



COMPUTER CONNECTIONS
Working it out

SHARING SUCCESS
Across the media

RESEARCH RAPPORT
Furthering science

Barometer

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As the Met Office prepares to install a new IBM supercomputer at Exeter, Science and Technology Director, Alan Dickinson, explores some of the taxing questions it will be put to work on.

They can only give you answers

It was the Spanish cubist painter and sculptor Pablo Picasso (1881–1973) who observed that computers “... can only give you answers.” And he was right. Picasso would have witnessed tremendous advances in technology in his lifetime as it constantly pushed boundaries, grew inexorably and, like him, challenged his contemporaries’ views of the world. Today, its rate of change shows no signs of abating and it’s critically important to everyone — the public, government and business — that the Met Office keeps up with its latest developments.

With the arrival of a new IBM supercomputer at the Met Office next year, we’ll be posing key questions on behalf of all our customers for it to work out (pages 9–10). What will the weather be like today, tomorrow, next week and for decades to come? How can we help people and organisations take better action to avoid the impacts of severe weather? How can we encourage everyone in the UK and beyond to reduce and prepare for the effects of climate change?

But computers can only process the information they’re given, so getting the best from technological advances has always relied on human intervention to input the data, ask the right questions and interpret the output. That’s why the work of our skilled observers, modellers, researchers, forecasters and, as this issue of *Barometer* shows, our collaborations is so important, as we continue to work in unison towards settling these issues. Learning more about the how minuscule dust particles can have an enormous bearing on the weather and climate (page 15) is just one small, but immensely important, example of this joint work.

Our work touches everyone’s lives — another soggy summer in the UK left many ‘staycationers’ disappointed, while an active Atlantic hurricane season brought chaos to Haiti, Cuba and some US coastal areas (page 5). Every single country will be affected by climate change and the increasingly severe weather we expect it to bring. The Met Office thrives on the challenge of providing ever more accurate and

localised forecasts, but we cannot advance weather and climate science on our own. That’s why working in collaboration on meteorology, oceanology and hydrology is at the heart of our Corporate Plan 2009/10–2012/13 which is due to be published next spring and we’ll continue to make scientific connections across the world. Our work is far-reaching, world-changing and based on the latest scientific and technological breakthroughs, so much so that we’ll be dedicating a future issue of *Barometer* to our worldwide collaborative work to balance this edition on our UK partnerships.

There were numerous UK collaborations to choose from for *Barometer* and it would have been impossible to cover them all, so here’s a selection. We peer behind the scenes at Met Office Media and explore how today’s technology means you can literally have the weather in the palm of your hands (page 6). We reflect on our strong links with the BBC through Radio 4 staple, the Shipping Forecast

(pages 13–14). *Barometer* also looks at the many different ways in which the Met Office and Natural Environment Research Council (NERC) are connected (pages 11–12), not least through our new supercomputer that will be shared with NERC-funded projects.

The Met Office has kept pace with many leaps in technology over the years. From our first steps towards producing computer forecasts in the 1950s to the multiple simultaneous forecasts we plan to run on the new supercomputer. The weather and climate are in constant flux and we’re here to ask the right questions to guide the choices you make — from whether or not to take an umbrella to how much the world’s climate will change. That’s because, in truth, computers are only part of the answer. The rest is down to you and me.

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Cap and gown

The Met Office is listed in *The Times Top 100 Graduate Employers* — a prestigious annual directory featuring Britain's best known and most sought-after graduate recruiters.

Each year, during the first two weeks of September, the directory is distributed to final year students at the top fifty universities named in *The Times Good University Guide*.

The Met Office offers graduates rewarding careers and opportunities in weather forecasting and scientific research and in other areas such as Information Technology, Engineering, Consulting, Sales and Marketing, as well as Corporate Services (such as Human Resources and Finance).

For the first time, in 2008 the printed directory was accompanied by a website **www.Top100GraduateEmployers.com** where students can find in-depth profiles on each of the employers featured.



Part of the UK's Vanguard Photo: Cody Images

Bright Navy

From the Battle of Trafalgar to the D-Day landings and contemporary warfare the weather has always been a critical factor in military operations, which is why the Met Office stands shoulder-to-shoulder with the UK's Armed Forces.

On 1 October 2008, the new Joint Operational Meteorological and Oceanographic Centre (JOMOC) took over the role of providing meteorological and hydrographical support to UK military units on deployment. Based at a joint headquarters in Northwood, JOMOC brings together the Met Office's Defence Meteorological Centre, High Wycombe (which had served RAF and Army requirements) with the Royal Navy's Fleet Weather and Oceanographic Centre, Northwood.

Making use of the existing naval facilities, JOMOC is staffed by forecasters from the Met Office and the Royal Navy. Its strategic role is to provide data, advice and products on all things weather and water related — from the seabed to the edge of space — to support the UK's Armed Forces away from home on operations or exercises.

A joining of minds



Aerial view of the University of Exeter

The Met Office and University of Exeter are putting their heads together in a joint programme of climate research.

We're developing a shared vision for the further study of climate observations, modelling and forecasts, as well as the impacts of climate change. Together, we plan to look at the effects of a changing climate on human health, well-being and economic success for a sustainable future, and translate climate change scenarios into policy development.

With the Met Office's and University's extensive research links across the world, Exeter has the potential to become a global centre for climate studies and advice. Over time, we plan to attract other partners to this important programme, while influencing research funding in the UK.

On 22-24 September 2008, a major international conference was held at the University to discuss the impacts of climate change and ways to adapt. The packed three-day programme attracted distinguished speakers and delegates who, together, tackled five key issues: improving predictions of climate change; impacts and ecosystems; technology for adaptation and mitigation; policy responses and behavioural change; and the coupled human-environment system.



Wang Fang of China wins gold in the 100m T36 final at the Beijing 2008 Paralympic Games
Photo: PA Photos

Chinese takeaway

As the Paralympic Games in Beijing drew to a close, Met Office forecasters were in the Chinese capital to find out how the weather can affect such prominent international events.

