societies that depend upon them. Imperial College London researchers embrace the crossover between science, technology, medicine and business to achieve strategic goals on the impacts of, and adaptation to, climate change.

Looking ahead, changes in climate and environment will certainly affect ecosystems and human systems, but important questions remain over how. The Grantham Institute has recently hired Dr Kris Murray to consolidate research on impacts and adaptation across Imperial and to develop appropriate advice for stakeholders. ■

DR KRIS MURRAY

PROFILE

Grantham Lecturer in Global Change Ecology

Kris Murray is a new lecturer at the Grantham Institute, with a joint appointment at Imperial's School of Public Health. An ecologist with a background in disease ecology and conservation, he is leading a new programme focussing on the links between environmental change and health.

He says: "Environmental change is having a range of direct and indirect effects on health. For example, with global climate change some places are seeing more frequent or more intense 'extreme events' like heat waves and floods. The European heat wave of 2003 caused over 60,000 excess deaths and caused crop failures that dramatically affected food production."

But Murray approves of the more positive outlook on climate change and health proposed in medical journal *The Lancet* in 2015. "We now realise that many of the biggest challenges also represent opportunities. Reducing the use of coal, for example, will cut carbon emissions and at the same time improve air quality, which would reduce respiratory illness. Once you factor in these very costly impacts on health, alternative, lower-carbon energy systems looks increasingly attractive from an economic perspective."

Murray also has an interest in the links between the health of people, wildlife and the ecosystems we inhabit. "Habitat loss can in some cases increase the burden of infectious diseases, by boosting the abundance of disease vectors such as mosquitoes. Understanding these relationships better could help find win-win solutions for health and the environment." ■

INVESTIGATING AIR POLLUTION AND HUMAN HEALTH

Professor Paolo Vineis

Air pollution has major effects on health in developed and developing nations and is directly affected by climate change. From Imperial's School of Public Health, Professor Paolo Vineis (pictured, centre) leads a network of institutions in an €8.7-million European Commission (EC) research project to understand the mechanisms by which polluted air leads to cancer, and other heart and lung diseases. "The EC is very keen to use our results for policy," says Vineis.

Exposomics hopes to identify further links between exposure to air pollution and specific physiological effects on the body

Through the network, called Exposomics, scientists measure the levels of certain molecules in real time in the blood of thousands of subjects. Vineis hopes to identify further links between exposure to air pollution and specific physiological effects on the body.

One study measures exposure to airborne particles that are produced when people use solid fuels – like coal, charcoal and wood – for cooking or heating. "We had 200 volunteers wear backpacks filled with measuring instruments for 24 daytime hours, three times a year," says Vineis.

"We have already deepened our understanding of exposure to certain ultrafine particles," he says. ■

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PROTECTING BEE POPULATIONS

Dr Richard Gill

The UK has over 20 species of bumblebee and around 230 species of solitary bee. Richard Gill, a Grantham Affiliate from Imperial's Department of Life Sciences, is involved in bee conservation work, especially looking at wild bees.

"Maintaining healthy populations of bees is important for agriculture, food security and the environment," he says. "I want us to know how environmental stresses, such as pesticides, affect the behaviour of bees and their colonies."

"We are responsible for trying to mitigate human actions such as the use of pesticides, which may inadvertently threaten bees," says Gill. "It's about getting the right balance between crop protection and a healthy population of insect pollinators. Our research provides objective evidence that we will be submitting to the European Food Standard Agency's enquiry into the risks posed to bees from a class of pesticides called neonicotinoids." ■

