



WEATHER ON SHOW
Showcasing our science

ADVICE AND GUIDANCE
On-site forecasters

THINKING DIGITAL
Listening to users

Barometer

Issue 21 www.metoffice.gov.uk Met Office magazine





Looking back over the year, the Met Office has adapted to the changes and risen to the challenges presented by each season, says Chief Executive, **John Hirst**.

Something for all seasons

Once again, this is a busy year for us with big events such as The Queen's Diamond Jubilee, and the London 2012 Olympics. However, while we concentrate on delivering day to day as the challenges emerge, it's important to stop and reflect on the last 12 months, so this special, year-end edition of *Barometer* covers some of the highlights of 2011/12.

The range of features in this issue is a reminder that our customers are as diverse as the weather we forecast. Weather is always inspiring and at the Met Office we embrace the variety each season brings. While we're helping people in the UK with our pollen and UV forecasts (see page 3) our work also benefits people all over the world as we support countries in understanding their sensitivity to weather and climate (see page 21 for a round-up of our international activities).

Following a long, successful relationship with the Ministry of Defence, the benefits of our move

to the Department for Business, Innovation and Skills (BIS) are already apparent. Our close relationships with the BIS family and other partners are helping to combine advice and alerts for a range of natural hazards. Have a look at page 23, where Virginia Murray, Head of Extreme Events and Health Protection at the Health Protection Agency describes the formation of the Natural Hazards Partnership, of which the Met Office is a leading member.

Our high-profile work continues to be reported in the media with several notable Met Office contributions to TV programmes over the past year (see page 11). Life at the Met Office is never dull as each day brings a changing view. Some of the most critical forecasting challenges of the year were during winter when we provided consistent and reliable guidance throughout. At Heathrow airport, for example, our on-site weather forecaster helped BAA consider the implications of our snow warning, made 24 hours in advance

with pinpoint accuracy. In addition to Heathrow, we have on-site specialist forecasters at a variety of locations, as illustrated on page 19.

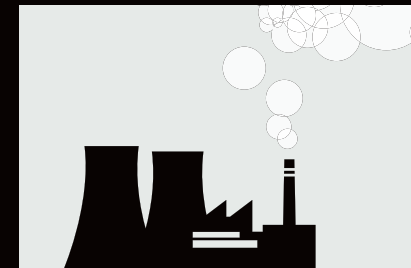
The world-renowned Met Office Hadley Centre continues its groundbreaking research into climate variability and change. Extended contracts with the Department for Energy and Climate Change (DECC) and the Department of Environment, Food and Rural Affairs (Defra) recognise our unique climate expertise. One example of this is the pioneering research into the links between industrial pollution, Atlantic sea-surface temperatures and natural disasters (page 27).

Upgrades to our supercomputer make it possible to use the state-of-the-art climate models required for this type of research. We make extensive use of technology of all kinds, including satellites which enable us to monitor weather and climate from space (see page 14). We also use technology to help us communicate more effectively.

This year, the Met Office was named in the top 10 UK social brands and number one in the services sector. Our website has also been updated as we have introduced improvements that our visitors have asked for (see page 9).

Seasons change and so does the Met Office. As we evolve — contributing to economic growth, informing Government policies and following many other opportunities — it's important that we maintain our core science capabilities. Equally, developments must not cost the earth, so we remain true to our responsibility to carry out our work in a sustainable way, as described on page 25.

In this issue – a look back at the year



News and updates

03 In brief

New civil contingency response aircraft
Weathering the storm
Healthy forecasts

04 Sports science

29 Extraordinary Weather

Features

05 Key weather events

Hot spring, wet spring

09 Thinking digital

Updating our website

11 Weather on show

Met Office in the media

14 Observations from space

The importance of satellites

17 Wind-borne virus

Assessing the risk of Schmallenberg

19 Forecasters in residence

Embedded with our customers

21 Stronger, together

Helping vulnerable communities

23 The Natural Hazards Partnership

Working in partnership to produce early warnings

25 Making a difference

Striving for sustainability

People

07 Our people

Robert Napier, Chairman

28 Science profile

Dr Ben Booth, Climate Scientist

30 Celebrity weather

Professor Jim Al-Khalili

Science

27 Science focus

Pollution, ocean temperature and 'natural' disasters

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Win

a framed weather
chart and tour!