The visit was part of an active connection between the Met Office and the Chinese Meteorological Administration that goes back many years. While they were there, our two forecasters looked at the ways essential weather information was communicated across Beijing to the various venues used in the games. This was invaluable, as the Met Office came away with a very clear understanding of how vital accurate and timely weather forecasts are for events on the scale of the Olympics and Paralympics.

We'll undoubtedly take from the Chinese experience as we prepare for the London Games in 2012.

Chill in the air



A healthy outlook to winter Photo: Alamy

Chronic Obstructive Pulmonary Disease (COPD) is a lung condition often aggravated by cold weather. It affects some 900,000 people in the UK and causes acute breathlessness which can make everyday life very difficult. Cold air can worsen symptoms by narrowing airways, making it even harder to breathe. Chest infections are also common in winter.

Healthy Outlook COPD Forecast Alerts from the Met Office tell people when wintry weather is expected via an automated telephone service. Giving patients several days notice of chilly conditions helps them plan their lives and avoid exposing themselves to the cold air which might trigger an acute attack.

Figures from the National Health Service reveal a 24% fall in the number of COPD-related hospital admissions from the 189 Practices that signed up to the service last winter. Admissions fell by just 3% in the same areas where GPs hadn't subscribed to the special COPD service.



Whatever the weather, we help keep runways open and flights on time

Cleared for take-off

The UK experiences some of the most variable weather in the world. But whatever arises the Met Office can help airports and airlines keep runways open and flights on schedule.

Weather-related airport delays are frustrating for passengers and costly for airports. OpenRunway is a new online service from the Met Office that makes it easy to see what the weather's doing at any UK airport. It provides detailed weather information on the current conditions and forecasts up to five days ahead to help airports and airlines plan for the weather.

Airframe icing is another common cause of winter delays and unnecessary costs for airlines. Our global Aircraft De-icing Service warns of icing events up to five days ahead with high accuracy — in recent winters it has proved to be 98% accurate and saved up to 30% on de-icing bills. The online service includes site-specific forecasts and alerts users to deteriorating conditions via phone or email.

Our aviation forecasters also stand ready for customers' calls 24 hours a day, so that airlines and airports are fully prepared for whatever the weather has in store.



Holidaymakers were noticeably absent on UK beaches again this year Photo: PA Photos

A growing number of families opted for a 'staycation' this year in the hope of enjoying a great British summer. But the cloudless skies that many wished for were missing.

Absent without leave

The sun seemed reluctant to make its presence felt again this year, as another seemingly absent summer in the UK brought changeable weather and only short spells of sunshine for 'staycationers'. In a season that will be remembered as another damp squib, an altered jet stream brought rain from the Atlantic that in a sunnier summer would have troubled Iceland.

In June, the Met Office and Environment Agency announced a pilot service to alert emergency responders to the potential for surface water flooding. This built on the lessons learnt in Sir Michael Pitt's year-long review following the large-scale flooding last summer and on advances in extreme rainfall forecasting that have been achieved in recent years. The joint Environment Agency–Met Office team based at Exeter successfully anticipated a number of flash floods so that drains could be cleared of leaves and other debris, giving the excess rain somewhere to go.

It was getting on for the end of July before summer 2008 made its real debut. Temperatures peaked on 28 July when the sun showed its face across

the whole of the UK with 30.2 °C measured at Cambridge, 28.5 °C at Inverailort (Highland), 28.8 °C at Penhow and Usk (south-east Wales) and 25.9 °C at Castlederg (Co. Tyrone). In keeping with these cheerful conditions the Met Office signed a deal with IBM for a new supercomputer that, from next year, will be used to create even more accurate and detailed forecasts of the weather and climate.

'Awful August' was so named by the Met Office because of the further unsettled weather it brought to the UK, in contrast to the sunny sabbatical of late July. During what was the dullest August in a series from 1929, gusts of 60 mph churned the English Channel while yet more rain soaked large swathes of Britain already water-logged by the earlier downpours. Most regions of the UK experienced well above-average rainfall over the month, with parts of Northern Ireland and eastern Scotland receiving nearly double what they would normally expect. Intense rainfall brought flooding misery to householders across these two regions — with Northern Ireland experiencing its wettest August in a series from 1914.

To protect British sun-seekers abroad, the Met Office briefs the Foreign and Commonwealth Office on tropical storms and hurricanes throughout the year. At one point during the 2008 Atlantic hurricane season, three weather systems formed in quick succession and spun across the Atlantic. Haiti was hit particularly hard by Hurricane Hanna that caused flooding and mudslides, killing 529 people and leaving around 48,000 homeless. Hard on Hanna's heels, Hurricane Ike — one of the season's fiercest — barrelled across the Caribbean bringing fresh misery to Haiti, before wreaking havoc in Cuba and some US coastal areas. And behind Ike, in what was threatening to become a particularly active Atlantic hurricane season, tropical storm Josephine formed but dissipated over the open waters of the eastern Atlantic.

In the UK, we're sometimes affected by the remnants of hurricanes travelling back across the Atlantic in the form of deep depressions. Some western parts of Britain felt the influence of ex-hurricane Hanna, for instance, which got autumn off to a wet and windy start. As we look ahead to the rest of 2008 and contemplate donning winter woollies, scarves and gloves, many will be disappointed by the lack of a sunny summer in the UK. Like the 'staycationers' themselves, the sun seemed to have decided not to venture very far this year.

With warm springs, wet summers and late autumns, the weather can seem predictably unpredictable. But, as people become more concerned about the effects of climate change on their daily lives, Met Office Media is working around the clock to ensure you have the weather information you need in the palm of your hand.

What's in store?



Our weather information can be adapted to all kinds of media

Whether you're a daytripper or a global business manager, knowing what's in store for the weather can make or break your plans and mean the difference between a smile or a frown at the end of a busy day. But, just like the sports results or breaking news, the weather forecast, in its own right, holds interest for an increasing number of people in the UK as dramatic weather events and unseasonal weather herald an era of climate change.