TAPPING INTO CITIZEN SCIENCE

Dr Wouter Buytaert

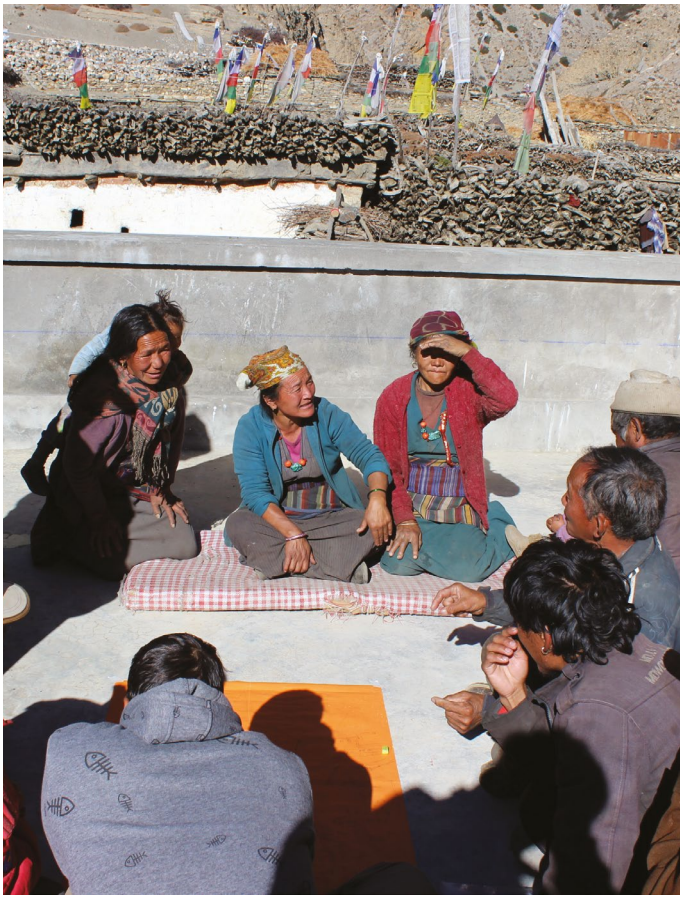
Grantham Affiliate Wouter Buytaert leads a citizen science project with poor mountain communities in Peru, Kyrgyzstan, Ethiopia and Nepal. Local people create knowledge directly relevant to improving their livelihoods. In Peru, they collect data on rainfall and river flow, which has already been used to identify vulnerable parts of the river catchment and fence off areas to stop cattle doing further damage to already unstable soil.

"Citizen science projects require a huge effort of time and commitment, but can be win-win for the communities and the environment," says Buytaert.

The interdisciplinary project is funded by the UK's Department for International Development (DFID), the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC).

The Institute is publicising the project to bodies such as Unesco and policy makers in the run-up to the Paris 2015 UN Climate Change Conference.

Appointed to the Department of Civil and Environmental Engineering, Wouter values his association with the Institute: "It allows me to interact more easily with people outside my department, and keep track of funding calls and events." ■



People in a Nepal mountain community sharing their experience of changing water availability and resulting uncertainties in their farming practices

Ones to watch

7

Imperial engineers are building a laboratory to design and test the next generation of Unmanned Aerial Vehicles (UAVs). Low-cost flying 'drones' can be equipped with sensors to accurately map environmental parameters like temperature, humidity and salinity, or the distribution of bacteria or vegetation. Laboratory Director and Grantham Affiliate **Dr Mirko Kovac** sees many uses for these robots in environmental and climate research.

8

Grantham Affiliate **Professor Guy Woodward** is looking into the effects of global environmental change on natural ecosystems. He explores how warming alters food webs by studying interactions between plants and animals in streams of different temperatures around the Arctic Circle. His group recently set up 100 experimental pond ecosystems in the grounds of Imperial's Silwood Park Campus in Berkshire. The results will inform efforts to conserve or restore ecosystems that have been altered and damaged by climate change, acidification, or invasive species.

9

High salt intake has been linked to increased blood pressure, putting people at risk of heart disease and other health conditions. Sea level rise is increasing the frequency of coastal flooding in vulnerable areas such as Southern Bangladesh, making drinking water extremely salty. Imperial researchers **Dr Adrian Butler** and **Professor Paolo Vineis** are conducting field research in the lower end of the Ganges delta in Bangladesh, investigating the effects of drinking salty water on human health, and new ways to provide people with safe, fresh water.

Alyssa Gilbert
explains her priorities for the Institute's interactions with the wider world

Alyssa Gilbert *joined the Grantham Institute as Head of Policy and Translation in April 2015.*

Tell us more about your title 'policy and translation'?
The Grantham Institute is Imperial College London's window on the world of climate change and the environment. The 'policy' part of my job is to gauge the issues of most concern to policymakers and business leaders, then feed them into our long-term planning as well as more immediate policy outreach activities.

At the same time, the Imperial community is a vast source of knowledge and expertise. The 'translation' part of the role means directing this knowledge to the right audiences in the right style and format, at the right times.