All you have to do to win is fill in our online survey at
www.metoffice.gov.uk/barometer/survey

If you win you'll receive a behind the scenes tour of our media operations in London for you and a companion. We're also offering three runners-up prizes of framed weather charts of the day of your choice.

Winners will be notified by 1 September 2012 and the visit will be arranged for a mutually convenient time in October.

New civil contingency response aircraft



The new Met Office Civil Contingency Aircraft (MOCCA) enables us to respond to a range of civil contingency events, including future volcanic eruptions.

Following the eruptions of the Eyjafjallajökull volcano in 2010 and the Grimsvötn volcano in 2011, the Facility for Airborne Atmospheric Measurements (FAAM) aircraft was used to monitor and make informed decisions on the potential impacts of the ash cloud.

Now, in addition to FAAM, the new MOCCA provides a back-up aircraft.

As well as being used to monitor volcanic ash incidents, MOCCA can sample a range of other gases and aerosols in the atmosphere such as dust and smoke from fires like the one at the oil depot in Buncefield in 2005.

We operate MOCCA on behalf of the Civil Aviation Authority (CAA), in partnership with Cranfield Aerospace and DO Systems. Fully integrated with the Met Office Hazard Centre, observations from the aircraft are sent via satellite to Met Office forecasting and incident response teams to help keep people safe on the ground and in the air. The observations will also be used to enhance our world-leading atmospheric dispersion models.

➤ For more on our atmospheric dispersion models and how they are used to monitor the spread of the Schmallenberg virus, see page 17.

Weathering the storm

For the finance and insurance markets, knowing what's in store over the next 12 months is critical. The Met Office and Lloyd's, the world's specialist insurance market, have teamed up to promote the latest scientific research on North Atlantic hurricanes.

Landfalling hurricanes in the US are the costliest of all natural hazards, with the total bill for Hurricanes Katrina, Wilma and Rita in 2005 reaching an estimated \$90 billion.

Created specifically for the finance and insurance markets, the report, *Hurricanes and Long-term Climate Variability*, examines the latest research papers from several leading

organisations. The study explores how atmospheric climate and oceanic conditions influence the formation of powerful storms and what drives them to make landfall.

This industry leading study provides critical information to professionals who manage hurricane risk, enabling them to make more confident decisions. This adds to the range of products we provide for the finance and insurance markets including a forecast of the total number of tropical storms which is published each May on our website.

➤ The report is available at www.lloyds.com/hurricane

Healthy forecasts

Our health forecasts keep people well throughout the year, but in summertime our pollen and UV forecasts really come into their own.

The sun has both positive and negative effects on health, so knowing when and how to stay safe is important. That's why we're helping people to reduce the risks of sun cancer and damage, but still enjoy the benefits of the sun.