Ever since 1936, when a Met Office forecaster first presented the weather bulletin live on BBC Radio, the Met Office has been dedicated to keeping everyone in the know. Today, the Met Office Media unit provides services to all the major broadcasters in the UK, including the BBC, ITV, ITN, GMTV, Channel 4, Scottish Television and UTV. With technology constantly expanding the horizons of broadcasting, the Met Office vision of making its forecast essential to everyone, every day is becoming a reality.

People to people

Each day, Business Manager of Met Office Media, Juliet Gardner, liaises with existing and new clients. It's her job to respond to the broadcasters' unique and individual requirements as she dashes between client meetings, the Met Office in Exeter and the recently relocated Met Office Media facility now based at Millbank Studios, London.

"I feel very lucky. I have worked at the Met Office for 20 years, across every sector, and I'm very excited to be working in the media business today," enthuses Juliet.

"The timing is right. Met Office Media can generate fantastic weather content with the WeatherEye graphics that create, not just 2D and 3D weather information, but also dynamic virtual imaging," she continues. "At the same time, new mobile and online technologies such as the iPhone are creating new platforms for up-to-the-minute weather information."

Live wires

Previously located on Gray's Inn Road, North London, Met Office Media is now based at new studios in Westminster, at the heart of the UK's political and media centres. From here, a staff of ten plus Juliet and colleague Paul Mills, Head of Media Business, run a 24-hour operation ensuring that broadcasters as well as online and mobile providers can keep their end users informed about the weather around the clock.

"Met Office Media offers complete solutions including datafeeds, graphics and visualisation, presenters and scripts, as well as training and support. It can create an entirely bespoke service tailored to your requirements," explains Juliet.

Weather works

In addition to providing weather information, in whatever format and package is required, Met Office Media also works with clients keen to develop weather sponsorship or advertising partnerships. Weather sponsorship is one of the most lucrative offerings for media owners and is another example of how Met Office Media is making the weather work for business.

➔ For your chance to win a behind the scenes tour of Met Office Media at Millbank Studios in London, simply complete and return the prepaid card at the back of this issue.

Weathering the storm

Former BBC weather presenter, **Penny Tranter**, is now Meteorology Training Manager at the Met Office. For Penny, communicating accurate weather information has always been the natural inspiration behind her career.

It's January 1968 near Troon in Ayrshire. The howling winds and hammering rain of the famous Clyde Valley storm are doing their worst but in the midst of the destruction, a seven year-old Penny Tranter is having something of a weather epiphany. "The storm made me really curious about the weather," recalls Penny. "I wanted to know why the weather could be so bad that it caused so much devastation."

A family move to Salisbury where the weather was notably different to western Scotland intensified Penny's interest. "It might sound nerdy, but in my teenage years, the weather really began to fascinate me," she continues.

"I even made a mini weather station in the garden. It was then that I realised I wanted to be a weather forecaster."

Screen test

Penny studied environmental sciences at the University of East Anglia and joined the Met Office in 1983 as a graduate trainee forecaster, a role that took her the length of the UK, from Glasgow to Southampton.

"I was passionate about forecasting," says Penny. "I enjoyed the whole process from looking at the charts and working out what the weather was going to do, to communicating that information as clearly as possible."

Following a spell in the commercial arm of the Met Office, Penny applied to become a BBC weather presenter and after a television audition at the BBC in London was offered the role. Completing her first broadcast on 7 November 1992, Penny went on to become a familiar voice on the radio, as well as a friendly face on television, broadcasting weather reports across all BBC channels.

"I thrived on the challenge of presenting weather information to the public, especially in times of severe weather," says Penny. "Getting the forecast right and presenting the information in a pleasant way — even if it was bad news — were absolutely key."



“Getting the forecast right and presenting the information in a pleasant way — even if it was bad news — were absolutely key”

Back to college

After more than 15 years of presenting the weather at the BBC, Penny began to look for a new challenge; and, in January 2008, was appointed Training Manager at the Met Office College in Exeter. Here, she's responsible for managing the time, skills and training resources of the college.

With 14 trainers, the college puts all new forecasting recruits through an intensive programme, equipping them with the theoretical and practical skills they'll need to forecast the weather to the Met Office's high standard. From there, trainee forecasters can choose a specialism.

“Broadcast meteorology is very different from defence forecasting, which in turn is different from commercial forecasting,” explains Penny. “We have specialist trainers for each subject area so the trainees can focus on gaining the expertise required to do their job to the best of their ability.”

Yet it's not just forecasters that benefit from the services provided by the college. Other Met Office staff can attend courses to get a basic grounding in meteorology to aid them in their jobs — from the Communications team to the scientists who run the forecast models.


Sharing skills

The Met Office College also works with external clients — from the media to utility companies to government departments. “We're often approached by colleagues who have identified a need for client training,” says Penny.

For instance, her team is currently working with the Highways Agency to offer training on OpenRoad — a tool used to predict when the worst weather will strike and how it will affect the UK's road network (see *Barometer* issue 9 for more details on the service). The aviation industry is another national customer seeking training this time to the World Meteorological Organization's standard in understanding how the weather affects both chartered and scheduled flights across the world. The Environment Agency also uses the training to inform its work on rivers, flooding and pollution.

Although it's not as direct as standing in front of a weather map speaking to countless BBC viewers, managing the Met Office College still links Penny's role to her original passion for getting important weather information out there as effectively as possible.

“As Training Manager I can put my forecasting knowledge to very good use,” says Penny. “My new challenge is communicating the benefits of meteorological training through the business side of the Met Office to ensure that our customers get the best weather information they need, when they need it.”

 To find out more about the changing face of forecasting in the media, turn to page 6.