Our outreach activities include our web and social media presence, briefing papers and policy notes, seminars, interdisciplinary workshops, and dedicated face-to-face meetings and briefings.

Where do you see yourself focusing this activity?
Today, most of our business and policy links are within the UK, but much of our research is global. In order to do the Institute's work effectively, I am expecting to make new European and international connections.

How do you get involved in a major event such as the Paris 2015 UN Climate Change Conference?
Representatives from Imperial have been at preparatory meetings and will be attending the conference, as stakeholders in the negotiations, and as a source of scientific advice to the policymakers. But this conference is a staging post in the journey towards a future without greenhouse gas emissions, not an end in itself. Our role at the Institute is to run a long-term programme that meets tough challenges, for example on the technology needed to bring down the costs of climate change adaptation.

What opportunities do you see ahead with the Institute's new remit, taking on environment as well as climate change?
The Institute's broader remit means we have the opportunity to work with more great Imperial people. Our work will now include talking about Imperial's strengths in environment-related research, and we are forging new links with policymakers in areas such as ecology and conservation, and the effects of environment on human health. ■

Brian Hoskins reflects on his years at the Institute and his hopes for the future

***Professor Sir Brian Hoskins CBE FRS** is a doyen of meteorology, pioneering new methods in near-term and extended-range weather prediction, far ahead of their time, from the 1970s onwards.*

This year he has been awarded the Gold Medal of the International Union of Geodesy and Geophysics; the Royal Meteorological Society published his most influential papers in a 'Brian Hoskins Special Collection' edition; and a meteorology conference was held in Reading in honour of his 70th birthday.

Sir Brian was Director of the Grantham Institute from its inception in 2007 to 2014, and is now its Chair.

How did your career lead you to become Director of the Grantham Institute?
I gave my first public talk on climate change in 1985 and was later a Special Adviser to the UK government. In 2000, I helped write a report on energy and climate change for The Royal Commission on Environmental Pollution. When Imperial approached me in 2007 I had reached the stage where I wanted a major job focussed on the issue – the Directorship was just right!

How has the Institute evolved since you began?
Before we started, Imperial's excellent research on the science and engineering aspects of environment wasn't known as well as it should have been. I hope we've changed that, by enabling new research, assisting the EU Climate Knowledge and Innovation Community [Climate-KIC] with its UK hub at Imperial, and starting up successful PhD and policy outreach programmes.

How do you persuade people that climate change is serious?
We need to make arguments that will speak to different sectors of society. I've come to realise people are persuaded by what they can see. Tell them about the likely impact on their back garden; on their children and grandchildren. How will they cope with heavier rain when people have already built houses that are susceptible to flooding?

In general, UK governments have taken it seriously and, to some extent, have acted on it. But there is a political barrier associated with people who think the market rules, come what may. However, the market does not put a cost on ruining our future world. We have to move away from a dependence on fossil fuels before really dangerous climate change is apparent.

What are your hopes for the Paris 2015 UN Climate Change Conference?
Governments are all deciding ahead of Paris what emissions reductions they can offer. Nothing short of an emissions reversal will be enough to keep warming below 2° Celsius, but I hope the negotiations will result in a process to assess the size of the gap we have to make up. Then all should get to work on ratcheting up the countries' offers. I hope there is still the opportunity to save the Earth as it is now for my grandchildren. ■

EDUCATION

As a hub for climate and environment research at Imperial College London, the Grantham Institute is well-placed to deliver multidisciplinary postgraduate education programmes. Students have access to academic expertise across the College's broad remit of science, engineering, medicine and business, and the Institute secures unique opportunities for them thanks to its partners in academia, business, government and the public sector.

MSc Climate Change, Management and Finance

The Grantham Institute and Imperial College Business School are recruiting for a new Master's course, starting in September 2016. Admitting up to 40 people each year, the course will equip students with the interdisciplinary skills required in business on issues relating to climate change and sustainability.

"This innovative new programme will educate business leaders of tomorrow by combining quantitative business-centered teaching with leading expertise on how to tackle current and future issues around climate change and sustainability."