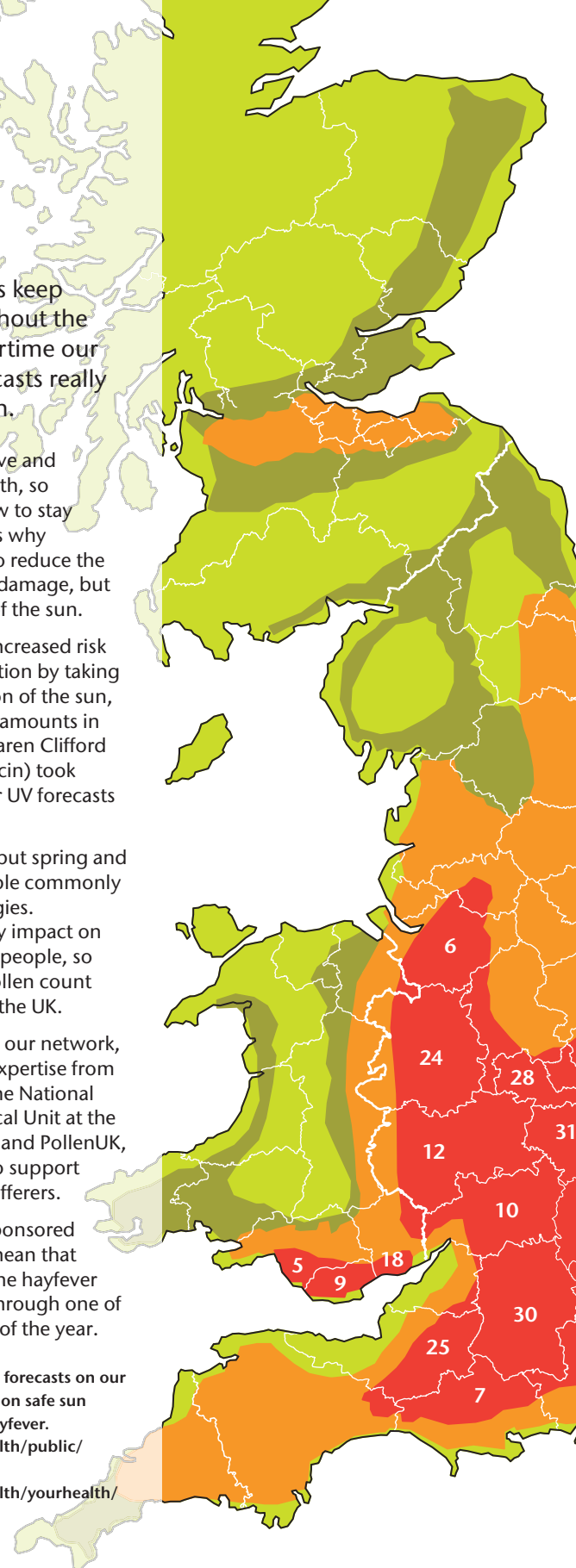
Our forecasts warn of increased risk to health from UV radiation by taking into account the position of the sun, cloud cover and ozone amounts in the stratosphere. The Karen Clifford Skin Cancer Charity (Skin) took over sponsorship of our UV forecasts in April.

Hayfever seasons vary, but spring and summer are when people commonly suffer from pollen allergies. Symptoms can seriously impact on the well-being of some people, so we manage the only pollen count monitoring network in the UK.

Using information from our network, our weather data and expertise from organisations such as the National Pollen and Aerobiological Unit at the University of Worcester and PollenUK, we produce forecasts to support allergy and hay fever sufferers.

Our pollen forecasts, sponsored by Benadryl this year, mean that people can cope with the hayfever season, helping them through one of the most difficult times of the year.

➤ Find our pollen and UV forecasts on our website, together with tips on safe sun exposure and managing hayfever.
www.metoffice.gov.uk/health/public/pollen-forecast
www.metoffice.gov.uk/health/yourhealth/uv-and-sun-health



Sports science

The weather can have a huge impact on all sorts of sports — from cycling to surfing, cricket to beach volleyball. As the UK's national weather service, we're always there when it matters, applying our science so that people can make the most of the weather.

Many sports are affected by the weather in some way and conditions are important to athletes and spectators alike. Sometimes the impact of weather on sport is clear for all to see. It can help or hinder — headwinds make running and cycling harder, while tailwinds help push us forward. For instance, some world records are invalid if set under certain conditions.

Most of those participating in indoor sports like squash or badminton aren't too worried, although heat can affect athletes' performance, but for sports like sailing or windsurfing, the weather is central to the entire event. On the whole, dry and settled conditions are favoured by most competitors in most sports. However, high temperatures can be challenging, significantly affecting the performance of athletes and, in extreme cases, can cause heat illnesses such as heat cramps and heat stroke.

Spectator sport

But it's not just the athletes that suffer for their sport, as anyone who has spent the day watching their team in the rain will know. On top of that, stadiums often produce localised weather effects due to the shelter provided from the seating galleries, making them particularly warm and stuffy on hot days.

Many a British summer has been spent watching the cricket hoping the pitch doesn't become waterlogged during

considerable breaks for the rain. Despite having a retractable roof on Centre Court since 2009, rain delays and frantically covering the court will still continue at Wimbledon. To help people make the most of weather windows, or duck for cover at the right time, we have the responsibility of forecasting the weather for major sporting occasions like Wimbledon and the Olympics.

Major sporting occasions

This year, we are providing forecasts for venues around the country throughout the Olympic and Paralympic Games. This provides an opportunity to demonstrate the breadth of what we do, as we work with many different people to help

them manage all the weather-related issues associated with making the Games a success. For example, we'll be working closely with the emergency response community and other teams responsible for security.