Predicting the future has always been at the forefront of the Met Office's activities. Every day, hundreds of meteorologists, research scientists and climate change experts work on the detail that goes into creating a bigger picture of the weather — later today, tomorrow, next week and for decades to come. But there's no point collecting any of the observations, that form the bases of these forecasts, if there's nowhere for the data to go.

Though it had less power than a desk calculator, the first 'computer' arrived at the Met Office in the early 1950s. Ever since then, computers have played an essential role in predicting the weather and now underpin all Met Office forecasts. Yet, just as the weather and climate are constantly changing, so too is technology and it's critically important to the public, government and business that the Met Office keeps up with these developments.

Super power

In August 2008, the Met Office signed a contract with IBM for a new supercomputer. It will be the second most powerful system in the UK and one of the top 20 most powerful systems in the world, enabling the Met Office to achieve even more accurate and detailed weather and climate forecasts.

With a whole-life cost of over £50 million, including a £33 million contract with IBM covering the hardware, installation, support and maintenance, the decision to purchase the new supercomputer was not taken lightly. Met Office High Performance Computing Programme Manager, Peter Williams, spent three years working on many areas of the acquisition, including the business case that was presented to and approved by the Met Office Board and the then Defence Minister, Derek Twigg MP.

"As well as writing the business case for the purchase of the supercomputer, it was my responsibility to coordinate other aspects of the programme," explains Peter. "To support the new supercomputer, we're also having to replace the data archive system known as MASS (the Managed Archive Storage System) which acts as a repository for all the data produced by the supercomputer. Staff computers and networks will also need upgrading and forecast models transferred from the old to the new system."

Investing in the future

So, what are the benefits to the public, government and business of this massive project? "In a nutshell, if the Met Office spends £20 million on hardware

The new supercomputer will also have a third cluster for collaborative work, accounting for 13 per cent of the overall resource.

for the new supercomputer, there will be a socio-economic benefit of hundreds-of-millions-of-pounds over the next few years," says Peter. "Better forecasting means that organisations and people can take better action to avoid the impacts of severe weather. Meanwhile, better climate research means that the UK will be better able to reduce and prepare for the effects of climate change."

This view is shared by Met Office Chief Executive, John Hirst, who attended the contract signing with IBM Vice President, Dave Kay. John said, "In a world where the effect of extreme weather events is becoming more severe and the potential impact of global warming is becoming ever more apparent, the Met Office plays an increasingly vital role in researching and forecasting these events." He adds, "The new supercomputer is an important step in delivering our strategic targets."

All systems go

The process of installing the supercomputer is a major project, which will take many months to complete — once the hardware is installed and the forecast models loaded, the computer's performance will be tested. Only then will the system be fully accepted from IBM. Then, in 2011 it will be given a midlife upgrade.

As with the previous installations, the new supercomputer will be housed in two separate IT halls with distinct power supplies and air conditioning systems so that should one hall fail, the other can keep the system up and running. The new supercomputer will also have a third cluster for collaborative work, accounting for 13 per cent of the overall resource. This cluster will be shared with researchers funded by the Natural Environment Research Council (NERC) without jeopardising the security of the main system.

"We are working with NERC to decide the projects that will use the shared cluster. This concept represents a major leap forward in collaboration on meteorology and climate change science and research," explains Peter.

However you look at it, the Met Office's new supercomputer represents more than just a big shiny box and a lot of ones and zeros — it's the future of weather forecasting and one of the UK's greatest assets in the face of climate change.

Ones and zeros

Forecasting is about to take a big leap forward. With the arrival of a new IBM supercomputer at the Met Office, more accurate weather and climate change predictions will give even more power to the people.



Did you know?

- > In the 1950s, the Met Office ran its early forecast models on one of the world's first computers installed at the University of Manchester. At the time, 1,000 calculations per second could be achieved which vastly out-performed human 'calculators'
- > Over the next two decades, several generations of computers came and went including LEO 1 built by catering company Lyons; Meteor built by Ferranti Mercury; and KDF-9 built by English Electric
- > Each computer was substantially more powerful than the last, enabling Met Office research scientists to develop ever more sophisticated computer models
- > By the mid 1970s, forecasters could begin to rely on models run on an IBM 360/195 computer. When the new system is installed in 2009, it will have been 27 years since Met Office forecasts last ran on an IBM computer
- > Changes in technology at the Met Office have provided ever greater numbers of faster processors, allowing forecast models to run on many processors at the same time
- > The Cray T3E, installed at Bracknell in 1997, was the first time these Massive Parallel Processors were put into operation. With 880 processors, it was the third most powerful computer in the world at the time
- > In 2004, the Met Office relocated from Bracknell to Exeter and changed its computer again. The combined NEC SX6 and SX8 systems delivered thirteen times the power of the T3E
- > The new IBM supercomputer, which will underpin Met Office forecast and climate programmes until 2014, is the second most powerful system in the UK, and the twentieth most powerful system in the world.
- > By 2011 it will be a million, million times faster than the first computer used by Met Office scientists



Joining the dots

By working together more closely, the Met Office and Natural Environment Research Council have shared many successes. Today, the two organisations are collaborating on several new jointly-funded studies that underline the impacts of climate change.



“The Met Office and NERC scientific community are taking a more strategic approach to climate change in order to provide the best possible advice and information to those who need it.”

As the UK’s main funding agency for research and training in the environmental sciences, the Natural Environment Research Council (NERC) has always had a certain chemistry with the Met Office. A world-leader in climate change research, the work of the Met Office Hadley Centre corresponds with the expertise of many NERC-funded organisations and has led to numerous collaborations over the years. But as the need for climate change research shifts focus, so too must this successful partnership.

“No longer just an issue of scientific research, climate change is now a major problem facing society,” explains Chris Gordon, Deputy Director of Climate Science at the Met Office Hadley Centre. “So rather than only entering into collaborations initiated by individual scientists, the Met Office and NERC scientific community are taking a more strategic approach in order to provide the best possible advice and information to those who need it.”