Dr Mirabelle Muûls
Programme Director, MSc Climate Change, Management and Finance

PhD opportunities: Science and Solutions for a Changing Planet

In 2014, the Institute welcomed the first cohort of students on the Natural Environment Research Council (NERC)-funded Science and Solutions for a Changing Planet Doctoral Training Partnership (SSCP-DTP), building on its existing PhD opportunities. This vibrant programme encompasses all areas of environmental science, with research topics centred on NERC's three key societal challenges: Benefiting from natural resources; resilience to environmental hazards; and managing environmental change.

The SSCP-DTP draws on the strengths of its seven core partners and more than 27 public and private sector partners to build a collaborative community, with students and partners engaged through supervision, secondments and guest lectures.

During their time at Imperial, SSCP-DTP students develop the broad range of interdisciplinary skills fundamental to tackling the challenges of environmental change. Bespoke training courses, events and secondments offer them the opportunity to reflect on their own work as well as to learn how research can inform decision makers. ■

SSCP-DTP CORE PARTNERS:

- British Geological Survey
- Centre for Ecology & Hydrology
- Imperial College London
- Met Office
- Natural History Museum
- Royal Botanic Gardens, Kew
- Zoological Society of London

KIERAN BROPHY PROFILE

SSCP-DTP student based in Imperial's Department of Physics. Kieran's PhD research is on atmospheric transport modelling of CO_2 in California.

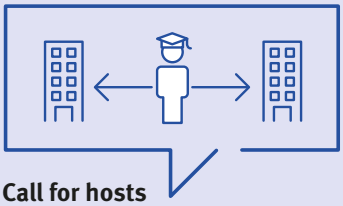
"Everyone on the programme is incredibly friendly and motivated – it's a great vibe," he says.

"This year's residential professional development course was the highlight for me," says Kieran. "We had three days of team building, problem solving and presentation skills." He also values a studentship at the Met Office, one of the core partners.

"The DTP keeps me on my toes."

Taking on a secondment

SSCP-DTP students are immersed in a host organisation to learn how research can inform and affect decision making in business or government.



Call for hosts

Can your organisation teach the SSCP-DTP students a thing or two? Secondments are for second- or third-year students and should be designed around a specific problem or area of interest, lasting between three and six months. Contact Sophie Smith (sophie.smith@imperial.ac.uk) to discuss your proposed secondment. ■

Highlights of the SSCP-DTP year

SSCP-DTP conference
Students meet with DTP partners and peers to build relationships, share knowledge and demonstrate the impact of their work.

Personal development
A bespoke residential course gives students a grounding in research management skills, communications, group dynamics and personal awareness.

Challenge teams
Regular problem-solving groups, journal clubs and presentations keep teams of students on track to deliver a challenge project, alongside their main research programme.

Skills gap training
The programme provides professional skills identified as priorities for the environmental sector, and teaching in six cross-disciplinary areas:

Translating research into practice

Risk and uncertainty

Sustainability

Computational science

Modelling

Environmental informatics

Where are they now?

The Institute congratulates all its students who completed their studies in the past year, including:

Dr Torben Struve
Postdoctoral researcher at the Max Planck Institute for Marine Microbiology, Germany.

Dr Gina Tsarouchi
Graduate engineer at HR Wallingford, a consultancy specialising in civil engineering, environmental and water management.

Dr Timothy Foster
Postdoctoral researcher at the Robert B Daugherty Water for Food Institute at the University of Nebraska, USA.