Big sporting events give us an opportunity to showcase some of the latest developments in our science. For example, detailed information on sailing conditions is so important that we're making use of cutting edge high-resolution models of Weymouth Bay to produce detailed wind and wave forecasts.

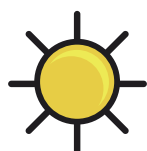
While rowers and canoeists favour light winds and warm temperatures to make decent progress through the water, for sailing events a steady wind direction and speed provide the ideal conditions. We have also installed a near-shore observation buoy off Weymouth Harbour to provide detailed weather observations to support weather forecasting for the sailing events.

Whether you're hoping to get out on the golf course or planning a trip to an Olympic arena, our science comes into play in all our forecasts to make sure you're fully prepared for sporting action this summer.



Hot spring, wet spring

It was a contrasting spring as the warmest March on record was followed by the wettest April.



March



3rd warmest March on record for the UK

5th driest on record with only 36.4 mm of rain

The two distinctly non-average months of March and April were heavily influenced by the position of the jet-stream, as shown in the illustration above. In the depths of winter, this fast moving ribbon of air in the high atmosphere usually flows across the south of England, steering low pressure systems across the Atlantic towards the UK. In the height of summer, it flows across northern Scotland, deflecting unsettled weather to the north of the UK. In March, the jet stream was heading north and brought settled and unusually warm weather, but a southerly shift in the jet stream's track brought unsettled weather for April.



April



Wettest April in the UK for more than a century

+70 mph wind speed in exposed locations

March was the third warmest and the fifth driest on record for the UK with 36.4 mm of rain compared to the average 95.9 mm. Dry conditions meant that the Environment Agency declared drought conditions, while water companies across southern and eastern England introduced hosepipe bans.

The reason it was so unseasonably warm early in the year was mainly due to the air flow above the UK. With high pressure, we had settled conditions with light winds and sunshine. During the daytime, the sun provided plenty of warmth and the light south to south-easterly winds drew more warm air towards us from continental Europe.

April was in stark contrast to March. Not only was it cooler on average than March — the first time this has happened since 1998 — it was the wettest April in the UK for more than a century. While there was snow in some areas just before Easter, the weather was mainly dry and bright for the London Marathon.

Even with the wettest April on record, after two dry winters, parts of the UK remained in drought. Much of the rainfall was in the south of the UK, with England having more rain than Scotland. Despite the rain, sunshine during April was not far off average.

Large parts of the UK had wet and windy conditions over the weekend of 29 April. Winds gusted over 70 mph in exposed locations. The strongest gust at a non-mountain site was 71 mph at Mumbles Head in West Glamorgan.

Cold weather for the early May Bank Holiday weekend arrived after a particularly wet and windy weekend to finish April. Severe Weather Warnings were in place for Monday 30 April and Tuesday 1 May for many parts of the UK as persistent heavy rainfall was widespread.

Some areas had much of their normal monthly average rainfall within 24 hours. The joint Environment Agency and Met Office Flood Forecasting Centre issued many Flood Warnings and Alerts. The heaviest rainfall was in southern England causing localised flooding, while other parts of the country, particularly the far north, saw little or no rain.

A few snow showers in early May seemed out of context for the time of year. However, while it's not completely normal, it's not completely unusual either, as it snowed in May last year and in 2010.

Weather is often in the news but weather forecasters hit the headlines in May after His Royal Highness the Prince of Wales and the Duchess of Cornwall delivered the Met Office weather forecast on the BBC during a tour of BBC Scotland's Glasgow headquarters. It's not the first time the Prince has



had a close-up view of the Met Office's world-leading forecast science, after visiting our Exeter HQ in 2009.

The end of May was dry, warm with blue sky and almost unbroken sunshine. Temperatures reached 28 °C in places, with the warmest day of the year so far on Friday 25 May. Even with variable cloud cover, UV levels were high so we encouraged people to stay up-to-date with our UV forecasts to avoid sunburn.

Throughout May, we were busy providing weather forecasts to the London Organising Committee of the Olympic Games and Paralympic Games (LOCOG) as well as local and national government for the Torch Relay, Olympic and Paralympic Games to support event organisers, competing athletes and visitors and spectators.



