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technology

INSPIRED COLLABORATIONS  
Generating new ideas

# Barometer

Issue 22 [www.metoffice.gov.uk](http://www.metoffice.gov.uk) Met Office magazine



# Smart thinking



In post from September 1st, new Met Office Chairman **Greg Clarke** brings fresh perspectives at a time when innovation and ideas have never been more important for the organisation's future success.

## Introducing

## Greg Clarke

- Former Chief Executive of FTSE 20 company Cable and Wireless Communications PLC and ASX 50-listed Lend Lease Corporation of Australia
- Chairman of the Football League since 2010
- Non-executive director for organisations including BUPA, T-Mobile and MTN South Africa
- Honours degree in Business Studies; MBA from Cass Business School, London
- Greg is married with four daughters, loves golf and football — and is a lifelong fan, as well as former Chairman, of Leicester City

By working at the forefront of what is possible, we are enabling more people to access our advice and services, helping the UK to become more resilient, competitive and sustainable.

My interest in science goes way back — well beyond the moment when I chose management over physics for my degree. But it's a passion that's stayed with me throughout my career running multinational public companies — crystallising during the seven years I was managing Lend Lease Corporation in Australia from 2002 to 2009.

It was then that I became deeply involved with understanding the impact of weather on the built environment in general and the company's construction division in particular. Joining the Met Office as Chairman now gives me a unique opportunity to support a world-class organisation tackle some of the biggest issues our planet will face over the next 10, 20, 30 years.

New ideas are pivotal to good science — theories that can be verified through

repeatable experiments and then exploited to solve problems. So it's fitting that we're now owned by the Department for Business, Innovation & Skills (BIS), an arrangement that encourages bold new thinking across industries.

Our feature on innovation and invention in this edition of *Barometer* (see page 7) explores this theme with Caroline Griffiths, Head of Innovation at EDF Energy, one of the Met Office's clients. Caroline shares her thoughts on how EDF is learning from us — and we're learning from them.

An accompanying feature on the ThinkUP initiative (see page 11), investigates how a Met Office team is helping to support an innovation culture — working with EDF Energy, the Environment Agency, University of Exeter Business School, BIS and others.

Our piece on the 'science of attribution' (see page 19) then brings the innovation concept to life through an example of science that's adding to our

understanding of extreme weather events.

The collaboration theme that's supported by our diverse BIS links also flows strongly through the new Met Office Hadley Centre Climate Programme (see page 9) — an initiative designed to build on the UK's climate capability by bringing together the best minds from science, Government and industry.

Kirstine Dale, our Head of International Services and Climate Services for Government, explains how the programme will drive joined up thinking to underpin the UK's climate capability over the next three years to 2015.

Sharp, creative minds have again been hard at work in three other fascinating areas covered in this *Barometer*:

Wind energy is explored through a guest article (see page 15) by Ian Burrow, Head of Agriculture and Renewable Energy at NatWest. Ian discusses how the Met Office is working with the bank to help investors make the most of the wind energy opportunity.

Growers' Nation is an exciting new app developed by a Met Office team (see page 17) which cleverly combines location, soil, climate and growing data to help anyone aiming to grow their own produce.

Finally, a feature on flood forecasting reviews the ongoing success of the Flood Forecasting Centre following integration of Met Office and Environment Agency resources.

Like me, I hope you'll enjoy discovering more about the vital work of the Met Office through these and other stories in this 22nd edition of *Barometer*. I look forward to my learning journey in the months to come — and the chance to support a unique organisation in the years ahead.

➤ *Barometer* is also available online at [www.metoffice.gov.uk/barometer](http://www.metoffice.gov.uk/barometer)

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## Water intelligence

We are working closely with the water industry to launch a suite of innovative weather intelligence models.

For the water industry, operational and financial performance is closely linked to weather conditions. As climate change is predicted to increase the likelihood of weather extremes, together with the additional pressure on water resources, our forecasts are becoming ever more important.

To better anticipate the effect of weather across the water distribution network, we are combining our forecasting expertise with industry specific knowledge of companies like Thames Water. The result is new intelligence models that are designed to improve understanding of the impacts of the weather on pipe leakage and burst, as well as demand and seasonal night use.

Within the water industry there is a move from requiring post-event analysis, to wanting more proactive impact-based forecast services. As Stephen Herndlhofer, Manager of Risk & Analytics at Yorkshire Water describes, “The risk from extreme weather to the operational and financial performance of our business, as evidenced by recent events, does appear to be increasing.”

## Virtual learning



Met Office College Online, MOCO, a virtual learning environment accessed via the web, has been developed for customers of the Met Office College.

The new interactive website contains different resources and activities including e-learning

modules, videos, PDFs, questionnaires, chat rooms and quizzes.

Some MOCO content is available to all, but after registration, customers can select and pay online for single course licences. The site is initially being made available to the offshore oil and gas market and the first course on the site is for Offshore Met Observers.

More e-learning courses will be developed to complement our existing portfolio of courses. MOCO will also start to be integrated into all classroom courses with resources being made available online for delegates to access before, during and after attending courses.

There are plans to integrate web conferencing into the site so that live training can be delivered remotely. This will be particularly useful for international capacity building projects, where delegate travel is prohibitively expensive.

➔ Access MOCO at <https://elearning.metoffice.gov.uk/>

## Staying one step ahead



This winter we are working with the Department of Health and the Health Protection Agency to provide a Cold Weather Alert service.

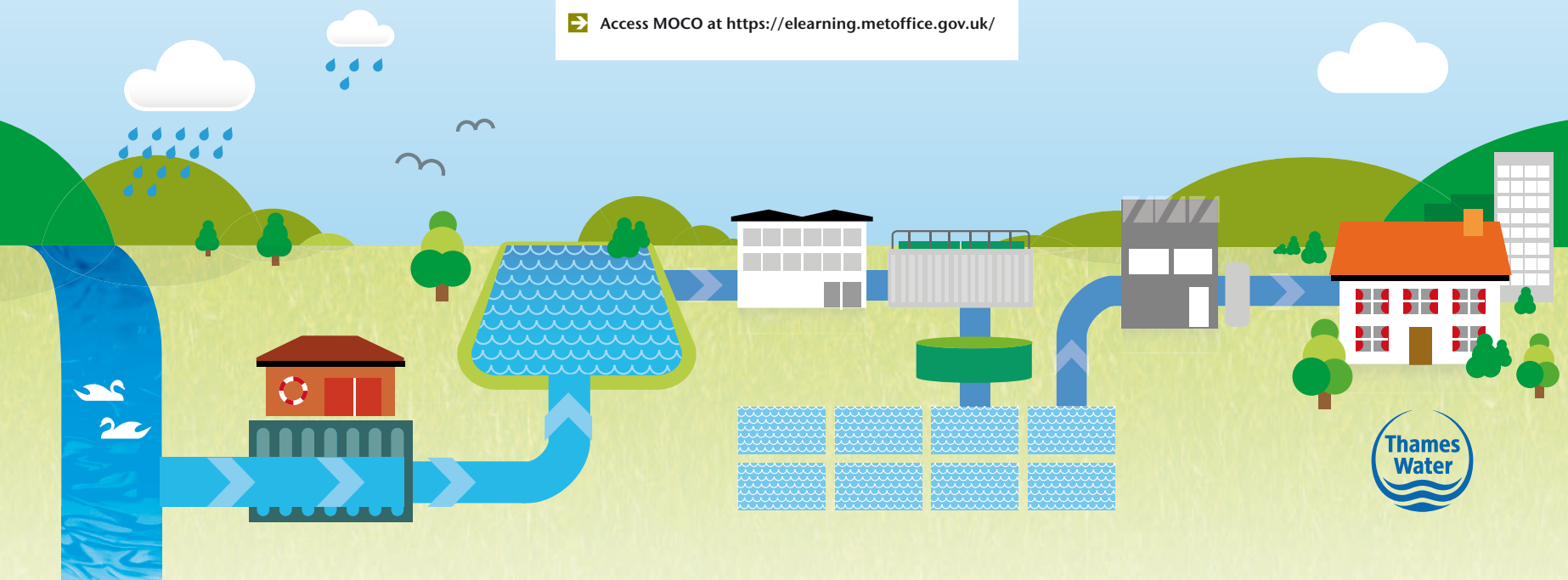
Each year, around 27,000 more people die during winter in England when compared to non-winter months.

The introduction of the Cold Weather Alert service last winter as part of the Cold Weather Plan has been warmly welcomed by public health and emergency responders across the country.

