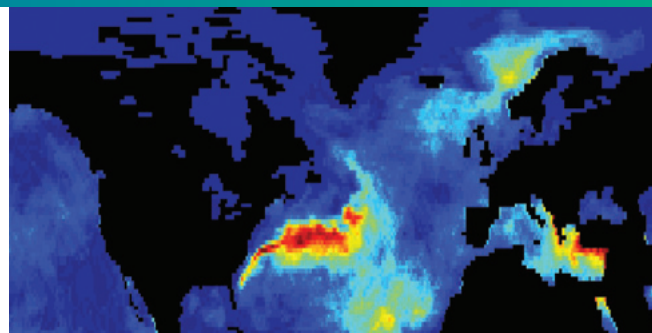


**Imperial College
London**

outlook 2012



Grantham Institute for Climate Change

An institute of Imperial College London



“ In the face of continuing denial of climate change and the priority for action, we are proud of the Institute’s work and its drive to present the relevant issues as well as future options to mitigate and adapt.”

– Jeremy and Hannelore Grantham

FROM THE DIRECTOR

Foreword

MANY OF YOU WHO WORK WITH THE INSTITUTE or take part in our events will be aware that I have decided to retire from the post of Director once a successor is appointed. I am very proud to have led the Institute over the past four years from our founders’ vision to an internationally recognised organisation carrying out multidisciplinary research on climate change and translating this into real world impact. This has only been achieved through the commitment and hard work of my colleagues here at the Institute, the support received from academics and researchers across Imperial, and the encouragement and funding from Jeremy and Hanne Grantham.

Over this period, the Institute has actively supported new researchers and research areas. Many of our researchers have gone on to take academic positions either at Imperial

or elsewhere, and our focused support for research has led to the establishment of new programmes, such as ocean-atmosphere interaction, incorporating the development of next generation computational techniques.

I am delighted that our first cohort of Grantham PhD students, who joined about the same time as me, have now graduated and are taking up positions in academia or business, where I look forward to them extending the influence of the Institute in their new walks of life.

Although evidence of climate change due to greenhouse gas emissions from human activity has become more robust, much remains to be done. There is a need to re-engage with politicians who, with Europe consumed by the financial crisis, have taken their eye off the climate change agenda; and also to develop feasible and affordable technological options to mitigate the worst of the risks.

I will not be breaking my ties with the Institute completely. I look forward to supporting it in the role of Chairman and continuing my association with colleagues here at Imperial for many years to come.

Professor Sir Brian Hoskins CBE FRS, Director
Grantham Institute for Climate Change



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FROM THE INNOVATION DIRECTOR

Stimulating economic activity

AS THE INSTITUTE HAS MATURED, the three pillars of research, policy and innovation have come together to encapsulate the Institute's activities, with innovation in climate and global environmental change proving essential to tackle the mitigation and adaptation challenges we face.

The Climate-KIC (Knowledge Innovation Community), funded by the European Institute for Innovation and Technology, was established to drive innovation to address the challenges of climate change, and by doing so, to stimulate economic activity in Europe.

The KIC is an open innovation community involving 118 partners including universities, government agencies and businesses. Regional and city governments are key to its success as they often have commitments to reduce carbon emissions and manage the impact of climate extremes.

Building business

An example of the KIC approach in action is a UK firm called Naked Energy, which aims to take advantage of a key problem with solar electricity generation. As solar arrays heat up in the sunshine, their efficiency falls and so does their power output. Naked Energy has developed solar photovoltaic arrays which are cooled by water, generating hot water as well as extra electricity. As a result of its involvement in the KIC, Naked Energy now has validated measurements of its equipment in action, making it easier to attract customers and investors. Sainsbury's, another KIC participant, is in discussions with Naked Energy regarding the installation of solar collectors on its supermarkets.

Technology integration plays an important role in Climate-KIC's innovative culture, working with businesses to look at ways to combine technologies to deliver innovative solutions. One such business is developing heat storage systems that will help to reduce peaks in energy demand.



Innovation in education

We are also keen for the KIC to produce innovative forms of education. We have introduced *theJourney*, a summer school which has had 150 students in its first two years and will take another 200 in 2012. They are top graduate students who take a literal journey through Europe, experiencing climate change innovation in action, and are challenged to design their own business in this arena. The emphasis is on learning-by-doing and the creation of a community that innovates together.

Those taking part in *theJourney* are given the opportunity to realise their entrepreneurial potential, something that has led to the formation of six start-up companies so far. In the vanguard of these are DeCo!, a sustainable farming company in Ghana, and ElectricFeel, looking at electric bicycle systems in Switzerland, both of which were set up in *theJourney's* first year.

Professor Richard Templer, Innovation Director and Director Climate-KIC UK

A year in the life of the Grantham Institute

MAY

Where next for renewables?