See a full timeline of the weather during the Queen's reign on the Met Office website.

➡ www.metoffice.gov.uk/events/diamond-jubilee/queens-weather-history



waynehewes / Shutterstock.com

Lovely jubbly

With grey skies and rain, the Queen's Diamond Jubilee was reminiscent of the morning of her coronation 59 years ago. However, despite the wet weather, people celebrated with parties across the country. Refusing to let the rain dampen their spirits, more than one million people watched The Queen's barge travel along the River Thames among a flotilla of tugs, steamers, pleasure cruisers, dragon boats and kayaks.

Ready steady

In September, Met Office Chairman **Robert Napier CBE** steps down after six years in the role. Here he shares his thoughts on how the organisation has evolved in that time, and the reasons for its success.

Ask any experienced senior manager to identify the most important pre-condition for an organisation's success and you will probably hear the answer 'good leadership'. This was certainly Robert Napier's first priority when he took the role of Met Office Chairman, following eight years as Chief Executive at the World Wildlife Fund (WWF), and a distinguished commercial career.

"My first job was to oversee the appointment of a new Chief Executive, bringing John Hirst on board. John and his team have been so successful in developing a clear vision of how the Met Office can help right across society and industry."

While Robert recognises many things have changed at the Met Office during his tenure, he also points to the 'constants' that make the organisation so unique.

"One thing that simply doesn't change," says Robert, "is the commitment and loyalty of our extraordinary staff — who are brilliant and inspiring people. This is as true now as it was six years ago, alongside the fact that science remains at the core of what we do."

In-tune with online

But while some things stay constant, other constantly evolve. Robert cites IT as one of the most powerful external influences, radically changing Met Office operations and service.

"We're not just developing our science through powerful resources such as supercomputers," he explains, "we're embracing exciting new tools for interacting with our customers."

The Met Office's hugely popular weather app is one example of this. With nearly one million downloads by February 2012, it has proved to be one of the most successful apps in the UK. The organisation's Twitter account has also grown rapidly — showing 64,000 followers by April this year, one of the largest followings of any public sector organisation and contributing to a 'Best Use of Social Media' award in 2011. But perhaps most surprising of all is the performance of the Weather Observation Website (WOW) — which has harvested 20 million observations from 1,700 sites in 145 countries since launch in spring 2011.

Come rain or shine

Robert has guided the Met Office in the face of an increasingly tough financial climate, the arrival of a new Government in 2010 and new ownership under the Department of Business Innovation and Skills from July 2011.

"Being in BIS allows us to better focus on how we can contribute to growth, expanding our support to commercial activities, and making more and better data available; which, in turn, helps others to expand their businesses," says Robert. "BIS is encouraging us all the time in this area, as we set ourselves targets to grow our business contribution."

The Met Office has also adopted a brand new mind-set focused on delivering ever-more innovative products and services. Under the leadership of Chief Executive John Hirst, the Met Office now pays much more attention to its outputs — understanding what customers want, rather than delivering what it thinks they may need.

"John has done a great job in moving customer focus forward," says Robert. "We now have a real hunger to keep our customers satisfied. It's a hunger that wasn't there six years ago when I first joined."

Today, Robert sees the Met Office as a much sharper organisation. One that truly knows that science is at the heart of what it does and how to put that science to good use. He also recognises that the Met Office is better at understanding the potential of partnerships — working with UK universities, and organisations such as the US National Oceanic and Atmospheric Administration (NOAA), the National Hazard Partnership and Environment Science to Service Partnership.

But of particular satisfaction to the outgoing Chairman is the shift in the public's perception of the Met Office as a respected global leader in climate change.

"Although politically, climate change is not currently at the forefront for many governments around the world," says Robert, "its realities are now well-proven and accepted. This has changed over the last six years thanks to the pioneering work of our experts at the Met Office Hadley Centre."

“One thing that simply doesn't change,” says Robert, “is the commitment and loyalty of our extraordinary staff — who are brilliant and inspiring people. This is as true now as it was six years ago, alongside the fact that science remains at the core of what we do.”

Climate of success

So what other Met Office achievements stand out for Robert since 2006?

“Winning both the Olympic and BBC forecasting work are of course very important milestones. But it's the way we've risen to the challenge of extreme events such as the Eyjafjallajökull volcano in 2010, severe snow in Scotland and the Cumbria floods, that prove to the world that we're not just world leaders in the science of forecasting, but in the way we communicate it too.”