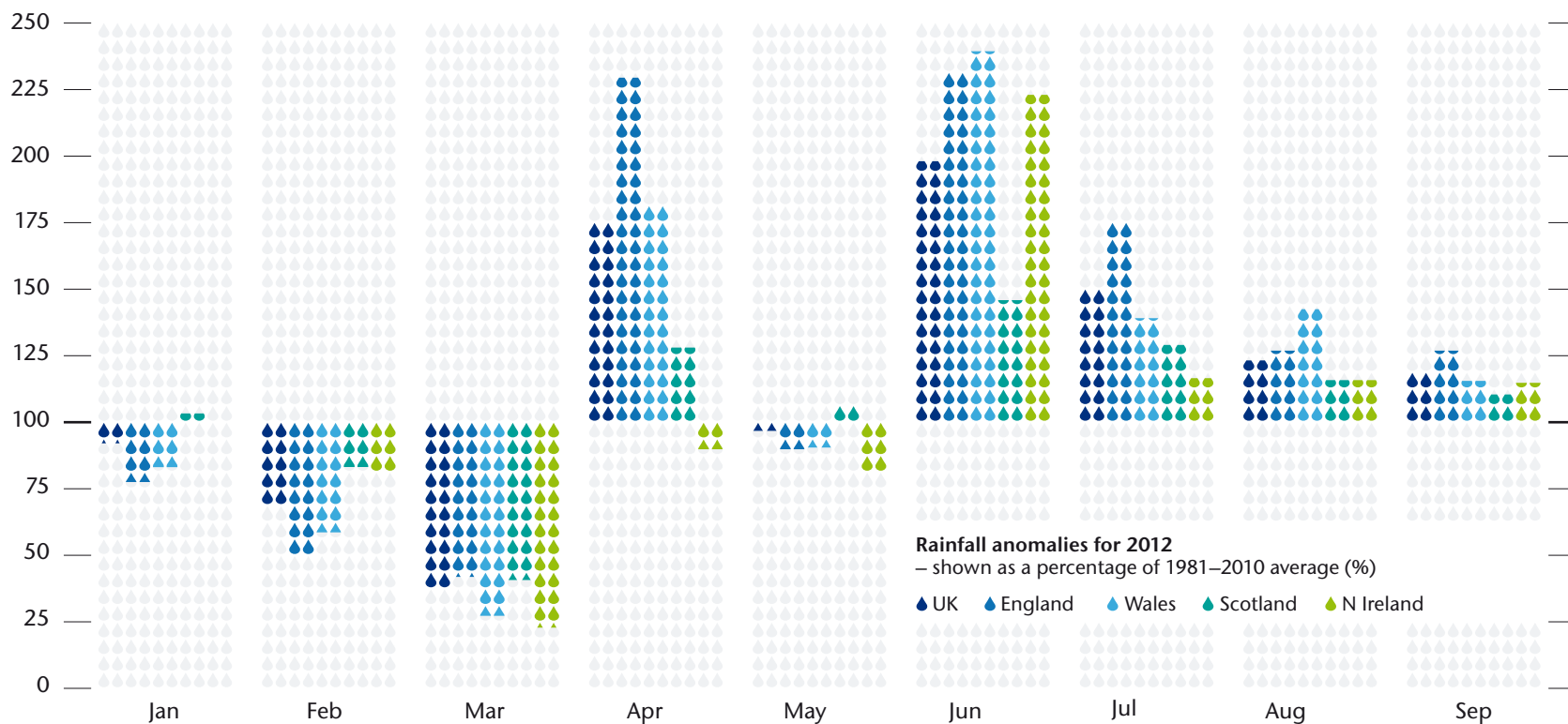
The purpose of the Cold Weather Plan is to avoid the dangers of severe winter weather. It increases resilience by raising public awareness and encouraging those in contact with people most at risk from cold weather to take action.

The Cold Weather Alert service operates in England from 1 November to 31 March, in association with the Department of Health. Met Office alerts are sent to the Health Protection Agency and NHS Trusts. They are also featured on our website and via our Twitter feed.

➔ Find out more about the Cold Weather Alert service at [www.metoffice.gov.uk/weather/uk/coldweatheralert](http://www.metoffice.gov.uk/weather/uk/coldweatheralert)







Graph showing how rainfall this summer was often at much higher levels compared to the last three decades.

# From one extreme to another

Despite it being the wettest summer in 100 years, the London 2012 Olympic and Paralympic Games gave us something to smile about.

## Wet summer

In June, July and August, 370.7 mm of rain fell across the UK, making it the second wettest summer on record since the 384.4 mm of rain which fell in the summer of 1912. These totals followed a record wet April, and an April to June period that was also the wettest recorded in the UK.

August was the driest and sunniest of the summer months across the UK with 109.5 mm of rain and 154 hours of sunshine. The mean temperature for August was 15.3 °C, in a month that also saw one of the hottest days of the year, as it reached 32.4 °C at Cavendish, Suffolk on the 18th.

# 370.7mm

Record summer rainfall

Summer 2012 was also one of the dullest summers on record with just 413 hours of sunshine. This makes it the dullest summer since 1987 when the UK saw only 402 hours of sunshine. To complete the disappointing picture, it was also a relatively cool summer with a mean temperature of 13.9 °C, some 0.4 °C below the long term average. Despite this it was a little warmer than the summer of 2011 which saw a mean temperature of only 13.7 °C.

# 154 hrs

August sunshine

## Unsettling experience

During June, July and August, unsettled weather was never far from the UK. Movements in the track of the jet stream, a narrow band of fast flowing westerly winds high in the atmosphere, contributed to the wet weather over the UK. This led to periods of heavy and prolonged rain, as well as short but exceptionally heavy thundery downpours interspersed only with brief warm sunny spells.

# 13.9 °C

Cool mean summer temperature

It was the second wettest summer on record in England, third wettest in Wales, eighth in Northern Ireland, and the sixth wettest in Scotland. In terms of sunshine it was the fourth dullest summer in England, the fifth dullest in Wales, ninth in Scotland and the 15th in Northern Ireland.



Our forecasts received widespread praise from event organisers and competitors alike.

Our forecasts received widespread praise from event organisers and competitors alike. Rod Carr, London 2012 Field of Play Manager at Weymouth and Portland, where the Olympic sailing events were held, praised our forecast services, commenting: “The Met Office team was first class — not only in the technical accuracy of the forecasts, but also the quality of the daily briefings and ability to engage meaningfully with the Race Management Teams. The International Sailing Federation and several National Team Leaders were also very complimentary about the forecast service, with several saying it was the best met service they had ever experienced at a Games.”

## First-class forecasts

Highly trained and experienced Met Office forecasters with an understanding of the sports they were forecasting for worked alongside Olympic and Paralympic Games organisers not only at Weymouth and Portland, but also at Eton Dorney and London. Our forecasters provided round-the-clock support and advice on weather conditions throughout the Games.

Cora Zillich, Venue Media Manager at the Eton Dorney rowing venue, said: “Here at Eton Dorney we have worked very closely with colleagues at the Met Office to support the race scheduling. The advice we received was absolutely spot on.”



## Olympic success

Thankfully, the London 2012 Olympic and Paralympic Games were held under largely clear skies. Looking back at the successful summer of sport, the opening and closing ceremonies provided impressive and mainly dry events, brightening up the otherwise dull, wet summer weather. It was our responsibility to provide forecasts to the London 2012 Olympic and Paralympic Games organisers, athletes, coaches, spectators and those responsible for transporting and ensuring the safety of huge numbers of visitors.

“The Met Office team was first class — not only in the technical accuracy of the forecasts, but also the quality of the daily briefings and ability to engage meaningfully with the Race Management Teams.”

During the Olympics we used cutting edge technology in our operational forecasting to help improve the accuracy of forecasting for small-scale weather features like showers. This involved using a much higher resolution version of the Met Office forecast model which is used to simulate what the atmosphere, and weather, will do next. Now, some of the specific forecasting developments such as the high-resolution forecast models that were used and tested throughout the Olympics will be further refined so that they can be used in the future, leaving a legacy that will benefit the UK well after the Olympic and Paralympic Games are over.



Find out more about how we supported the London 2012 Olympic and Paralympic Games at [www.metoffice.gov.uk/olympics/london-2012](http://www.metoffice.gov.uk/olympics/london-2012)



# Putting our heads together

As a key customer for weather services, EDF Energy is now partnering with the Met Office. The collaboration is supporting an innovation culture that will benefit both organisations.

EDF Energy generates around one fifth of the UK's electricity, employs 15,000 people and is the country's largest low-carbon energy producer. The company has a constant need for accurate weather information to help it predict energy demand within the UK and protect valuable assets.

"What's interesting is that we and the Met Office face similar challenges," explains EDF Energy Innovation Manager for Business-to-Business, Caroline Griffiths.

"We each have lots of talented people whose job is to come up with creative, working solutions to drive our companies forward, so trying to capture and track innovation is difficult. Both organisations also have to meet the requirements of diverse groups of people — working within a clear framework of delivering value. Our joint priority is to deliver against our obligations to all stakeholders and commit to continuous innovation to better serve and anticipate our customers' needs."