Lord Adair Turner, then Chair of the Committee on Climate Change, launched their Renewable Energy Review at the College. With renewables playing an important role in meeting the UK's carbon budget and 2050 target, Lord Turner suggested the focus should now be on creating a stable investment environment, introducing incentives and supporting longer-term commitments for less mature technologies.



JUNE

Predictability

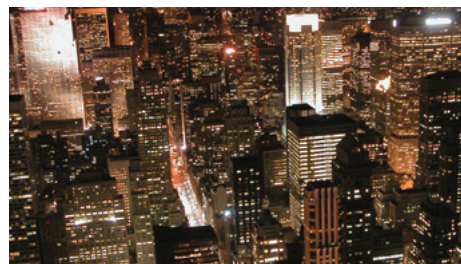
Presenting to delegations of member states, observers and representatives of the Diplomatic Corps in Geneva, Professor Sir Brian Hoskins' keynote lecture on "Predictability Beyond the Deterministic Limit" was well received at the World Meteorological Congress, which meets every 4 years. This was only the twelfth such lecture since its inception in 1967.



JULY

Future energy scenarios

Simon Buckle was an invited panel speaker at this event, organised by Shell. The meeting discussed the potential solutions to meet rising energy needs in a low-carbon future, asking how much impact technologies can have in meeting this need and what a 2 degree target would mean for fossil fuel use and global GHG budgets.



may

june

july

august

september

october

november

2011

NOVEMBER

Living with limits

Martin Wolf, Associate Editor and Chief Economics Commentator at the Financial Times, presented the 4th Grantham Annual Lecture looking at the limits of growth, resources and climate change. Painting a bleak picture of increased demand for natural resources, combined with the threat



of profound changes in global environment, he asked 'is this tension between human aspirations and natural limits manageable technologically, economically, socially and politically?'

DECEMBER

Changing gear on carbon reduction

Our conference brought together industry and government officials to question how businesses should position themselves to deliver the cuts necessary for the 2050 targets, while continuing to thrive. The Secretary of State for Energy and Climate



Change stated that 'halving our emissions to hit the Fourth Carbon Budget will mean changing the very fabric of our economy'.

JANUARY

Demanding energy

Energy demand set to increase – this was the message given by Dr Fatih Birol, Chief Economist of the International Energy Agency, at a Grantham Special Lecture where he outlined the likely energy trends and climate challenges that will face the planet in the coming decades as a result of this demand.



AUGUST

Joining up

A Roundtable Discussion with Dr Yvan Biot, Head of Climate Change and Environment at DfID, offered an opportunity to share thoughts in Imperial on DfID's strategic research targets and their contribution to key questions about climate change and the environment in developing countries.



SEPTEMBER

Building emissions

The Institute hosted a one-day workshop with the International Energy Agency, bringing together leading analysts from around the world to discuss how the building sector could realise major carbon reductions and what the barriers are to achieving successful policies for improving the building stock.



OCTOBER

Adapting institutions

Sir John Lawton, former Chairman of the Royal Commission on Environmental Pollution, discussed the Commission's last report on 'adapting institutions to climate change', which explored how institutions will need to change the ways in which they work as a result of climate change.



2012

december

january

february

march

april

FEBRUARY

Tackling industry

Emissions from industry currently make up over 40% of global CO₂ emissions. The Institute's 7th Briefing Paper, launched at a workshop for key representatives of heavy industry, takes a look at the technical options available to reduce emissions from industrial processes and the policies that can drive their uptake.



MARCH

Irrational avoidance of the unpleasant

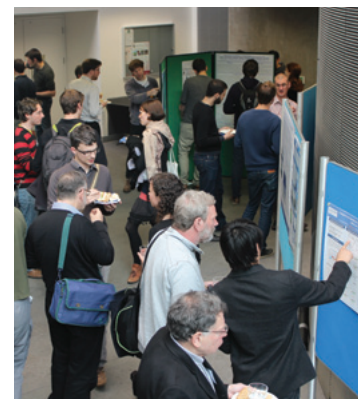
Examining resource and social limitations, with regard to climate change impacts, and asking 'what are the implications for the future of the global economy?', were the themes of Jeremy Grantham's Special Lecture at the Institute, which drew on his considerable experience in the financial sector to provide a unique look at these problems and their potential threat to our global society.



APRIL

Model oceans

The Institute's Ocean Day brought together over a hundred academics from the main oceanographic centres in the UK in a discussion of the physical aspects of the oceans. Academics shared ideas on the importance of ocean-atmosphere interactions, questions raised by the advances in observations and numerical modelling of oceans, and the opportunities given by the spatial and temporal scales of models.



Translating research into impacts

THE PACE AND SCALE OF FUTURE CLIMATE CHANGE will be decided by just a few of the world's major countries and regions, including, of course, the US and the EU that have until recently been the main emitters of fossil fuel related CO₂ emissions. But despite their low levels of CO₂ emissions per capita, Policy Director, Dr Simon Buckle says that "the greatest contributors to the growth of future emissions are likely to be the rapidly developing mega-economies of China and India. How they continue to develop is therefore crucial to all our futures. This is why the Institute has been working hard to understand the challenges and opportunities these countries face."