Robert needs no prompting about the qualities needed for his successor, whose appointment is well underway and will be confirmed in early summer.

“You need someone who's been around, who knows how the world works. As the Met Office guides the nation at times of crisis, its Chair has to remain steady and focussed on the big picture.” All invaluable strengths, for which Robert has shown an incredible knack in using over the years.

We thank Robert for his huge contribution and wish him all the very best for the future.



Thinking digital



As the emphasis on digital media continues to grow, we increasingly expect to have information how, when and where we want it. And weather forecasts are no exception.

For an organisation like the Met Office, staying on top of the latest developments in the digital world is crucial. Because technology moves so fast, this means constantly listening to users to understand what type of weather and climate information they want — and responding both with new innovations and updates of current technology.

One such update was the launch of a new website at the end of March 2012. The updates, which involved teams right across the Met Office, aim to make things even easier for users, as Terry Makewell, Head of Web & Media explains.

“We have given our website a fresh new look, introducing innovative new features to improve the visitor experience. We’ve also listened to our users and taken up many of their suggestions.”

The need for change

The reasons for building the new site were three-fold. The first was feedback from existing site users. “We have a very engaged user base and that’s always been very valuable for us,” says Terry. Gathering feedback is a constant process, but it was time to take these suggestions and turn them into reality.

Secondly, consultations with key stakeholders identified what users expect when visiting the site. As Don Leslie, Met Office Communications Manager describes, “We’ve listened to our users and taken up many of their suggestions. They highlighted the desire to extend the three-hourly forecasts to make them available for five days ahead — which has now been put in place.”

The third reason is connected to the changes in both science and technology that have taken place since the launch of the last site. These significant advances have led to the development of new products and ways of displaying content — for example, temperature range forecasts and timelines.

A better user experience

Every change to the website was made with a single goal in mind; to create a better experience for visitors: “It’s basically about understanding what our users want from the site and ensuring that we provide them with all relevant information,” says Don. This means working towards providing a more intuitive, more interactive and overall more usable site.

What’s changed?

The new website has a refreshed look and feel, as well as improved navigation and new content. Following user feedback, the Met Office reworked the design and layout of the site to create a more intuitive environment. It now features:

- > **new homepage** — incorporating a ‘widget’ style approach
- > **new content** — including more detailed weather information, more quickly accessible
- > **improved navigation** — more intuitive with a new look and feel
- > **increased customisation** — capsulated content in configurable widgets means users have much more control over their experience
- > **forecasts from more sites** — weather information is now available for over 5,000 forecast sites
- > **pan and zoom maps** — giving users a forecast more closely tailored to their needs



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Met Office

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Climate Learning News Invent

Amber Warning of severe weather has been issued

Regions affected: Orkney & Shetland, Grampian, Central, Tayside & Fife, Strathclyde, North West England, North East England, East Midlands, SW Scotland, Lothian Borders, Yorkshire & Humber, Highlands & Eilean Siar, West Midlands, Wales, South West England, London & South East England, East of England, Northern Ireland

Location
Place name or postcode

Light hours
London
Sunrise: 0446
Sunset: 2122

UK weather
Weather Rainfall
Forecast for 1600 Thu
Updated: 1300 on Thu 28 Jun 2012
Get detailed forecast map for UK

UV forecast
THE KAREN CLIFFORD SKIN CANCER CHARITY
www.skcin.org
City of London
Thu Fri Sat Sun Mon
Updated: 1300 on Thu 28 Jun 2012
Get a detailed UV forecast for City of London

Five day forecast
Green Flag Green Flag breakdown cover, prices start from £20
City of London

Day	Weather	Temperature (°C)		Wind (mph)
		Max.	Min.	
Thu		28	15	10
Fri		20	16	15
Sat		21	13	13
Sun		19	13	12
Mon		18	14	10

Updated: 1300 on Thu 28 Jun 2012
Get five day forecast for City of London

News
Thunderstorms bring torrential downpours
Met Office reveals climate of Olympic Games venues
27 Jun 2012
Detailed climatology information from the Met Office provides an insight into the typical weather that can be expected at Olympic and Paralympic Games.
Met Office to see further space weather collaboration
Wimbledon 2012 to start dry and bright
Updated: 28 Jun 2012