Joining forces

This strategic approach takes the form of the Joint Climate Research Programme (JCRP), due to be launched at an event in spring 2009. Jointly managed by both the Met Office and NERC, the programme prioritises resources and projects to fill critical gaps in the national portfolio of climate research.

Selected by a joint committee, the partnership with NERC will focus on four key priorities: improving monsoon forecasting; developing climate-quality satellite data; evolving the atmospheric chemistry and aerosols model; and, growing high-resolution climate modelling capabilities using a shared supercomputer.

“Each project has a direct link to the UK’s ability to understand and address the effects of climate change,” continues Chris. “For example, by improving the Indian monsoon simulation in our models, we’ll improve the accuracy of our predictions about how the monsoon will be affected by climate change — which could ultimately save thousands of lives.”

All inclusive

High-resolution climate modelling has already been the subject of collaboration by the Met Office and NERC through a joint project with the Japanese Earth Simulator group and NERC’s National Centre for Atmospheric Science (NCAS). Building on this shared work, the Met Office–NCAS partnership has focused on the development and evaluation of a new high-resolution climate model (called HiGEM) that will be used in environmental and climate change research. By identifying it as a joint focus for the partnership and one of the four initial priority projects, it’s been possible to further resource this work and move its development forward.

As the JCRP grows more projects, both new and existing collaborations will be included as part of the programme. “Moving forward, we’d like to see all relevant parts of Met Office and NERC-funded programmes eventually being integrated under the partnership,” says Chris. “It’s the best way to ensure that, as a scientific community, we’re doing everything we can to get world-class climate research to the people who can use it to make a difference.”

Close fit

It’s not just the relationship between the Met Office and NERC scientific community that’s getting closer. Feeding into Living With Environmental Change (LWEC) — a multi-partner, interdisciplinary programme that aims to ensure maximum connection between government policy and environmental research — we are ensuring that climate change science also fits closer with the needs of governments and businesses.

“By responding to the research needs identified by LWEC we can offer the best science at the right time,” explains Chris. “This will enable decision-makers to deal with the scientific issues of climate change as effectively as possible, and keep the UK at the forefront of international climate change science.”

Joint Climate Research Programme at a glance

- > Having worked together in many areas of climate research, the Met Office and NERC are taking a more strategic view of current and planned joint projects to fill any gaps in the research
- > This combined approach takes the form of the Joint Climate Research Programme (JCRP), jointly managed by the Met Office and NERC and due to be launched at an event in spring 2009
- > The overall aim of the JCRP is to strengthen the UK’s world-leading reputation in climate science, bringing the Met Office and NERC even closer together
- > The programme will also draw from international collaborative work, such as the development of a high-resolution climate model based on the Met Office’s Unified Model — the only modelling system in the world capable of producing weather forecasts and climate predictions
- > In time, as the JCRP grows more projects, all relevant parts of Met Office and NERC will be integrated under the partnership
- > Each project will be time-limited, with a clear plan of action and measures of success and will link directly to the UK’s ability to prepare for and adapt to the effects of climate change
- > Project findings will be shared with policymakers in government and decision-makers in business so that they get the right information at the right time to make a difference
- > With climate change no longer just the topic of scientific research but a major problem facing society, this Met Office–NERC partnership will contribute to a joined-up UK response to an urgent global issue.

Image left: Canoes stranded in the sand during one of the worst droughts ever recorded in the Amazon region, October 2005.

Photo: Daniel Beltra/Greenpeace

Moderate becoming good

While many of us are lulled by the soporific tones of the Shipping Forecast that's broadcast to thousands of listeners on BBC Radio 4, for the marine community it can mean the difference between running into danger on the high seas or sailing home safely to a cup of tea and a warm bed.



Photo: Kos Pictures

Ever since it was first broadcast on BBC Radio in 1925, the Shipping Forecast has become a British institution. It has the very real and critical role of keeping people safe at sea and is provided by the Met Office on behalf of the Maritime and Coastguard Agency (MCA) as part of the Safety of Life at Sea (SOLAS) international agreement. But it also has a far wider influence than the seafarers who use it to plan their voyages, departing from or arriving into British waters.

"Many of the landlubber listeners, which are much more numerous than those of the marine community, have only a vague idea of what the forecasts mean, or even where the sea areas are," says Sarah Boland at BBC Radio 4. "Yet, they love the rhythm of the familiar phrases — and perhaps the sense of comfort derived from being safe at home while, out in the darkness, sailors pitch their skills against the perils of the ocean."

Poetry please

Indeed, it is the Shipping Forecast's capacity to captivate its listeners' imaginations that has inspired authors, poets, musicians and composers in their work. Poets Seamus Heaney, Sean Street, Carol Ann Duffy and, more recently, Wendy Cope in her ABC of the BBC have all been stirred by its almost hypnotic tones.

In *C is for Closedown*, Wendy Cope describes announcer Alice Arnold bringing the broadcasting day to an end at 0048 hours:

*'An almost empty building
Someone all alone
Reads the Shipping Forecast
To a microphone
Listeners in bedrooms
Listeners at sea
Thousands of them
Hear her speak invisibly
Hear her through the darkness
Hear her say goodnight
Picture her alone there
Switching off the light'*

Wordsmith

It's not just these poets who put a lot of thought into the Shipping Forecast. Compiling the script for broadcast is an art in itself. Marine Forecaster at the Met Office, Paul Hutcheon, works to a strict format and tight deadlines to produce the famous forecast.

“There are several challenges to writing the Shipping Forecast script,” explains Paul. “Despite having to forecast for a very large area — stretching from Iceland to Iberia — for weather, wind and visibility throughout a 24-hour period, I only have a maximum of 380 words to describe these conditions because of the limited time slot allocated on BBC Radio 4. Within this word count I must also include a preamble, general weather scenario and a list of gales in force. The forecast deadlines can be very challenging too, especially when the weather is extremely unsettled and there are gales around the shipping areas.”