Building on earlier work on India and China's 2020 emissions intensity reduction commitments, the Institute in collaboration with the International Institute for Applied Systems Analysis in Austria, has made a detailed technological and demand side assessment of the mitigation options open to China to 2050 as it continues to develop. A similar study of India's 2050 mitigation options is currently nearing completion.

“China could account for nearly 30% of global emissions by 2050 so the Institute's work is very important in showing that there are feasible – if challenging – low-carbon scenarios for China consistent with the global 2 degree target.”

Engaging with policy makers

Dr Simon Buckle explains that the Institute's work focuses on carrying out world class scientific research and translating into real-world impact. "The Imperial culture is something that is both very distinctive and valuable",

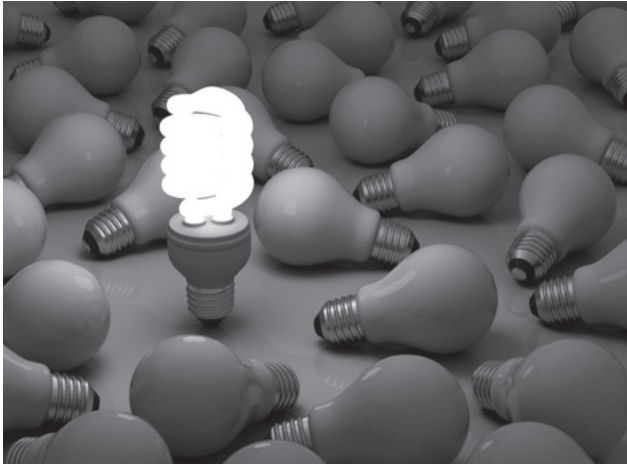
he says and notes that "both of these major country studies were funded by the UK Government under the AVOID programme, which provides key advice on avoiding dangerous climate change brought on by greenhouse gas emissions, demonstrating how the Grantham Institute is able to marshal the best scientific and technical expertise to inform climate policy development both nationally and internationally".



Dr Buckle sees the Institute working on practical projects with industry and government, as well as on fundamental research or policy questions, and he spent most of 2009 working with colleagues at Imperial and around Europe to create a new innovation organization – the Climate-KIC.

These endeavors are bolstered by the successful partnerships grown from the Institute, one such being the College's relationship with Sainsbury's, the third largest supermarket chain in the UK.

"Our engineers have been working with Sainsbury's to decarbonize their stores and improve energy efficiency," says Dr Buckle. "They've been smarter in how they integrate energy systems within the stores, so that the company can make better decisions about when to use power and when to switch things off. This obviously has impact, and one they can measure in terms of their energy bill!" The challenge is now to translate this learning into



new scenarios, for instance cities and households, and Imperial and its UK partners such as the Institute for Sustainability have a huge role to play in this.

Getting the message out

Dr Buckle is clear that the Institute must continue communicating the scientific evidence around climate change, its risks and uncertainties. A large part of this is helping to make sure that the debate is evidence based: “We target our communications and publications to address some of the key questions in climate science, its likely impacts and how we might mitigate those risks. We engage widely with industry and commerce, with Government and NGOs, with young people and the wider public on these issues.”

“It’s not made easier by the financial crisis,” he says, “which makes people more focused on short-term rather than long-term challenges. The urgency around tackling climate change hasn’t gone away and one of our main

““ Dr Ekins-Daukes’ work, with our Indian partner, the Divecha Centre in Bangalore, aims to understand how local atmospheric conditions affect the output of concentrated solar power systems.”

““ For the next 30 years or so the success of climate mitigation will depend heavily on how successful we are at improving energy efficiency: the sort of project we’ve worked on with Sainsbury’s. That drives energy efficiency while making money for the business.”

challenges is to help make cost-effective mitigation feasible.” The Institute’s policy team is therefore assessing the mitigation potential of key low-carbon technologies and tackling emissions and resource efficiency in industry, working closely with academics at the College carrying out research in these areas.

Evaluating the impact of the Institute’s work is often difficult, but it is something it is trying to do as part of a programme funded by the Higher Education Funding Council for England (HEFCE) and led by the London School of Economics. “We continually want to improve what we do and this programme is an ideal way to learn about what our stakeholders want from us and how best we can deliver that,” he says.





Uncertainty and limitations

THE IMPACT OF CLIMATE on human activity is generally through extremes of rainfall or heat, associated with rapid change. These extremes seldom occur, so there are few of them in the observations on which climate change models have been evaluated. “We have reservations about our competence in predicting average behaviour from models, but we can have even less confidence in the results about extremes,” says Professor Sir Brian Hoskins, the Director of the Grantham Institute.