So while innovation is by no means new to both organisations, there are plenty of opportunities for promoting it further. Caroline sees it as a vehicle by which evolution and transformation is possible. "It helps us differentiate and therefore reach our ambition to be the leading supplier of energy to British business. Innovation provides a space

in which people can think differently, enabling them to drive the business forward."

"It's about identifying the differences between what we're doing today and what we need to do tomorrow," says Caroline. "It's also about recognising the importance of the innovation and entrepreneurial skill set — something that's often underestimated."

## No time like the present

But while innovation is a popular buzz word, it also inspires appetite and fear in equal measure. How do you justify the resources needed to innovate in a tough commercial climate when it's tempting to 'batten down the hatches' and hang on to what you have already?

For Caroline, the argument is clear cut: "There are plenty of studies that show that innovating in an economic crisis helps businesses remain competitive so they can emerge on the other side. Hunkering down simply to maintain your position is not viable for large organisations in the longer term."

## Sharing best practice since 2011

It's this shared commitment to the innovation concept that saw the EDF Energy-Met Office partnership take off in 2011 — an arrangement that's resulted in a fertile exchange of ideas ever since.

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GLOBAL LIN  
CHANGING  
MORE BENEFITS TO BUSINE  
RESEARCH  
VISION  
IDEAS  
WEATHER  
HARNESSING  
CREATIVITY GROV  
INNOVATION



EDF Energy is investing in its future and its people, building an innovative training environment for all EDF Energy employees due to open at the end of 2013. It will help further develop the skills needed for today and for tomorrow — including innovation and collaboration skills.

Caroline considers that EDF Energy can benefit from embedding a framework comparable to the Met Office's ThinkUP Academy (see more on page 11). So, having seen the advantages of a scheme first launched in 2008 and also sent a number of its staff on ThinkUP courses, EDF Energy is developing training and development specific to harnessing the innovative and entrepreneurial skillset.

This initiative flags up the importance of innovation for the corporate culture," says Caroline, "and the need for the right tools and methodology for innovating on a day to day basis. It really puts the subject on the map."

In the same collaborative spirit, Met Office employees have taken part in several of EDF Energy's innovation road shows and 'away days' and learnt from sharing best practice.

#### Let it flow

Caroline believes that one of the most important drivers for innovation is 'openness' — the ability of an organisation to hear the voices of its own staff, as well as that of its customers and marketplace. Creating a forum for capturing ideas — and testing their viability — is therefore critical for making this happen.

Both businesses have automated online systems for enabling customers and employees to put forward suggestions and then assessing them. At the Met Office it's 'Idea Street', a website created by the Department for Business, Innovation and Skills. EDF Energy's business to business equivalent is the 'Powering Innovation' web portal, with both partners working closely to make ideas management as effective as possible.

#### Rooms for improvement

While an online ideas repository is something no innovative company should be without, having the right physical space where people can push the boundaries is equally important.

Again, both companies have been sharing thoughts on the use of dedicated rooms and areas where staff can 'think outside the box' — for example the Met Office's welcoming, brightly coloured ThinkUP room in Exeter and a range of facilities across EDF Energy's UK sites.

Caroline Griffiths acknowledges their vital role, highlighting the importance of an appropriate working environment where employees spend most time — their day-to-day work stations and offices.

"Psychology of the environment is key. All spaces need to be appropriate for the job," says Caroline, "and they also need the right tools and technologies for recording and sharing ideas in the working space as well as having specific rooms to encourage collaboration of ideas amongst groups."

#### What next for the collaboration?

New ways of working innovatively will continue to evolve, for example those inspired by jointly attended sessions at the University of Exeter's Innovation and Entrepreneurial Directorate. Online forums will develop further to encourage ring fenced areas where senior managers can better share ideas, as well as interact with customers.

"In terms of the partnership," says Caroline, "we'll continue to share the innovation journey and influence each other's experience of it. And it's not just about what you see, but the integral layers that sit behind the organisation. It's so much more than a brand exercise."

TECHNOLOGY  
IDEAS VISION  
NEW THINKING RESEARCH  
CREATIVITY SKILLS  
LINKS CREATE BUILD KNOWLEDGE  
G BEHAVIOUR STIMULATE  
CESSES  
H INNOVATION COLLABORATION  
G SKILLS POTENTIAL ENVIRONMENT LEARNING  
WITH NEW THINKING CONSULTING  
ENTHUSIASM VISION SKILLS TOOLS IDEAS  
WORLD

What are the causes of the recent trends in global warming? How resilient are vulnerable systems such as the Arctic and Amazon? And what impact is human activity having on extreme weather events? These are the kind of big questions the Met Office Hadley Centre Climate Programme aims to tackle.

# Delivering world-leading science

Running from 2012–2015, the Met Office Hadley Centre Climate Programme — which is funded by the Department of Energy and Climate Change (DECC) and the Department for Environment, Food and Rural Affairs (Defra) — is at the core of the UK's climate capability. It draws on the expertise of scientists and academics in research institutes across the country and even further afield. Its main purpose is summed up by Kirstine Dale, Head of Climate Programmes for Government at the Met Office:

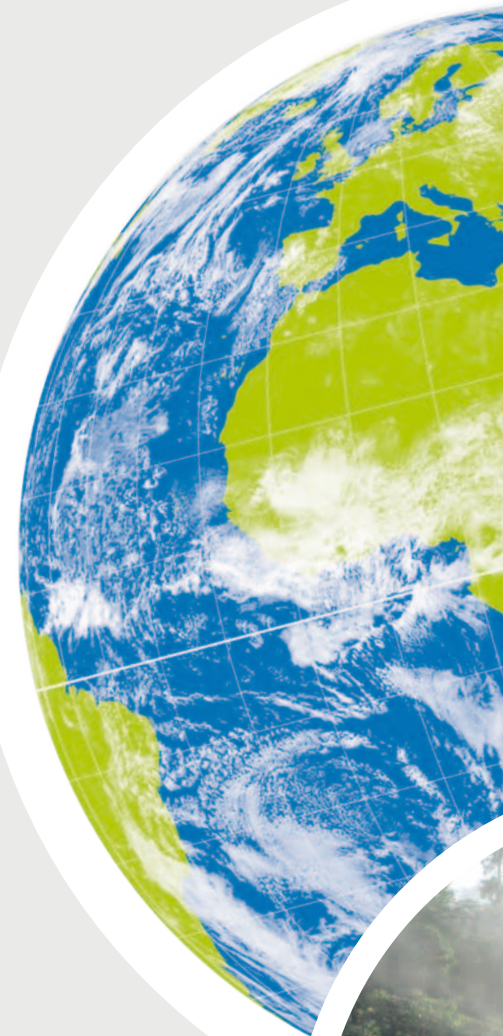
“It's about providing government with the impartial scientific evidence they need to make decisions to help the country mitigate and adapt to the risks of climate variability and change.”

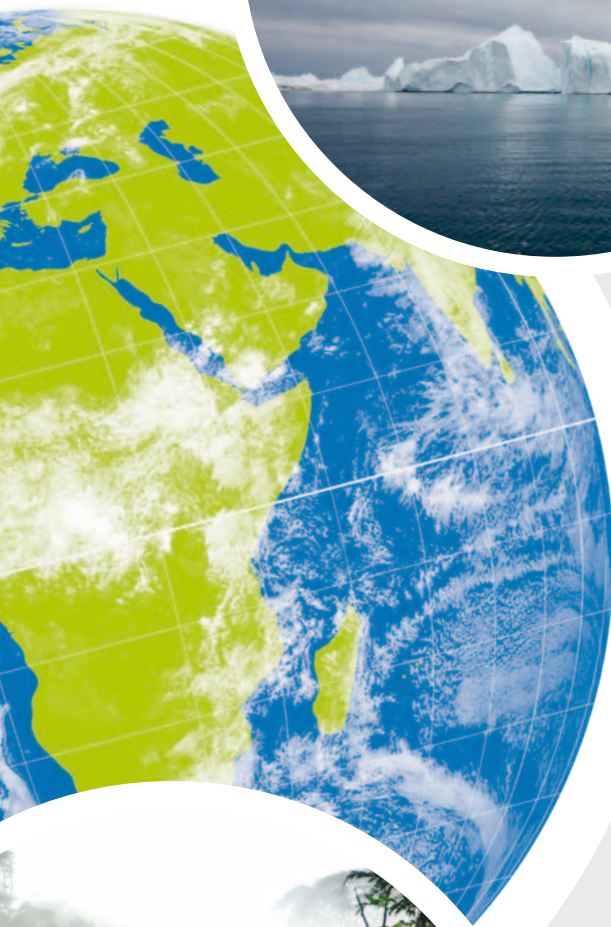
But importantly, the programme not only delivers tools for mitigation — it also helps policy-makers make the most of opportunities for economic growth in the context of a globally changing climate. And, in addition to this, it helps maintain the UK's position as a world-leader in climate science.