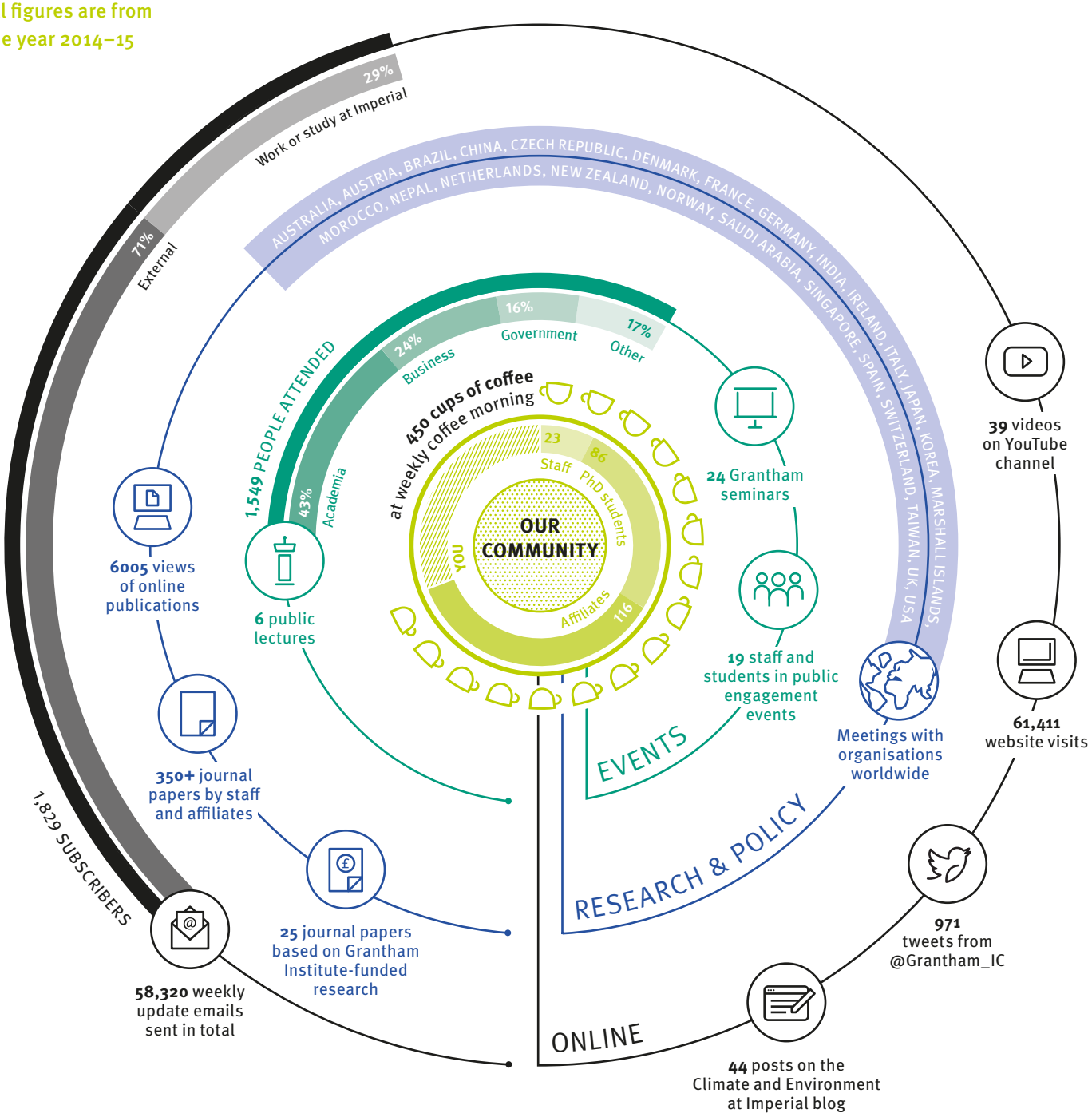
Dr Marie-Therese v. Srbik
Recently graduated and pursuing opportunities in the automotive industry.