“The Indian monsoon usually varies by no more than plus or minus 10%,” says Professor Hoskins. “But there is a significant risk, with climate change, that it will move outside these boundaries.”

“This could lead to problems for India, which already struggles to get enough water for irrigation of agriculture and for its population,” says Professor Hoskins. “If the ground dries out, that also influences climate,” he says. Managing the ground water is therefore important in the context of the risk of climate change.

Managing resources

For the past 50 years, people in the Ganges Basin have been using more and more ground water. It has now dramatically decreased. Brought to the surface, it re-infiltrates the ground, runs off into rivers or is used for irrigation, entering the atmosphere through evaporation and transpiration by plants. Local people are now suffering water shortages. Dr Wouter Buytaert is part of a joint British and Indian project researching how the resource is used. “We hope to feed our results into the Ganges

River Basin Management Plan to improve water resources management in the area,” he says. They may also tease out how local water use affects the monsoons.

Fifty years ago, the Ganges Basin was a natural environment, but this is no longer the case. “Northern India is the largest contiguous irrigated area in the world, and the Basin is the most densely populated large river basin in the world,” says Dr Buytaert. “When you travel through it, it’s incredible to see how urbanized the entire region is. It’s all houses, buildings and intensive agriculture. In an area seven times that of the UK, you hardly see any landscape that’s not been intensively altered by human activity.”

The team will collect field data on parameters including ground water levels, irrigation, crops planted and the water they use, river flow, soil types, vegetation, land cover and precipitation.

Evidence from global climate models supports the idea that local water use has a direct feedback on the local climate. The models are however coarse: they only give the big picture. The team’s more detailed studies are the only way to see if they’re accurate.

“If we can quantify the impact of water use on the monsoons, that would be a major scientific breakthrough,” says Dr Buytaert. “But our immediate aim is more modest. What excites me is the hope that we’ll improve water management locally in the field.”

“A lot of research going forward on climate will be associated with the impact changing climate extremes will have on specific regions,” says Professor Hoskins. “That means we have to improve our understanding of the system we’ve been describing, its modelling and our evaluation of the information the models are giving us.”

Critical transitions

Thresholds of change (often referred to as tipping points) occur in climatic as well as other systems. For example: has global warming already disturbed the equilibrium of the Greenland Ice Sheet? At a workshop in March 2012, Professor Jeroen Lamb from Imperial College’s Department



of Mathematics, and his colleagues, discussed whether it would be possible to identify universal phenomena underlying these changes.

“The basic questions climate researchers want to answer are, ‘Will climate change and its impacts occur quite suddenly, can we see them coming, and if we can, can we stop them?’”, says Professor Lamb.

“From a mathematical point of view, you sometimes can see underlying phenomena that are quite universal and are not so visible to people working on the applied side.”

The workshop was the first to bring a broad spectrum of international researchers together to discuss the development of theory in this area and has identified the potential for new collaborations.

Mitigation potential

CARBON EMISSIONS ASSOCIATED WITH our energy generation and use are changing the Earth's climate. Experts at Imperial are working with the Grantham Institute to identify the most promising new energy saving and generating technologies. They aim to calculate how much potential these would have to reduce carbon emissions.

"We work with technologies such as solar power and carbon capture and storage, where there is a strong expertise base at Imperial," says Jenny Nelson, who is Professor of Physics and a Theme Leader at the Grantham Institute. "We also assess emissions from heavy industries such as steel, cement and chemicals, and ways of reducing them."

Carbon capture

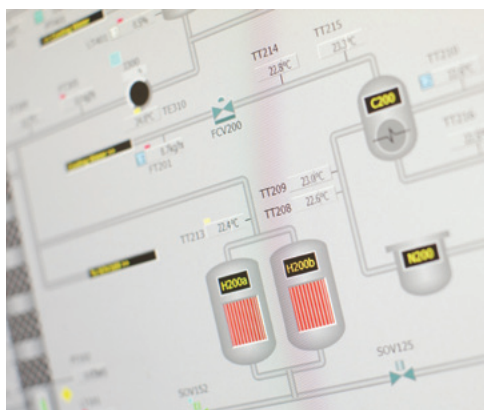
As far as carbon capture and storage (CCS) goes, the Grantham Institute aims to translate Imperial's research into policy. "The largest academic CCS project in the country is at Imperial," says Dr Paul Fennell, Imperial's Senior Lecturer in Clean Energy, "so the Institute is supporting and working alongside some of the best research in the world."

An example of the way the Grantham's expertise feeds into Government policy is its recent reassessment of the regulations UK power stations have to meet to get planning permission. The site a power station is built on has to be big enough to take the whole plant, including the space that has to be allocated to future equipment for CCS. In a Government-commissioned report, the Institute updated the data, concluding that the space to be set aside for CCS equipment could be reduced by 20%. Given the land area available, this meant that five extra combined cycle gas turbine power stations (at a combined value of £2.5 billion) could qualify for planning permission.