## Success stories

Since the Met Office Hadley Centre's inception in 1990, the government funded research programme has gone from strength to strength — and produced some impressive results along the way.

One such success was the delivery of the UK Climate Projections (UKCP09) — an analysis tool that the programme played a central role in developing. It provides comprehensive climate projections and uses them to illustrate the potential range of changes the UK could experience — and their likelihood. These are then broken down by geographical region. It's the first time anywhere in the world that a product of this nature has been generated specifically to inform a risk-based approach to adaptation planning. In a recent development, the Met Office is now using results to examine how renewable energy systems, such as wind power, might be optimised in a future climate.





## The big issues facing the Met Office Hadley Centre Climate Programme today

- Monitoring the size of trends in temperature and other aspects of the Earth system, and understanding their causes.
- Understanding, in near-real time, how human activity is impacting the risk of extreme events. Historically such analysis has taken years to complete.
- Providing long-term datasets and climate models to support decision-making on renewable energy deployment — from wind to wave, now and in the future.
- Quantifying the resilience of key systems — such as the Arctic and Amazon — to changes in climate.
- Developing a world-leading Earth system model to include and improve the representation of important processes such as the nitrogen cycle, glacier melt and permafrost.
- Providing future climate projections on time and spatial scales needed to inform planning.

The flagship success of the programme has been the development of world-leading climate models, and the incorporation of important Earth system processes, to enable state-of-the-art analysis of long-term changes in global climate. A major focus is understanding potentially dangerous rapid climate change such as accelerated loss of Arctic sea-ice extent or the potential from rainforest die-back. Like a vast jigsaw, adding Earth system processes, such as ice-sheet dynamics and atmospheric chemistry helps create a much fuller view of our climate, how it has changed over time — and what it is likely to do in the future. This information provides key part of the evidence needed by government to plan and negotiate the UK's role in global mitigation strategies.

The programme is also key to the development of a system to produce global temperature predictions for the coming decade. 'Decadal' prediction sits on the challenging boundary between weather forecasting and much longer-ranging climate projections. Although still very much a research area, the development of decadal prediction gives scientists the opportunity to improve their understanding of climate mechanisms which are important for predictions in both the near and long-term. This research will continue to develop, leading to improved predictions of the frequency of Atlantic hurricanes. It has huge implications for certain global industries, such as shipping and, especially, insurance.

Finally one of the key strengths of the new programme is the emphasis on knowledge integration. Led by Jason Lowe, Head of Mitigation Advice at the Met Office, the Knowledge Integration team aims to better explain the science and address the evidence needs of Government. In doing so it helps realise the value of Defra and DECC's investment in the underpinning climate capability by addressing the questions that enable policy development.

### The future

The 2012–2015 programme is already enjoying huge success. As for Kirstine's hopes for its future: "During the programme we're hoping to further develop and consolidate the science that underpins the programme and in doing so strengthen and build the UK's national climate capability," she explains. "We will also be looking for ways to engage with a wide range of stakeholders, and opportunities to realise the value of the underpinning science by delivering climate services not only for Defra and DECC, but for other organisations in the UK and beyond."



## A passion for innovation

# ThinkUP

Innovation has become an essential ingredient of modern business. But how does it happen and what can be done to encourage it?

It's easy to agree that innovation really matters whatever business you're in, but how does innovation really happen? And what can be done to encourage and support staff in making it happen even more? These are some of the questions tackled by Gary Holpin, founder of ThinkUP — a small team dedicated to innovation at the Met Office.

"I've always been interested in innovation, and my day job involves coming up with new product concepts," Gary explains. "ThinkUP began when I was looking for product ideas and I asked myself: how can we come up with great ideas when we need them? Is there more we can do?"

The Met Office has innovation at its core, pioneering advances in weather and climate science since its inception over 150 years ago. Today it continues to embrace new technologies from solar panels powering supercomputers to embracing new platforms such as social media.

Recognising that continued improvement must be at the core of any highly innovative organisation, Gary and a small group of like-minded Met Office staff decided to dedicate some time alongside their day jobs to learn what makes certain companies so

### The conditions for innovation

Gary and ThinkUP found that as well as treating innovation as a priority, many companies use certain 'magic ingredients' to increase their staff's creative potential and opportunities for innovation, including:

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A working environment that encourages informal collaboration and the sharing of ideas.

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A way for staff to share and build their ideas with other staff and managers.

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The opportunity and support to work on new ideas unrelated to their day jobs within the working day.

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Encouraging behaviours that give ideas a chance to grow rather than killing them too soon.

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Encouraging staff to constructively challenge the ways things are done, and take the initiative in finding better ways.

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Developing an understanding of how to tap into the creative abilities we all have, but many of us have forgotten how to use effectively.

innovative. The team visited several brand leaders including Google and Vodafone to research the aspects of their businesses that makes this possible.

Thorough this learning, the team set about implementing simple proven strategies to further accelerate the full creative potential of Met Office staff for the benefit of our customers.

"The exact mix of ingredients varies from company to company," says Gary, "but it's possible to identify a number of recurring themes, at the Met Office and elsewhere and these are backed up by academic research."

But the continuous drive for innovation at the Met Office is about more than direct business growth, he says. "Research has proven that companies that prioritise innovation are not only more successful, but their staff have greater job satisfaction."

Gary has found some companies particularly inspiring. "Visiting Google was great because as soon as you walk through the door it's obvious that they've achieved their success through making it easier for their staff to be innovative, like giving all engineers one day per week to work on a pet project chosen by them and not their managers," he says.

"Vodafone was also really interesting. They've embraced new technology to enable their staff to work anywhere, which means people aren't at fixed desks or stuck in meeting rooms all the time — they can work anywhere they need to, with the people they need to work with."



## The seeds of change

Since 2009, the ThinkUP team has trialled a range of tools and techniques with a focus on supporting creativity and innovation.

### Idea Street

An online ideas platform developed by the Department for Business, Innovation and Skills (BIS) for increasing public sector innovation. It gives staff a place to voice their ideas and comment on others'. The owners of the most promising ideas are encouraged to take their ideas forward.

### The ThinkUP Academy

A one-day introduction to creative thinking and innovation, designed to equip staff with the basic tools for being more creative in their day-to-day work. The scheme has been so successful that several high-profile customers and partners, including staff from Wrigley, EDF and BIS, have attended the course.

### The ThinkTank

A relaxed, dedicated work space to aid creative thinking, developed by ThinkUP. The team also works with property management and technical teams at the Met Office to ensure planned changes to the working environment meet with innovation best practice.

### Outreach

ThinkUP has developed close links with EDF, the University of Exeter, the BIS innovation team and the South African Met Service, to name but a few, to share experiences and research with others working in the field of innovation.

How is this research influencing what happens at the Met Office? "We realise that for people to engage with innovation we need to understand what works for us as an organisation," he says.

"We have a lot of learning from outside, but it needs to be relevant to us so we can support the innovation we already have here. Our focus is also about individuals. We realise that innovation and creativity comes from individuals feeling confident and free to explore their creativity and develop their ideas.

"We also recognise we have many different types of people here who work and innovate in different ways, so we need to respect those differences, understand them and tailor the tools and support we provide to their particular requirements".

This autumn marks an important step change in ThinkUP and innovation at the Met Office.