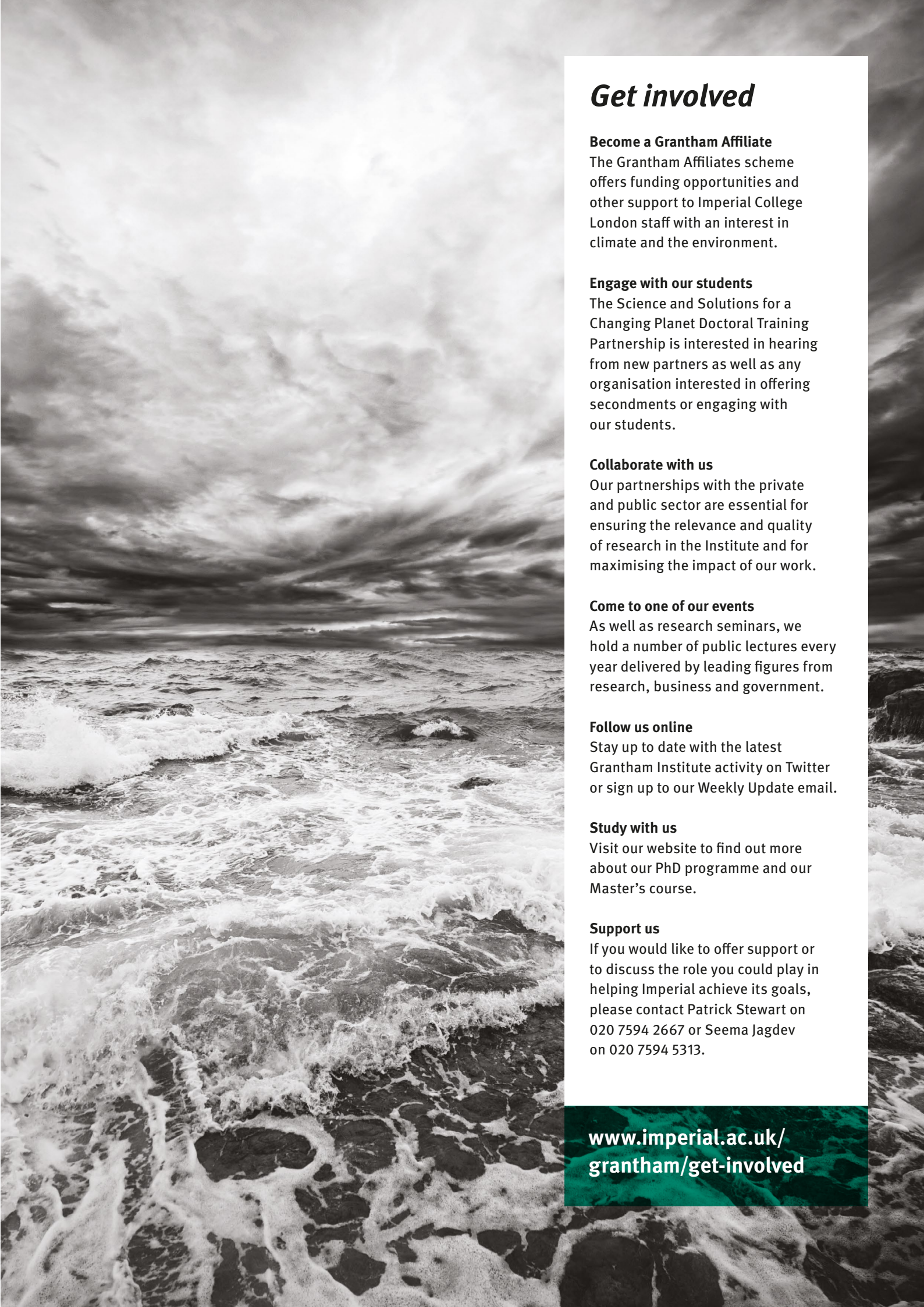
Dr Christoph Mazur
Research Associate in the Department of Chemical Engineering, Imperial College London.

Grantham Institute PhD alumnus **Dr Simon Funke** and his supervisor, **Dr David Ham**, won the 2015 Wilkinson Prize, an international prize rewarding a piece of outstanding numerical software. During his PhD, Funke used the software to determine the optimal layout for underwater tidal turbines.

A YEAR IN THE LIFE OF THE GRANTHAM INSTITUTE

All figures are from the year 2014–15





Get involved

Become a Grantham Affiliate
The Grantham Affiliates scheme offers funding opportunities and other support to Imperial College London staff with an interest in climate and the environment.

Engage with our students
The Science and Solutions for a Changing Planet Doctoral Training Partnership is interested in hearing from new partners as well as any organisation interested in offering secondments or engaging with our students.

Collaborate with us
Our partnerships with the private and public sector are essential for ensuring the relevance and quality of research in the Institute and for maximising the impact of our work.

Come to one of our events
As well as research seminars, we hold a number of public lectures every year delivered by leading figures from research, business and government.

Follow us online
Stay up to date with the latest Grantham Institute activity on Twitter or sign up to our Weekly Update email.

Study with us
Visit our website to find out more about our PhD programme and our Master's course.

Support us
If you would like to offer support or to discuss the role you could play in helping Imperial achieve its goals, please contact Patrick Stewart on 020 7594 2667 or Seema Jagdev on 020 7594 5313.

www.imperial.ac.uk/grantham/get-involved

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