"Gas turbines provide efficient and reasonably low-carbon power generation which can react to changes in demand and be retrofitted with CCS," says Dr Fennell. "Specifically, they can make up for variation in supply from renewables; and they don't release nearly as much CO₂ as coal-fired power stations per unit of electricity. In updating the regulations, the Institute is helping to provide the Government with a good scientific basis for its decisions."

The Institute also funds research directly, and a number of its PhD students in areas related to carbon capture graduated this year. One current PhD student is investigating life-cycle emissions of CO₂ during cement manufacture, and ways of reducing it.

The next stage is to work out the actual contribution that any new technology could make to emissions reductions in different countries and timescales. "Even if a solar panel is very efficient, it's not worth deploying if hydropower, say, is even more effective in a particular location," says Professor Nelson.



Switching to a low-carbon future

There's a huge research effort going into renewable energy technologies, but how can we determine the impact they could have in reducing CO₂ emissions? PhD student Chris Emmott is trying to find out. "My aim is to get a better understanding of a technology before it's implemented," says Chris. "You might think that a technology looks good but it might not in fact mitigate much. I hope my research will identify the particular elements that need more work."

Chris is concentrating on new types of organic and inorganic photovoltaics. The project is complicated by the fact that the move to low-carbon technologies may cost energy to achieve. There is also a trade-off between the speed of adoption and the extra emissions to be saved from future technologies. "The challenge," he says, "is to determine the nature of a technology before it exists commercially."



Ecosystem impacts

USING A MIXTURE OF EVIDENCE from fieldwork, the laboratory and the fossil record we are examining the effects of climate change on ecosystems. This approach is making the key questions about future challenges clearer. We are becoming more aware of the many ways in which species and habitats can adapt to warmer climates and higher levels of atmospheric CO₂. “We need to know why plants appear surprisingly resilient to climate change, unlike big mammals, which often cave in at the first opportunity,” says Professor Georgina Mace, Imperial’s Chair in Conservation Science.

Her colleague Colin Prentice, Professor of Climate and Biosphere Interactions, researches these issues via recent ice ages and the warm “interglacial” periods that separate them. He says: “While large mammals such as the mammoth went extinct at the end of the last ice age, smaller animals tended to survive by moving location. And there is only one known case of a plant going extinct as the climate changed extremely rapidly at the end of this period.”

Nature’s emissions

Professor Prentice’s latest research is on nitrous oxide, a greenhouse gas whose concentration in the Earth’s atmosphere is increasing. He says it is “dogma” that this increase is all due to the use of nitrogen fertilisers, but he has been able to show that it is caused in part by soils emitting more nitrous oxide as temperatures rise.

He says that working at the Institute allows him to pursue his interest in climate change on a global scale. “My colleagues have just published a paper in *Nature Climate Change* showing that plants can buffer an average temperature rise of 2-3 degrees without causing CO₂ levels to rise,” he says. This is the kind of temperature increase that seems likely to happen. This experiment was carried out at Imperial’s Ecotron, using a unique set-up of ‘mini-biospheres’ – closed ecosystems containing plants and soil, which regulate the composition of their own atmosphere – as analogues for the real biosphere that we live in.

Professor Prentice has also been looking at the gas isoprene, which many plants emit. It has a role in preventing methane, a greenhouse gas, from being removed from the atmosphere. He says: “This research involves work at all scales from the whole Earth to molecular biology. We are finding out why plants produce isoprene, especially when they are stressed by high temperatures and other pressures, as well as discovering its effects on the atmosphere. This is the sort of multidisciplinary work that I enjoy and that the Grantham facilitates.”

Further research is being developed by Grantham lecturer Dr Blake Suttle, who is working on making ecosystem behaviour more predictable. As the climate changes, plant species change their basic physiology and the ways in which they interact with other species. This work focuses on finding out which changes are more predictable than others. Without this knowledge, the behaviour of an ecosystem can become unpredictable if climate change tips a few species into unexpected behaviour, perhaps precipitating a wholesale change from forest to shrubland across a wide area.

Measuring change

The DIRECT (Diversity, Rainfall and Elemental Cycling in a Terrestrial Ecosystem) experiment at Imperial’s Silwood Park environment centre is investigating how predicted changes in rainfall patterns will affect grassland ecosystems. The experiment, led by Dr Sally Power, works by varying the amount of rainfall reaching grassland plots, through the use of transparent plastic shelters and roofs.

Dr Power says that by the end of the century, southern England is predicted to have drier summers and wetter winters. DIRECT shows that this change does not suit perennial species, which are short and have deep roots. Instead, annuals with shallow roots and rapid growth prosper better in these conditions.