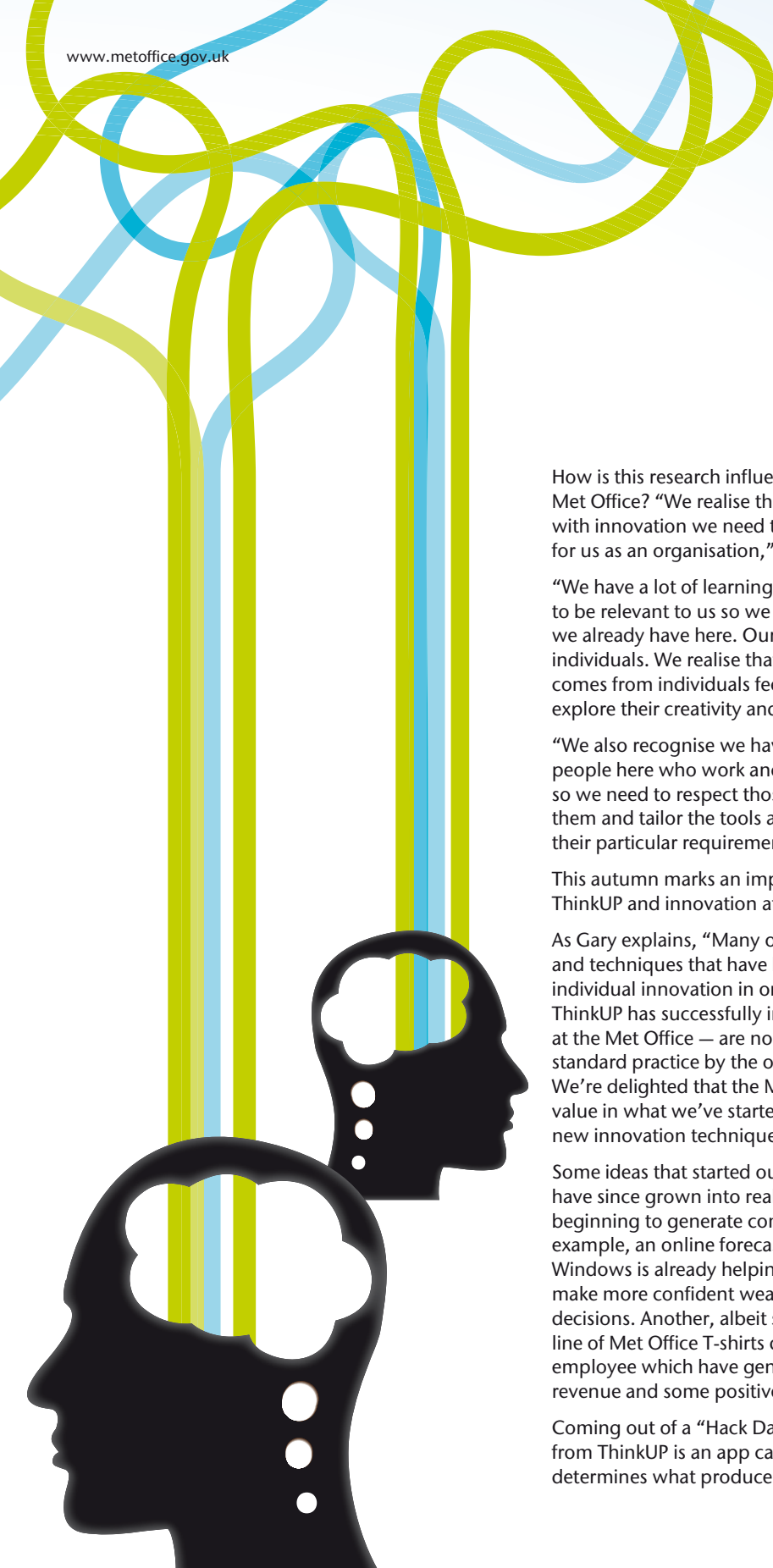
As Gary explains, "Many of the behaviours, tools and techniques that have been shown to support individual innovation in organisations — and which ThinkUP has successfully introduced and germinated at the Met Office — are now to be adopted as standard practice by the organisation as a whole. We're delighted that the Met Office has seen sufficient value in what we've started, and wants to embrace new innovation techniques and approaches."

Some ideas that started out as ThinkUP projects have since grown into real products, and are now beginning to generate commercial revenue. For example, an online forecasting system called Weather Windows is already helping airport operations staff make more confident weather-sensitive planning decisions. Another, albeit smaller, success was a new line of Met Office T-shirts designed by a Met Office employee which have generated new commercial revenue and some positive press coverage.

Coming out of a "Hack Day" run independently from ThinkUP is an app called Grower's Nation that determines what produce to grow and when, given

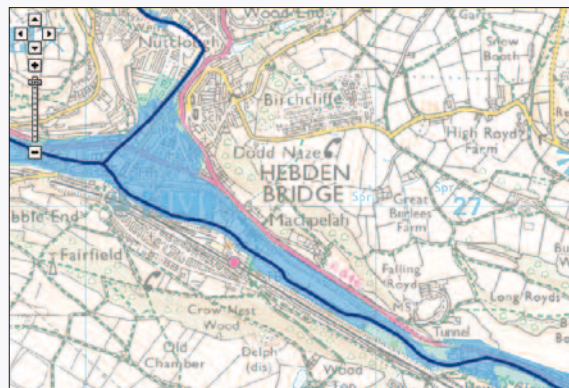
the soil type and current seasonal conditions, has achieved similar success. In fact, it recently won the global NASA space apps challenge in the Galactic Impact category (more on pages 17–18).

As Gary puts it, "We don't care where and how innovation happens, we just want to help Met Office staff by supporting them or suggesting tools and techniques that they may not previously considered. ThinkUP sees any innovation across the Met Office as a positive thing for staff, the Met Office and most of all, our customers."



## Will Lang

With this summer being the UK's wettest in 100 years, Chief Hydrometeorologist of the Met Office and the Environment Agency's Flood Forecasting Centre (FFC), Will Lang, had his work cut out. But the whole team — which combines expertise from both the Met Office and the Environment Agency — rose to the challenge. Here, Will describes how the partnership works and the strides they've made in streamlining processes.



*Environment Agency flood map of Hebden Bridge*

# Making a difference,



Following undergraduate and postgraduate degrees in mathematics from Cambridge and a PhD in astrophysics from Bristol University, Will Lang joined the Met Office as a forecaster in 1998. He's since progressed to become one of the managers of the FFC — a joint Environment Agency and Met Office partnership that was formed in response to the 2007 floods.

The partnership aims to reduce the impact of flooding in England and Wales by giving government and emergency services the information they need to better respond to extreme weather events. But flooding is a complex phenomenon. Not only is it caused by water from the skies but also by the way that rain behaves when it hits the ground which, in turn, is affected by many factors including the type of ground, the gradient of the land, current water levels and more. And the team also has to consider other factors which can cause flooding, such as high tides and large waves along the coasts, or rising groundwater within layers of rock underground.

Lessening the impact the weather has on flooding was one of the main reasons behind the FFC's creation. In response to the 2007 floods that swept across the UK, the independent Pitt Review made several recommendations. It recognised that the Met Office weather warnings were accurate and so were the Environment Agency's river flood warnings. But as Will explains, "It also recognised that the process of predicting flooding could be much more powerful if there was collaboration between our two services. So in 2009 the flood forecasting partnership was set up."

For Will, the key has been creating a common language between Met Office meteorologists and Environment Agency hydrologists — and a consistent, authoritative message. Before the joint partnership, it was very hard for government and emergency services to act on weather forecasts indicating a risk of flooding, because they were really only half the story.



# together

But as Will explains, “We’ve now created a team of hydrometeorologists who are experts in taking weather forecasts and translating them into a picture of flood risk for the whole of England and Wales tailored towards the emergency response community. Together we provide the definitive source for flood risk forecasting — and we communicate the right messages in the right way” says Will.

## Strides in flood forecasting

Since the FFC was set up in 2009, great advances have been made in the service it provides. Based at the Met Office in Exeter, scientists from both

organisations collaborate to produce the Flood Guidance Statement (FGS). This gives Category 1 and 2 responders (emergency services, local authorities, government agencies, utility and transport companies — plus health bodies) a daily, five day overview of flood risk in England and Wales.

Since time is a critical factor, the FGS service is designed to be as efficient as possible. Every day, subscribers to the service receive colour-coded alerts. Green is the lowest risk, and red is the highest. When the alert shows amber or red (i.e. medium or high risk of flooding), it will trigger

a teleconference with the various responders, which enables them to coordinate their efforts. “People tell us that they can’t imagine how we did things before,” says Will.

In fact, last June, when areas of Cumbria, Lancashire and West Yorkshire were about to have a month’s worth of rain in 24 hours, the FFC was able to give advance warning of several days. This meant teams from the Environment Agency and local authorities were able to get to the scene before the floods arrived, clearing drains, testing defences and preparing flood basins. As a result, the work of the FFC was highly praised by the then Secretary of State for Environment, Food and Rural Affairs, Mrs Caroline Spelman. In a statement she said, “I am very grateful for the diligent work of the Met Office and the Environment Agency staff in the Flood Forecasting Centre. Their forecasts, foresaw the flood event unfolding and meant that much work was possible in advance to lessen its impact.”

But forecasting is just one part of what the team does. In addition to doing 12-hour shifts to provide forecasts, the team also works on increasing the flood forecasting capabilities across both organisations. As Will explains, “We act as scientists, project managers — and advisers to coordinate and join together improvements. We’re the glue.”