Nevertheless, accuracy in the Shipping Forecast remains paramount. It’s vitally important that there is consistency between the Shipping Forecast and the gale warnings. Inconsistency — for example, a gale warning issued for Dover, but no mention of a gale in the Shipping Forecast — could cause confusion in the marine community, leading to flawed decisions and risked lives.

Clock comfort

The Shipping Forecast is broadcast four times a day on BBC Radio 4, and covers 31 sea areas ranging from south-east Iceland in the north to Trafalgar, which borders Portugal, in the south, and from Rockall in the west to Fisher, bordering Denmark, in the east. These are always read in a roughly clockwise direction.

Gale warnings are given first, followed by a general synopsis of the weather, before each area forecast is given, including wind direction, strength, weather, visibility and, when needed, icing warnings. The Shipping Forecast is accompanied by a 24-hour inshore waters forecast for the British Isles that is broadcast twice a day after the main Shipping Forecast. Observations for coastal locations around the UK are also read out twice a day.

Although it took Met Office Broadcast Meteorologist and BBC Radio 4 Presenter, Tomasz Shafernaker, a while to get to grips with the nine-and-a-half-minute bulletin, it now brings him great pleasure to read the Shipping Forecast at 0600 hours, following a long nightshift.

“At first, I found it rather daunting. However, reading the Shipping Forecast has turned out to be rather therapeutic and strangely calming. It’s a very nice conclusion to the shift,” says Tomasz. “Initially it was a challenge to learn how to pronounce some of the names of the shipping areas and inshore waters. But now I could almost say them in my sleep.”



The Met Office works closely with many scientists and across many disciplines in the UK and all over the world. Aerosol Research Scientists Ben Johnson and Jim Haywood reflect on how research into the properties of dust is brushing up weather and climate forecasting techniques.

Don't sweep it under the carpet

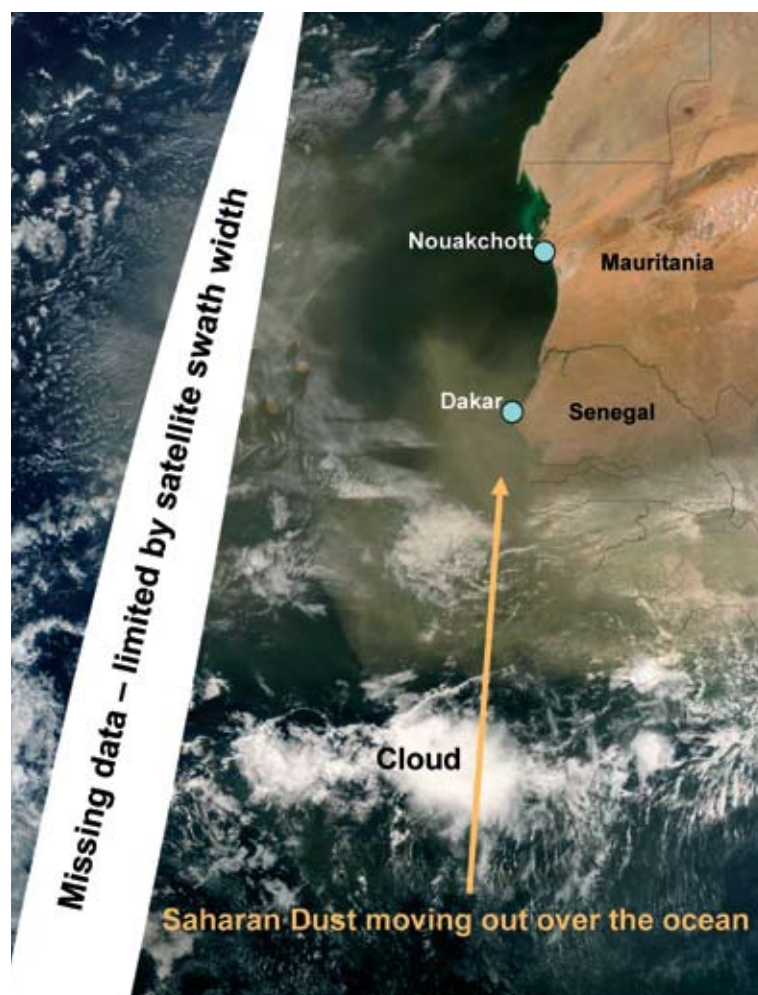


Figure 1: Dust storm on the 21 June 2007 during the GERBILS campaign. Image from NASA's Terra Moderate Resolution Imaging Spectrometer (MODIS)

A key area of ongoing research is the balance between the absorption and reflection of sunlight and outgoing infrared heat energy. Averaged over the globe, the incoming and outgoing radiative energy almost balances. But small deviations can occur, for example, by increasing concentrations of carbon dioxide (CO₂), which result in climate change.

The SINERGEE project (or to give it its full title: Simulations from a Numerical Weather Prediction (NWP) model to exploit radiation data from a new geostationary satellite, explore radiative processes and evaluate models) brought together experts in satellite remote sensing from the Environmental Systems Science Centre at the University of Reading with model developers at the Met Office. The team discovered that the global NWP model used by the Met Office was at odds with the satellite data, as the model showed too much infrared radiation leaving the Earth over a large swathe of the Sahara Desert. They pinpointed the error to the Western Sahara — a region that is frequently engulfed by airborne dust.

Huge dust storms generated over the Sahara regularly move out into the Atlantic Ocean and are clearly visible from space (figure 1). The dust reflects sunlight back into space causing a brightening of the planet, especially when the dust overlies the comparatively dark ocean. It also creates a greenhouse effect similar to that of CO₂ by absorbing infrared radiation, so reducing the amount of radiative energy escaping into space.

Combined, these effects change both air and surface temperatures and in recent years have been incorporated into the Met Office's climate models and forecasts. SINERGEE highlighted a need to also incorporate the effects of dust into the Met Office's NWP forecasts, but doing so posed many challenges. More precise details of the geographic distribution and vertical profile of the dust were required, while fundamental scientific questions

remained about the chemical composition, size and shape of the particles.