In addition, DIRECT has looked at the effect of climate extremes such as droughts on plant ecosystems. Dr Power says that these extreme events are bad for all aspects of plant behaviour. They cause vegetation to die back, reducing the amount and variety of biomass. The plants’ ability to act as a sink for carbon is also reduced as they are put under more stress. Other effects include a slowing down of microbial-driven processes such as nutrient turnover, with detrimental effects for plant growth and ecosystem functioning.

Ocean-atmosphere coupling

DR ARNAUD CZAJA LEADS THE GRANTHAM'S WORK on Earth systems. He says that a prime aim is to improve climate models, with an emphasis on the oceans. One product of this work is ICOM, the Imperial College Ocean Model, which was developed by the Applied Modelling and Computation Group. He explains that ICOM is an ocean model which has been developed from scratch, rather than being based on earlier models with roots in the 1960s.

Dr Czaja's main research interest is in the coupling between the oceans and the atmosphere. They exchange heat and material continuously, but it is not yet feasible to model the whole of the global ocean, or its interaction with the atmosphere on scales of tens of kilometres. "Not having this capability, or knowledge of these 100km interactions, might lead climate models to miss a significant source of climate predictability arising from the oceans."

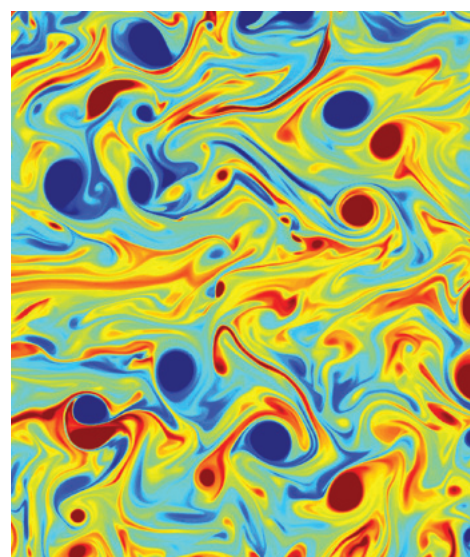
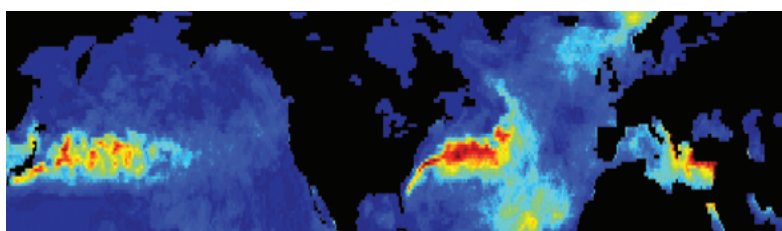
Linking the Gulf Stream

Dr Czaja has been looking at the Gulf Stream, the massive ocean current that flows from the Gulf of Mexico to the coasts of Western Europe. "The boundary of the Gulf Stream moves with time," he says. "We have shown that as the line between cold and warm water shifts, the cold fronts in the atmosphere above move as well." This work, which is about to be published, also points to the importance for the atmosphere and climate of the changes in the behaviour of the Gulf Stream on a decade-long scale.

He adds: "This coupling is very interesting because it has always been thought that the atmosphere forces the behaviour of the ocean, at least outside the Tropics. Now we are seeing the opposite effect in action." It has long been possible to model the ocean's influence on the weather in the tropics, such as the famous El Niño effect. It is harder to do this in higher latitudes where the ocean changes more slowly.

Dr Czaja says that this work will eventually allow climate models to be improved by building weather fronts into them, along with the clouds, rainfall and other things that they bring. "At the moment you might see a weather front in a climate model, but its interaction with the ocean underneath is not represented."

He adds that the Institute is working with the UK Meteorological Office to improve our knowledge of the impact of ocean-atmosphere interactions on climate predictions. "Imperial has people researching in oceanography in the Maths, Physics and Earth Sciences Departments. Working together within the Grantham has given it more cohesion and has put Imperial oceanography on the map."



Ocean currents

Dr Pavel Berloff studies mesoscale eddies in the ocean. These ocean features vary in size from 5km to 200km, and their physics resembles the behaviour of cyclones in the atmosphere. It has only become possible to observe them in detail with satellite instruments that measure the height of the ocean with centimetre accuracy. We now appreciate that these transient features transport about as much material in the oceans as the bigger and more familiar permanent ocean currents.

He says: "There are different ways of representing these eddies, either as waves or as isolated ocean features, a little like hurricanes in the atmosphere. In my work we are now seeing models and upper-ocean observations converge, so we can model the interactions between eddies and large-scale currents in detail. The next stage is to get detailed observations of the deep oceans and to model them, but that will call for a research programme that could extend over decades."



The Grantham community

THE GRANTHAM INSTITUTE INVOLVES SCHOLARS at every career stage from PhD student to distinguished professor. Now its younger members are taking steps to build an active student community.