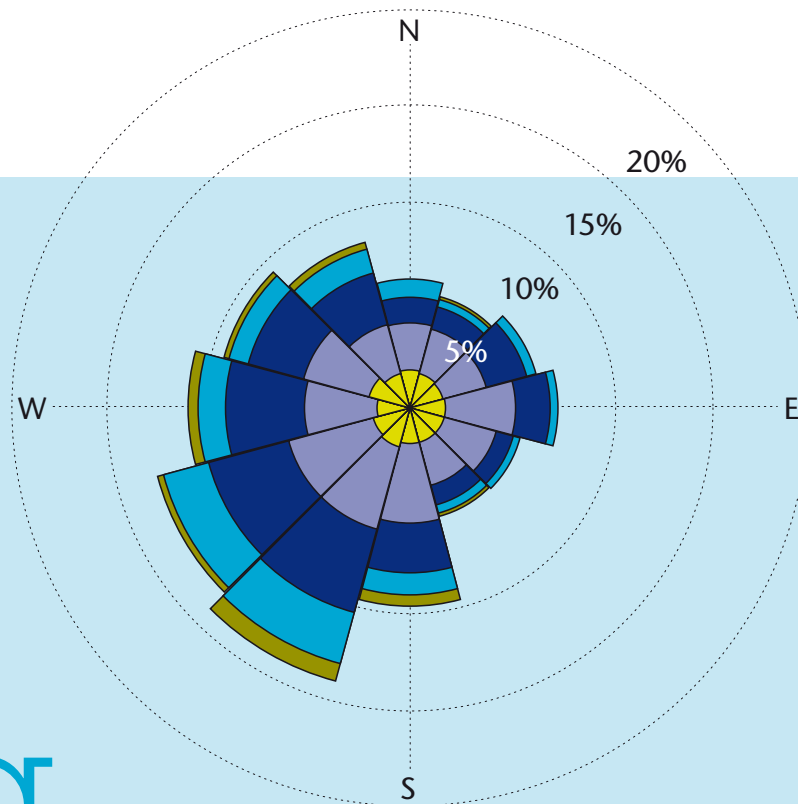
The close working relationship has been valuable on both sides. “Both here at the Met Office and at the Environment Agency, we’ve learned that our capabilities are stronger, and have more impact, when joined together,” says Will.

“We act as scientists, project managers — and advisers to coordinate and join together improvements. We’re the glue.”

*The Met Office's Virtual Met Mast™ makes it possible to understand the feasibility of wind projects by providing accurate data.*



Ian Burrow, Head of Agriculture and Renewable Energy at NatWest, describes the bank's collaboration with the Met Office which he hopes will encourage more people to invest in wind energy.



# Supporting renewable energy

There is a real push to use sustainable energy as many farming and rural communities recognise the cost saving and efficiency benefits of harnessing wind and solar power. A recent survey conducted by the National Farmers Union (NFU) and NatWest revealed that almost one third of farmers across England and Wales are currently involved in some form of renewable energy production and supply.

This surge in popularity is also down to the Government support and the commercial potential of using 'green' energy. Recent Government announcements on the changes to subsidies for renewable electricity claim they will create a multi-billion pound boom for the British economy, driving growth and supporting jobs across the country because it could incentivise

between £20 billion and £25 billion of new investment in the economy between 2013 and 2017.

Added to this, rising energy prices, the need for farming to reduce its carbon footprint, and economic pressures leading many farmers to consider diversification strategies, it is no surprise that the interest in renewable energy is high.

## Significant contribution

Onshore and offshore wind generation can make a significant contribution to the UK's renewable energy target of achieving 15% of energy from renewable energy projects by 2020 (as set out by the EU Renewable Energy Directive). With 40% of all wind energy in Europe blowing over the UK, it is clear we have some of the best wind resources in Europe that can be used

as a low carbon renewable energy supply. The Department of Energy and Climate Change (DECC) states that the UK already has more offshore wind capacity than any other country in the world.

All this highlights that there are plenty of opportunities where turbines could be deployed and we have found that the response from the farming community has been excellent. One in five farmers polled in the NFU/NatWest survey said they were producing clean electricity with one in eight using or generating renewable energy by summer 2012.

It is clear that farmers are taking notice of the developments in renewable energy and see a tangible benefit for their business. However, for many people, securing the required financial

investment is a key concern. Of those surveyed in the NFU/NatWest report 34% believed access to finance was a barrier, whereas the number was less (24%) from those farmers already involved with solar and wind projects.

At NatWest, we have already taken steps to help those businesses that see access to finance as a barrier. One of the ways we have done this is by setting up specific training programmes for both our agriculture and renewable energy managers to ensure they are better placed to understand and help clients. For our agricultural teams we have created a training programme accredited by the Chartered Banker Institute that helps our agricultural managers to be more professional in their day to day roles and keep abreast of key industry issues. This will lead to



# 40%

of all wind energy in Europe blows over the UK

# 34%

of those surveyed believed access to finance was a barrier to investment in renewables

# 1/5

farmers currently producing clean electricity

a Certificate in Agricultural Finance, a new formal qualification undertaken by all of our managers, expanding their knowledge of EU policy, tax and key sectors that make up the UK's agricultural market. It is also endorsed by the NFU.

In addition we have teamed up with Mark Newton, Head of Renewable Energy at Fisher German, rural and commercial property consultants, to create a tailored training programme for our renewable energy teams. The NatWest Renewable Energy Financing Programme is also accredited by the Chartered Banker Institute and ensures our managers undertake continuous professional development and understand issues facing customers looking to invest in renewable energy. We want to fully support our customers and both of these training programmes highlight our continued commitment to provide a professional service, as well as our aim to become the bank of choice for agriculture and renewable energy.

The training programmes were launched last year on the back of the bank's announcement about the £50 million Renewable Energy Fund. We have provided nearly half of this funding to support renewable energy projects and we are keen to fund more viable projects.

### Assessing profitability of wind turbine projects

In a move to make access to this funding more readily available we have teamed up with the Met Office to provide access to the most accurate

wind speed data. This helps assess the profitability of a wind turbine project and ensure customers have all the right information from the start. We encourage farmers and landowners to commission a Met Office report, called Virtual Met Mast™, which accurately defines how much wind there will be at specific locations. A Virtual Met Mast™ report can help anyone planning a wind project to better establish the right size turbine for their site and gives all parties a greater peace of mind when assessing the risks associated with the investment.

Our criteria for investment in wind turbine installation is considered on a case by case basis. Using the Met Office's Virtual Met Mast™ enables all parties to understand the feasibility of a wind project and provides the most accurate data. We have also introduced new funding terms, including an extension of the loan terms from 10 to 15 years following the announcement of reduction in the Government's Feed in Tariff (FiT) and flexibility around full security cover with the ability to use the Government-backed Enterprise Finance Guarantee (EFG) loan scheme subject to terms and conditions.

All in all we are striving to make investment in wind projects as straight forward as possible. By working together with the Met Office I hope to drive more investment and encourage more people to consider renewable energy sources. In turn, that will help people grow their business, improve their bottom line, reduce the risk involved in renewable energy projects and cut costs.

Ahead for Business »

## When considering Renewable Energy, speak to the experts

With energy bills rising, Renewable Energy can really help your business by not only reducing your costs but by also serving as an extra source of income. Our team of local Renewable Energy Specialists are put through independent accreditation, meaning they can provide you with the expertise your business needs and provide support across a range of Renewable Energy schemes – such as solar PV (photovoltaic) and wind.

To find out more about how we can help your business get ahead, visit [natwest.com/agriculture](http://natwest.com/agriculture) or call us on 0800 092 9116

Lines are open Monday to Friday 9am – 5pm (excluding Bank Holidays). Calls may be recorded.



 NatWest

Find out more about Virtual Met Mast™ at [www.metoffice.gov.uk/energy/vmm](http://www.metoffice.gov.uk/energy/vmm)

Not everybody has green fingers. But a new science-based app, supported by the Met Office, aims to make growing your own fruit and vegetables much easier.

# Grow your own

The new project is called Growers' Nation. It's the brainchild of Met Office Radar Products Scientist, Selena Georgiou, who started it with a team of fellow scientists, app developers, gardeners and a forestry school teacher during the NASA Space Apps Challenge earlier this year. This international competition challenged people to address societal issues of global importance — as well as those to do with space — during the course of one weekend.

The Met Office led the European effort and hosted one of the UK events. It was a great opportunity to use scientific weather and climate data in new and innovative ways. At the start of the weekend, NASA invited team leaders to pitch their ideas. Selena put forward a

concept based around helping people make better use of the space in their gardens, school grounds or local areas for growing their own produce. The idea was accepted and the Growers' Nation team was born. The original idea grew and it soon became clear that the benefits of an easy-to-use and informative application could be very wide ranging.

"An increasing number of people in the UK are showing an interest in growing their own produce, but some may be put off because they are new to it — and find the idea of getting started too complicated," says Selena.

To help get people growing, the team developed a global map application that incorporates climate, soil and weather data. It gives people information about the best time to sow, plant and harvest in their location — some of the main aspects that will encourage people to get started. The app is a real confidence-builder for people who have the passion, the energy and the time to grow produce — but had previously lacked the knowledge.





“An increasing number of people in the UK are showing an interest in growing their own produce, but some may be put off because they are new to it.”

“With increasing food prices, it makes total sense to make the best use of local available land. And we also think that if people can effectively grow produce locally and sustainably, then it could have a positive impact on the number of food air miles too,” says Selena.