With these questions in mind, a group of scientists from the Met Office flew to Niger in June 2007 to investigate the dust storms generated over the Western Sahara. The project was called GERBILS (or the Geostationary Earth Radiation Budget Intercomparison of Longwave and Shortwave Radiation) and made use of the BAe 146 aircraft, jointly run and funded by the Met Office and Natural Environment Research Council (NERC) through the Facility of Airborne Atmospheric Measurements (FAAM) (see *Barameter*, issue 9 for a profile on the aircraft). Fitted with sampling devices and an array of weather instruments, the FAAM aircraft made extensive measurements of wind-blown dust, characterising its properties as well as observing its effect on sunlight and infrared radiation.

Very high concentrations of dust were observed at various altitudes, some reaching 5–6 km above the Earth. At these heights, output from the onboard instruments concurred with satellite data that the dust was very effective at trapping infrared radiation.

Over the next few years, Met Office scientists will use the outcomes from the GERBILS experiment to improve satellite-based dust monitoring techniques. We'll also make explicit the links between dust, sunlight and infrared radiation in our NWP models, as we have done in our climate models. In fact, dust prediction is already part of the Southern Asia regional model and is planned for our global NWP model. It is hoped that this work will improve the accuracy of forecasts, not just over the dusty or desert regions themselves, but elsewhere — including the UK.

Collaboration will continue to play a key part in this important work, with further input from scientists in different organisations as far apart as Reading and Leeds, Paris and the USA, to name but a few.

Science profile



Jim Haywood,
Aerosol Research Manager

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

For Jim Haywood, scale matters. He has studied dust and other atmospheric particles for over fifteen years, from the tiniest compositional detail of each particle to its effect on our weather and climate. He has travelled the world, taken to the skies and published many articles. But, throughout his research, one thing has remained consistent — when it comes to dust, it's the little things that make a huge difference.

Jim's passion for dust started big. As part of his MSc in Applied Meteorology he began looking at how atmospheric particles contribute to the changing climate through their ability to reflect shortwave and longwave radiation. This then led to a PhD at the University of Reading followed by two years at the Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey in the USA.

God of small things

When Jim joined the Met Office Meteorological Research Flight (now Observational Based Research) in 1998, however, things got considerably smaller — microphysical in fact. "I went from working with large-scale global general circulation models to studying the make-up and behaviour of individual particles smaller than the diameter of a human hair," Jim explains.

Studying these particles closely as a mission scientist for Observational Based Research, Jim regularly boards the BAe 146 aircraft, jointly run and funded by the Met Office and NERC. Here, he gathers measurements and records information on how the size, shape and composition of tiny atmospheric particles affect their ability to interact with sunlight.

Dual focus

In 2004, Jim became Aerosol Research Manager. But reluctant to leave behind the valuable microphysical work of Observational Based Research, he negotiated a unique role that straddled two disciplines and now divides his time between heading up a team of two in Observational Based Research and a team of three working in the Climate Chemistry and Ecosystems group at the Met Office Hadley Centre.

"Aerosol science doesn't stop if you switch from Numerical Weather Prediction (NWP) to climate-based research," says Jim. "What I wanted from

this role was the opportunity to cross internal boundaries and produce aerosol research in a way that's most effective for the Met Office, using a wide variety of measurements to improve large-scale modelling."

And that's exactly what he does. Jim was a key contributor to the 2007 GERBILS project (see opposite page) designed to investigate a radiation deficit in the NWP model, due to neglecting the radiative impact of dust.



Gust front in the Sahara, 7 July 2007.

Magic dust

With a responsibility for managing and maximising the efficiency of Met Office–NERC research flights as part of his role, Jim has ensured the data gathered as part of GERBILS serves a purpose over and above confirming the NWP model's radiation imbalance.

"We have built a specific NWP dust model that can be used to help people in parts of the world where dust generation and circulation is hugely significant, for example, the Middle East," says Jim. "We're also looking to implement a dust scheme within the global NWP model in the next few years so that we can really factor in the effect of dust upon the weather to make forecasting more accurate."

Recently awarded a research fellowship, Jim remains as fascinated by dust today as he was at the start of his career.

"For me, what lies at the heart of my work is the study of something so small that can make such a huge difference to our understanding of the weather and climate on a global scale," he concludes. "It's truly fascinating."

The Met Office and Environment Agency have worked together, throughout another soggy summer, to trial Extreme Rainfall Alerts that warn of potential floods. Phil Evans, Met Office Chief Advisor to Government, looks to France for inspiration in the UK's response to the Pitt Review.

A French impression

Summer 2008 was damp and dull. A continuing La Niña in the Pacific again altered the flow of the jet stream to bring rain from the Atlantic that in a sunnier summer would have troubled Iceland. And while it may not have matched summer 2007 for either the intensity or the cumulative impact of the rain that fell, householders in parts of the Midlands, Northumberland and Northern Ireland were unfortunate enough to experience the misery of flooded homes.

In 2007, the total June and July rainfall for England and Wales broke records going as far back as 1766. Flooding occurred on an unprecedented scale with events later described as the UK's largest peacetime emergency since World War II. An estimated £3 billion was paid out by the insurance industry with a further £2 billion-worth of damage being shouldered by central government, local public bodies, businesses and individuals.

Hilary Benn, Secretary of State for Environment, Food and Rural Affairs, is currently setting out the future for flood risk management in England and Wales, building on the lessons learnt in Sir Michael Pitt's year-long review — and with potential ramifications for the whole of the UK. One of the key

recommendations he will have considered is a joint flood forecasting centre making best use of Met Office and Environment Agency expertise. This mirrors the solution to a previous lack of joined up working identified in France in the wake of devastating floods in 2002 and 2003.