Tim Foster, who is completing the first year of his PhD, says that for him, the Institute is a place where “you can go to a coffee meeting and get a new insight into your research project from someone in a different subject area.” He is one of the organisers of the 46-strong PhD group at the Grantham. They organise events to enable people from all the Institute’s science areas to interact.

One way of doing this is via their dedicated monthly seminars, at which students identify climate issues for discussion at group debates: they can tackle anything from climate change and food security, to how to engage with climate deniers on the key issues. These debates are further enhanced by speakers the students invite from industry, government and business, who share their thoughts and experiences with the cohort.

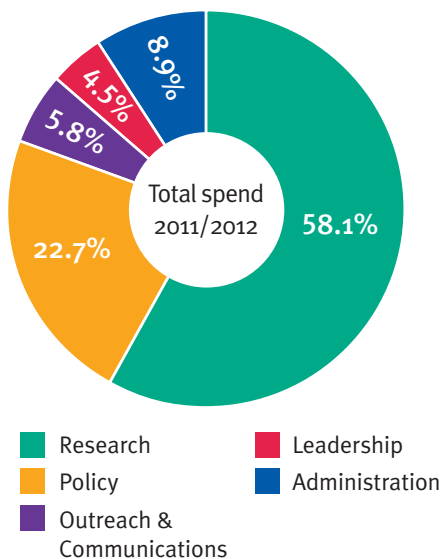
In addition, the group has gone on the road to see the Thames Barrier, “a real piece of climate change adaptation in action,” as Tim says. They also stage full-scale debates, such as the one looking at the UK’s low-carbon future in 2050, chaired by Professor Hoskins and with a distinguished panel of speakers.

Tim’s own PhD is on one of the biggest adaptation issues raised by climate change, the availability of water. His emphasis is on the key agricultural area of East Anglia. He explains that current water supply models focus on resources, and pay little attention to economics. He is adding this dimension, with an emphasis on the agricultural sector. “I am working on East Anglia, where water shortages would have a major economic impact, but the model will also be applicable across Southern England,” he says. “While water scarcity has long been considered in dry regions such as California and South-East Australia, it is now being taken seriously here because of two recent dry winters in the UK. Although the wet summer has alleviated the current problem, planning for future drought conditions remains a high priority.”

“Crucially,” says Tim, “water abstraction licences are not responsive to the changing availability of water.” Tools such as his model will help design policies which are flexible and which protect agriculture.

Investing in climate change research

In line with the Institute’s strategy, 2011-12 saw an increase in spend within policy activities, as well as our outreach and communications work.



Congratulations

We would like to congratulate all our students who have completed their studies here, successfully gaining their doctorates and moving on:

Dr Kwok Pan Chun: Postdoctoral Research Fellow at the Global Institute for Water Security, University of Saskatchewan.

Dr Clare Dyer-Smith: Postdoctoral Researcher at the Max Planck Institute for Polymer Research in Mainz.

Dr Alice Flint: Associate at McKinsey & Company.

Dr Ellen Fry: Endeavour Research Fellow at the Hawkesbury Institute for the Environment, University of Western Sydney.

Dr Lynsey McInnes: Postdoctoral Researcher in the Division of Ecology and Evolution at Imperial College London.

Dr Alistair McVicar: Analyst at Accenture.

Dr Alex Pigot: Postdoctoral Researcher at the Edward Grey Institute of Field Ornithology, University of Oxford.

Dr Danlu Tong: Graduate Chemist at BP.

Making an impact

THE INSTITUTE OFFERS A NUMBER OF OPPORTUNITIES for students to make an impact, either through internships within government departments and international organisations, or communicating climate research to schools and the public.

Technology perspectives

Luis Munuera, a PhD student at the Grantham, is working on models of future energy use in cities, and has looked at possible energy policies for India and China out to 2050.



He has recently added to his experience through a six-month placement at the International

Energy Agency in Paris, where he worked on its 2012 Energy Technology Perspectives report.

He says: “My chapter of the report is on heating and cooling, and feeds into my PhD, which is on the technology and economics of energy systems. For example, you might think that insulating buildings just reduces energy use, but in a low-carbon world it can reduce the size and cost of the energy infrastructure you need. Research points to the need for solutions that have benefits for the whole energy system, not just individually. These might involve high technology, or something as simple as storing hot water in a tank.”

Policy influence

Alistair McVicar is a Grantham alumnus who recently completed his PhD in fluid dynamics and climate change.

While working on his PhD, he carried out a three-month fellowship at POST, the UK Parliamentary Office of Science and Technology. It involved writing a briefing note for MPs and peers looking at energy efficiency. To do this, he spoke to a range of experts from industry, academia, government and regulators, in order to produce a balanced and impartial report.

He says: “The fellowship involved learning about the structures of the UK Parliament, speaking with various Government department representatives and attending select committee hearings, as well as watching Parliamentary debates, including Prime Minister’s Questions.”