### Turning a dream into reality

The project went on to win the NASA Space Apps Challenge’s ‘Galactic Impact’ prize at the international finals. And since then the enthusiastic team has continued work on the project, with support and funding from the Met Office.

“We’re really happy that the Met Office will be supporting the project for six months. This means we can really get it off the ground and build a more robust app that we hope will be ready in March — just in time for the growing season,” says Selena.

In addition to developing the app, the team is working towards creating related educational resources that will fit in with schools looking to start or maintain growing plot projects. As Selena explains, “The app will be a great free resource for a range of different people, from those starting

out in their back garden, to a primary school class who want to develop their own growing plot.”

### Going beyond UK shores

Eventually the team plans to expand its reach to farmers in developing countries, where access to comprehensive, science-based advice is hard to find. Unfortunately, in these areas access to smartphones is scarce too. So the team is exploring other ways to disseminate this information, such as SMS messaging and printed weekly digests.

As Selena reflects, “It’s been an exciting journey so far — but we’re still just at the beginning. Long-term, however, we’re hoping to make a real difference both in the UK, and in other regions of the world.”

## More winning designs

The NASA Space Apps Challenge was a meeting of great minds — and even greater ideas. Idea Street, a platform that gives staff the opportunity to drive innovation, — represented the UK public sector.

Here are just a few of the other fantastic challenges created at the Met Office HQ:

- **Hazard Map** — Met Office Weather Impact Research Scientist, Jo Robbins and Emma Bee, a Geographical Information Specialist who is on placement at the Met Office from the British Geological Survey, created a real-time hazard mapping app, which harvests information from existing social media and public data.
- **We Love Data** — A team based at the University of Dundee developed a device to warn hay fever and asthma sufferers when the next day’s pollen count was expected to be high.
- **Predict the Sky** — Met Office Applications support and development specialist, Emma Hibling, created an app to calculate when cloud conditions were just right, so you can watch astronomical phenomena, such as meteor showers.

We Love Data also won at the regional Met Office event. In addition to Growers’ Nation, the judges also agreed to sponsor and take forward two other challenges — Hazard Map has now linked up with ShelterBox, an international disaster relief charity, and Predict the Sky with Mubaloo, a mobile app development company.

→ To find out more about these challenges, visit [www.spaceappschallenge.org](http://www.spaceappschallenge.org)



# Extreme weather: an attribution perspective

A wealth of observations collected over the globe has shown convincingly that the climate is changing. But although climate change is expected to lead to more extremes of weather including more heatwaves, droughts and floods, does this mean that recent events like the Texas drought or Thailand floods of 2011 can be blamed on human emissions of greenhouse gases? Or were they actually natural disasters that could have happened anyway?

Such questions are increasingly being asked, prompted by the severe human and financial consequences of extreme weather. Identifying a need for better information on the links between extreme weather and climate change, Met Office scientists are leading the way in developing operational attribution services.

One analogy of the effects of climate change on extreme weather is with a cricketer who starts taking steroids and finds he hits twice as many sixes in the new season than he did during the previous one. For any one of the sixes, a spectator near the boundary rope would not know for sure whether the fact the ball was looping over his head into the stands was due to steroids. But it might be possible to attribute the increased number of sixes to steroids. And, given that steroids have resulted in doubling the number of sixes, you would be able to make an attribution statement; that, all other things being equal (such as the size and state of the pitch or weather conditions), the use of steroids had doubled the probability of that particular six.

As Dr Peter Stott, Head of Climate Monitoring and Attribution at the Met Office, explains, “The job of attribution of extreme weather events is to determine whether human induced climate change or natural climate variability, such as that due to changing solar output or variations in Pacific Ocean temperatures associated with El Niño, have altered the probability of a particular extreme weather event.”

The idea of attributing recent extreme weather has been trialled in a new publication published in the Bulletin of the American Meteorological Society (BAMS) and co-edited by Dr Peter Stott of the Met Office and Thomas Peterson of the US National Oceanic and Atmospheric Administration. The report, published in July 2012, examines six extreme weather events of 2011, including the Texas drought and Thailand floods, to put them into a climate perspective.

The report showed that the Texas drought, which led to extensive crop damage and livestock losses, was associated with La Niña conditions in the Pacific Ocean but that human induced climate change had also increased its probability. “Such a conclusion is important because while it underlines the need for societies to deal with natural climate variability,

it also shows the risks associated with such natural climate oscillations may be greater as a result of warming of the ocean and atmosphere,” says Peter.

The BAMS publication generated a great deal of media interest which indicates there is a large demand for this kind of attribution information. But it was only possible to examine six weather events of 2011 in time for the publication, showing that there is a long way to go before it is possible to provide scientifically robust information for the full range of extreme weather events that occur over the globe in any one year.

This is what Met Office scientists are endeavouring to address by developing an operational attribution system. This will be a continuous process of combining observations and computer models of the climate system. It will provide regular updates on the extent to which the changing odds of recent extreme weather events can be attributed to human-induced climate change or naturally occurring climate variability. While sounding straightforward, this presents a huge scientific and computational challenge at the forefront of climate science and Met Office scientists are collaborating with other attribution experts from around the world.

But, as Peter says, “If we don’t do this, we risk people making poor decisions based on past weather statistics which are no longer a reliable guide to current weather risks with a changing climate. By attributing the changing odds of extreme weather accurately, we hope we can avoid people blaming extreme weather on the wrong causes and help them improve their resilience to the vagaries the weather might throw at them.”

➡ Dr Peter Stott, Head of Climate Monitoring and Attribution works in the Met Office Hadley Centre. See pages 9 and 10 to read more about the Met Office Hadley Centre Climate Programme.





# Science profile



**Dr Peter Stott**  
Scientific Strategic Head  
for Climate Monitoring and  
Attribution

The Met Office employs professionals and experts who are constantly expanding the boundaries of weather and climate prediction. Here we meet one of them...

Take a heatwave, drought, flood or other extreme weather event. Are they caused by man-made climate change or are they simply part of natural climate fluctuations? These are the kinds of questions that Peter Stott tries to answer.

After studying at Durham and Cambridge, Peter completed a PhD at Imperial College on the environmental consequences of the Chernobyl nuclear incident — then went on to post-doctoral research on stratospheric ozone depletion at Edinburgh University.

Since then he has focused his efforts on investigating how and why the climate varies. This is the science of climate monitoring and attribution. At its heart is the development of a comprehensive set of observations on a wide range of elements and the use of climate models to understand the changes that have been observed. Knowing more about every element of the atmosphere and oceans is important if we are to build a complete picture of our climate.

A great deal has been achieved already. Peter has played an instrumental role in the development of such ideas through major contributions to the processes of the Inter-governmental Panel on Climate Change and become one of the world's most widely respected climate attribution scientists. Ultimately his work has led to the publication of the first ever attribution report in the 2011 State of the Climate report in the Bulletin of the American Meteorological Society. Peter was a co-editor of this report aiming to establish whether extreme weather across the globe in 2011 was connected to changing climate conditions.

## Real-world science

Herein lays the problem because not all extreme weather can be blamed on human activity. Firstly the climate varies naturally — weather is typically chaotic — and secondly there may be other reasons for natural disasters. The floods in Thailand last year were found to be due to factors unrelated to climate change including changes in the management of local river systems.

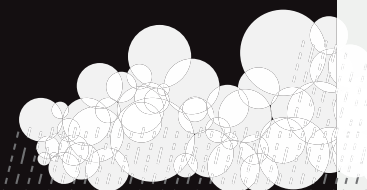
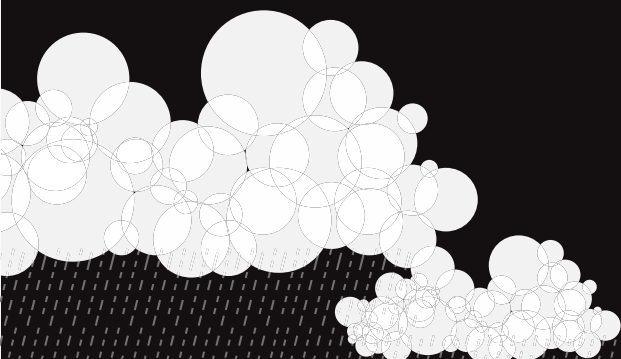
It's an especially tricky science. "The difficulty comes from trying to separate the causes of specific events,

from the 'background noise' — the variability in the earth's climate systems," explains Peter. To help them find and isolate the causes, Peter and his team are developing datasets, which collect information both nationally and globally. These include temperature readings from the land's surface, the atmosphere and the oceans — which help them monitor what's happening on a monthly and yearly basis.