If the French experience is anything to go by, the benefits will extend far beyond enhanced clarity and consistency in the issuing of warnings. A pooled approach will also provide a focus for fully integrating meteorological and hydrological research and development for improved flood forecast modelling. Since the creation of the Central Flood Forecasting and Warning Service (SCHAPI) in 2003 a number of technical and scientific innovations have served to provide what is widely regarded as the best flood risk management system in Europe. These include interactive 'vigilance maps' providing flow probabilities for French rivers directly to the public as well as soil saturation assessments combined with topographical data and weather forecasts to produce predictions for the risk of surface water flooding.

On this side of the Channel, Pitt praised the accuracy of the weather forecasts issued in the days before the worst of



Parliament, Reflections on the Thames, 1905, by Claude Monet Image: Bridgeman Art Library

last summer's floods. And with its 24-hour operational capability, the Met Office was identified in Sir Michael's report as the natural starting point for a multi-agency assessment and response to severe weather impacts.

But he also acknowledged the scientific problems associated with pinpointing these types of summer rainfall events and matching those forecasts with hydrological warning models. In response, the Met Office accelerated its ongoing research programme and this summer successfully delivered forecasts of extreme rainfall a further day in advance (up to three days from two) with probabilistic forecasting and pinpointing of storms within 30 square kilometres accuracy. These are now being communicated as Extreme Rainfall Alerts under the auspices of a pilot service for emergency responders from

a joint Environment Agency–Met Office team based in the Met Office Operations Centre at Exeter. The response from the resilience community has been positive and a number of flash floods have been successfully anticipated.

The Met Office's focus on extreme weather prediction has historically been separate from the Environment Agency's work on monitoring its impact on our rivers and coasts — with neither agency having responsibility for guarding against or forecasting flooding resulting directly from heavy rain. With further integration, emergency responders and operators of critical national infrastructure in the UK could be served by a warning system that is clearer, more consistent and fully aligned with our own world-leading science.

Weather words

Carolyn Brown

Carolyn Brown landed her dream job as a Radio 4 Continuity Announcer in 1991. From what was supposed to be a six-month contract, she's now an integral part of the news team, presenting daily bulletins and reading the Shipping Forecast.

A Radio 4 staple, the Shipping Forecast is as much a British icon as the monarchy, fish and chips, and the weather. Over the years, it's become part of the fabric of popular culture, with excerpts and parodies appearing in television programmes, music and literature.

For seafarers in British waters, the forecast provides essential — and potentially lifesaving — information. But its meaning and appeal serve other, more surprising purposes, as Carolyn explains:

"The tea ladies who run the ferry terminal on Lundy Island listen to the Shipping Forecast every day, as the number of visitors depends on the weather. So the forecast helps them plan how many sandwiches and scones to prepare."

From airwaves to ocean waves

Carolyn's career began in local journalism, before moving into regional radio. After a brief stint as a TV news presenter, she returned to the more comfortable surroundings of radio.

"I enjoy the anonymity of radio. There's no need to get dolled up every day, and you can go down to the corner shop looking a complete fright without being recognised. On a serious note, I think radio can do a much more thorough job of telling the news — it has that edge over TV."

Fittingly, when she's not working, one of Carolyn's passions is sailing — a love that began at the age of 11 when she spent summer months at a relative's sailing school on the Norfolk Broads.

Over the years, this love of sailing has grown. In fact, to become a confident skipper of a boat of five crew, Carolyn undertook the RYA Yachtmaster course. When it came to the theory test, she found her experience of reading the Shipping Forecast came into its own. She had to transcribe the forecast, which included reports from the coastal stations of the Maritime and Coastguard Agency, then use this information to draw a synoptic chart of the British Isles, complete with isobars, wind speeds and directions.

Now a qualified Yachtmaster, she sees herself as more of a cruising sailor than a racer. Her great sailing ambition is to cross the Atlantic but, for now, her sights are set on restoring her pride and joy — one of the oldest glass-fibre yachts ever built.

Setting the pace

As part of her job, Carolyn has the opportunity to go to a range of interesting events. She recently attended the Boat Show in London's Docklands, where she met Ellen MacArthur's shore crew. When they found out who she was and that she reads the Shipping Forecast they offered to give her a tour of the boat in which Ellen sailed solo around the world in 2001 — the Kingfisher.

"They started speaking at about 100 miles per hour, then looked at me rather mischievously and said, 'Sorry, are we going too fast for you?' A bone of contention for sailors is that they think we talk too quickly. But from a broadcaster's perspective, we only have about three minutes to read the Shipping Forecast out."

As Carolyn explains, although the forecast is supposed to be delivered at dictation speed, when adverse conditions have varying effects across all 31 of the sea areas, there's a great deal more to impart so the Radio 4 announcer has to speed up. Getting the balance right is essential as the information can mean the difference between life and death.

The final word

Broadcast four times a day, with an extended bulletin just after midnight, the Shipping Forecast sounds almost mantric to many people.

"After hearing some of the atrocious headlines in the news, I think the calm and measured tone of the announcer reading the forecast is an important reminder that some things just carry on and that the sea is a law unto itself."





Nice weather for ducks

Two consecutive soggy summers in the UK have seen lilos and sunglasses give way to umbrellas and wellies in weather more fitting for ducks. Most regions of the UK experienced well above-average rainfall, but nothing quite matched summer 2007 for the intensity of the rain that fell.

Summer 2008 saw more advanced warnings of this type of severe weather in the form of Extreme Rainfall Alerts, piloted for emergency responders from a joint Environment Agency–Met Office team based at Exeter. In another damp season, the partnership successfully anticipated a number of flash floods so that drains could be cleared of leaves and other debris, giving the excess rain somewhere to go.

From 2009, even more localised forecasts will be achievable when the second most powerful supercomputer in the UK is installed at Exeter. Better forecasting means that people can take better action to avoid the impacts of severe weather — even though it can't return the cloudless skies and hot weather that many wished for this summer.