Alistair says that POST’s briefing notes influence policy directly, so his experience there is invaluable for his new role as an energy analyst at the consultancy Accenture.

Energy islands

Sarah Lester is bringing Grantham wisdom to the younger generation. She is the Institute’s Research and Policy Impact Analyst, and has been taking energy research into schools with the Energy Islands game.

It works by getting school students to imagine they are in charge of one of three islands. One is a developing nation, one is already developed, and the third is a fast-growing nation comparable to China.

They find out first about the issues, and then use this knowledge to devise a low-carbon energy future for the island and for the whole world.

Sarah says: “The students learn that one nation cannot do it all by itself, so they have to work together. They also find out about different ways to reduce carbon, including nuclear power, renewables and carbon capture and storage. We are now doing this with 13 and 14-year-olds, a big ask. But they get the idea surprisingly quickly.”



Congratulations also go to our students who were awarded prizes in the last year:

Alvin Chan, who won Best Student Presentation at the IEEE Photovoltaics Specialists Conference, Seattle 2011.

Carys Cook, who won Imperial’s 2012 Science Challenge with her essay titled “Parliamentary election manifesto of a scientist turned politician” as well as I’m a scientist get me out of here.

Ute Hausmann, who won the 2011 student talk prize at the Challenger Society’s Ocean Modelling meeting

in Reading, as well as the American Meteorological Society’s 2011 Outstanding Student Oral Presentation Award at the 18th Conference on Atmospheric and Oceanic Fluid Dynamics in Washington.

Ana Mijic, who won the 2011 Overseas Research Students Awards Scheme.

A global Institute

CLIMATE CHANGE DOES NOT RESPECT POLITICAL AND GEOGRAPHICAL BOUNDARIES; its effects and the impact of our responses to it will be felt across the globe. This is why the Institute approaches the challenge from a global perspective, supporting research that addresses issues around the world.

Electric vehicles

Investigating the major structural changes required for road transport systems and related industries to deliver 95% reductions in greenhouse gas emissions by 2050.



Ocean dynamics

Developing mathematical models of physical processes in oceans in order to determine their role in maintaining the global climate.



North Atlantic storms

Using these storms as exemplars, researchers are looking at the uncertainties within various climate models and asking what the implications are for risk management in a changing climate.

Tropical deforestation

Using a range of economic and policy scenarios to determine what factors may predict deforestation at global to local scales, and informing policy decisions aimed at protecting these areas.

Road networks in the Amazon

Modelling road development in the Brazilian Amazon as a determinant of land use conversion, habitat loss and deforestation.



Biodiversity loss

Focusing on West Africa and bushmeat hunting, this study aims to understand how a household's decision making in response to environmental changes can affect the biodiversity of local species.

Disease control

Developing models to explore the impact of climate change on disease control strategies in Africa, producing a policy framework to evaluate the cost effectiveness of these options.



Drought risk

Extreme weather conditions are used to provide an insight into rainfall patterns in the UK and improve water run-off models. Such tools are useful in assessing water resources and long-term planning initiatives to cope in times of drought.

Permafrost thaw

Investigating how thawing changes the soil microstructure, with implications for the release of greenhouse gases that are otherwise 'locked' within the frozen soil. Additional effects can include building and infrastructure damage, as well as landslides.

Solar deserts

Improving predictions of energy production from concentrator photovoltaic systems in order to arrive at an optimal system design for desert installations.



Emissions pathways

Understanding the pathways through which China could reduce its energy related emissions by 2050 and the technologies needed to meet these targets, the barriers to their uptake and the implications for China's energy policy.

Climate health impacts

Looking at the implications of climate change on maternal health in Bangladesh as a result of changes in drinking water salinity.

Ice sheet instability

Pliocene sediments are used to construct a picture of the stability of the East Antarctic ice sheet and determine the risk of this sheet collapsing as a result of anthropogenic climate change.

Water resource management

Assessing whether the water usage patterns in northern India over the past 50 years are affecting the climate, focusing on the Ganges River Basin.





Grantham Institute for Climate Change

The Grantham Institute was founded with a mandate to drive forward climate change related research, translating this into impacts and communicating our knowledge to help shape decision-making. The Institute is integrating researchers and capabilities from all areas of the College necessary to tackle the challenges of climate change, through which we will work to offer practical scientific and technical knowledge of the highest quality.

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About Imperial College London

As the only UK university to focus entirely on science, technology, engineering, medicine and business, Imperial College London offers a critical mass of international research expertise and a vibrant home for innovation and enterprise. Imperial is committed to making sure that its research improves quality of life and the environment.

Sustained support for Imperial's climate change research is a sound investment in environmental improvement, and in developing the next generation of climate change pioneers, researchers, innovators and entrepreneurs.

Climate change regularly features on Imperial's home page at www.imperial.ac.uk, which is visited by over 1 million people each month.