## Real-time science

Peter's aspiration is to develop systems that will enable them to attribute the causes of extreme weather events in near real time — and then be able to relate recent events to the odds of such events occurring in the future as well as calculating the likelihood of wetter, drier, warmer or colder seasons. He believes they're about three years from creating this system "Initiatives like case studies of recent extreme weather and the establishment of an international group of scientists to advance attribution science are a great step along that path", he says.

It's this real-world aspect of the role that Peter loves. "We're not just asking abstract questions. It's about why things are happening the way they are. The work we're doing can help policymakers and communities plan and better cope with the weather."





Vadim Petrakov/Shutterstock.com

Climate variability and change have huge impacts on food security, water availability, human health and social and economic infrastructures. This is especially evident in Africa where people are particularly vulnerable to extreme weather and climate change.

Through improved predictions of climate variability and change it's possible to manage these impacts and sustainably reduce poverty in Africa. The partnership between the Department for International Development (DFID) and Met Office Hadley Centre is working, in consultation with African stakeholders, to advance understanding of current and future African climate, and bring new science into use.

### Consultation

The CSRP objectives were refined in consultation with partners in Africa. The aim was to help identify research directions that would best contribute towards enhancing the range and quality of climate information available to users in Africa. Interviews were held with regional climate organisations, national meteorological and hydrological services, universities, non-governmental organisations, government ministries and organisations acting on climate information to aid vulnerable communities. Consultations focused on requirements for monthly to decadal predictions — timescales of most practical use in developing resilience to climate variability and change.

The CSRP is enhancing the professional development of African scientists by running training workshops to help develop and disseminate new products based on CSRP research. In addition, eleven African scientists have been awarded study fellowships to research African climate issues. This has helped to advance the CSRP's objectives and to strengthen the climate science base in Africa.

### Predictions for vulnerable regions

A key focus of CSRP is advancing understanding of African climate processes to improve their representation in the Met Office Hadley Centre's HadGEM3 climate model — leading to better predictions of climate for vulnerable regions of Africa. Key results include improved modelling of rainfall in all the important sub-Saharan rainy seasons, enhanced understanding of the drivers of interannual variability in the West African Monsoon and a comprehensive assessment of the ability of present-day climate models to represent the important influences of the global oceans on African rainfall.

Early warning systems and adaptation planning are already being helped by the CSRP. For example, the



Attila JANDI/Shutterstock.com

timing of the onset of Africa's rainy seasons is crucial to agriculture; if crops are planted too early ahead of the rains, seeds rot in the ground; if too late, the early growing season is missed. Experimental forecasts of onset timing have been developed using the Met Office's seasonal forecast system and are being trialled by climate centres in East, West and southern Africa. These forecasts are the first of their kind and can help African regional centres and weather services improve predictions of rainy seasons, leading to increased agricultural output and food security.

A new monthly-decadal system has been developed and shows improved capability to predict rainfall and temperature averages over Africa out to five years ahead. This has enhanced potential to provide early warnings, for example, of drought or successive drought, and adaptation advice.

Information on how man-made climate change drives extreme weather in Africa is essential to inform adaptation strategies, and can help avoid inappropriate and potentially expensive adaptation. First results have focussed on the recent severe drought in the Greater Horn of Africa and indicate that man-made climate change has had little impact on rainfall in the short-rains season in this region (October to November), but may have increased the risk of drier-than-average conditions in the long-rains season (March to May).

A key objective of the CSRP was to bring research into practical use in Africa. This is now being achieved through ongoing climate science workshops held in collaboration with African centres, as well as active participation in Africa's Regional Climate Outlook Forums and policy forums for climate and development.

➔ Find out more about the CSRP at [www.metoffice.gov.uk/csrp/](http://www.metoffice.gov.uk/csrp/)

# Climate Science Research Partnership

The Climate Science Research Partnership (CSRP) is working with various African organisations to improve understanding and practical prediction of African climate to help alleviate poverty



# Monty Halls

## The spirit of adventure

Monty Halls is best known for his adventure and wildlife programmes — where his passion for the natural world has taken him across the globe and deep into the oceans. With occupations as diverse as TV presenter, explorer, eco-tours leader, diving writer and marine biologist, it's easy to understand what a crucial role the weather must play in his work. And why climate change concerns him so much.



Growing up initially in Malta, the toddler Monty was never out of the water. A life-long interest in marine biology followed, culminating in him gaining a First Class degree in the subject from the University of Plymouth at the age of 29 — having already served eight years in the Royal Marines.

It was while studying at Plymouth that he went on his first proper expedition to Belize to photograph a rare species of crocodile. Inspired by the trip, Monty set up his first company, Full Circle Expeditions which, in turn, attracted the interest of Channel 5 who ended up filming one of his round the world trips.

### Extreme experiences

One thing led to another and soon Monty was presenting natural history programmes, including Great Ocean Adventures where he dived with Giant Humboldt Squid — and BBC2's Monty Hall's Great Escape where he lived on Scotland's Western Isles for six months, recreating ancient crofting techniques.

Having such a close working relationship with the weather, it's little surprise he considers the elements 'massively' important when filming — especially when out at sea.

"The viewer might be thinking — what a lovely sunny day for the crew. The reality is, rain and wind above the surface causes big currents and limited visibility under water. You might be sitting in the boat for weeks waiting for that 'fair weather' opportunity."

In fact, coping with extreme conditions is an occupational hazard for Monty. Whether he's rolling around on fishing boats in Force 9 gales, out on manoeuvres with the Marines in northern Norway at -40 °C, or surviving debilitating temperatures of 52 °C in California's Mohave Desert.

To keep track of the weather Monty regularly uses forecasting websites. But he's also come across more traditional methods, such as the ones

used by some of the local fishermen he's met. These include following the movements of sandhoppers — tiny amphipod crustaceans that can, apparently, detect low-pressure systems. The theory goes, if they move up the beach and into the village, a storm is brewing.

### Climate concerns

When it comes to Climate Change, Monty is in no doubt about its impact.

"There have been some radical changes this past ten years. Everything seems out of kilter. Lambing happens much earlier. And I've seen peregrine chicks blown from their cliff top nests by unseasonal easterly winds."

He also is dismayed at the devastation of the coral reefs.

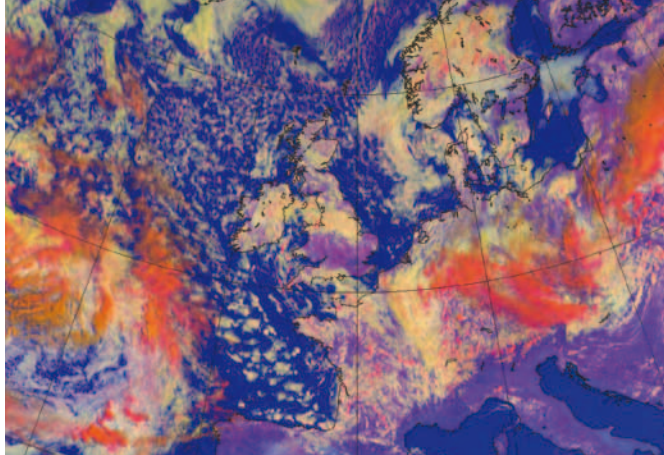
"They're like the fountain of life — super sensitive to any slight increase in water temperature and ocean acidification. The coral's delicate calcium carbonate skeleton is being fatally weakened. In fifty years time the Great Barrier Reef could cease to exist."

Monty believes that action needs to be taken at a G20 level and that the world's largest industrialised nations can't afford to wait to make significant reductions to CO<sub>2</sub> levels. "The wiping out of thousands of coral species won't just result in billions being lost in tourism; there will be huge economic problems for local fishing communities."

So what's next for Monty? His immediate plans are to continue with his current career — growing his Great Escapes business that consists of a shop and training centre in Dartmouth. He also has a new diving exploration series planned.

It looks unlikely Monty will put his adventurous spirit to one side any time soon. In fact, when asked what he would be doing if he had opted for a more routine occupation and his response is "I'd enjoy skipping yachts — I can't imagine doing something that didn't involve the sea."






### Then, now... and beyond

Looking back at forecasting methods of 50 years ago, it's amazing how things have changed. Back then, forecasters used hand drawn charts and manual observations. Now we use an IBM supercomputer which can do more than 100 trillion calculations a second.

With improved science and increased computing power, today's four-day forecasts are as accurate as one-day forecasts were 30 years ago. However, our forecasters still use their expertise to amend forecasts if necessary.

Beyond the present day, computers help us understand the Earth's climate, making forecasts decades into the future. This has enabled scientists to understand more about climate change and its impacts.

Forecast accuracy should increase further as technology advances, with Met Office scientists at the forefront of designing new forecasting solutions. So, it'll be interesting to see how we're forecasting the weather 50 years from now.

 The Met Office Library and Archive contain a wealth of information on forecasting methods over the years. Find out more at [www.metoffice.gov.uk/learning/library](http://www.metoffice.gov.uk/learning/library)