Events
AVIS the worldwide car rental name you can trust
Planning to attend an upcoming event? Check what the weather will be like.
Torch Relay
Sat 19 May – Fri 27 Jul 2012
Torch Relay
Sat 19 May – Fri 27 Jul 2012
Eden Project Sessions
Sat 23 Jun – Wed 11 Jul 2012
Wimbledon
Mon 25 Jun – Sun 8 Jul 2012

Met Office video
Thursday's weather forecast

metoffice
@mrs_manannan_ We are expecting some heavy rain and showers tomorrow morning in your area so there is a good chance you will ^MH
1427 on Thu 28 Jun 2012
metoffice
@offspringmadboy Not sure where you are but I can check your forecast for storms if you let me know ^MH
1422 on Thu 28 Jun 2012
conversation, follow us on [twitter](#)

Local forecast
Visit the Benadryl® Social Pollen Count.
London & South East England

“We have given our website a fresh new look, introducing innovative new features to improve the visitor experience. We've also listened to our users and taken up many of their suggestions.”

But, as with all the media types, platforms and possibilities available today, connecting with people is not just a matter of having a slick website, as Terry explains.

“We've got to look at what we can do across multiple channels, including mobile devices, tablets, TV and radio as well as being more active in the digital environment in general.”

The Met Office's social media is already thriving — but the challenge is to constantly evolve and stay with, if not ahead of, the times. Making sure media broadcasts take full advantage of new methods, in addition to more traditional channels, is also critical.

Staying one step ahead of users takes foresight and planning. The Met Office is constantly looking further afield at emerging trends as they happen, and being proactive about things people will find useful, but may not have come across yet: “We're thinking about what users will require in one, two, three years' time — so we can engineer our digital future accordingly.”

Looking ahead

In such fluid times for information sharing, the Met Office has many plans in the pipeline for further development. This will involve a more integrated approach — bringing all media channels together to make information more easily accessible. So it's not just giving users the content they want, but also the chance to choose the medium that works best for them, at any given time.

Although it's still early days, the response to the new site so far has been very positive. As Terry says:

“The Met Office is a very forward-thinking organisation, and there have been some excellent teams involved internally in developing the new website, so I'm very pleased with what's been done — but I'm also very excited about where we're going to take it next.”

Weather on show

From four-part TV specials to all kinds of books, Met Office expertise supports a wide range of media projects.



Great British Weather
Love Productions
for BBC One (2011)

**Bang Goes the Theory
Winter Special**
BBC One (2011)

Will it Snow?
BBC Two (2011)

**Horizon:
Global Weirding**
BBC Two (2012)

**Horizon:
What is One Degree?**
BBC Two (2011)

Drought: Inside Out
BBC One — English
Regions (2012)

**Orbit: Earth's
Amazing Journey**
BBC Two (This is the
23 degrees Blog) (2012)

Our burning national obsession with the weather has made it the star of countless TV and radio shows, not to mention books and websites. To help make sure these are accurate, as well as entertaining, media creatives frequently turn to Met Office scientists for their expertise. Recent months have been no exception, as Met Office Communications Manager Dave Britton explains:

“People might be surprised at just how much we do behind the scenes — helping to make sure that TV programmes, books and other projects are researched and underpinned by the Met Office’s world-leading science. ‘Global Weirding’, the BBC Horizon programme on extreme weather screened in April, is a great example of this in action.”

‘Global Weirding’ producers first contacted the Met Office in late 2011 to understand more about the facts of what appeared to be more frequent, unusual weather events such as violent storms and floods. They also wanted to learn if the views of Met Office scientists matched up with those of other weather organisations around the world.

Showcasing science

Once the proposed programme had begun to take shape, Dave’s team put the producers in touch with Met Office scientist Dr Adam Scaife and Met Office forecaster Helen Chivers. They then worked with the production team to take the idea further — showcasing some of the Met Office’s best science and adding additional interest and creativity. This included exploring aspects of winter and summer

climate and the ways it’s influenced by the annual changes in Arctic sea ice. The programme also enabled the Met Office to show how it helps countries understand the impact of extreme weather and plan for emergencies.

“‘Great British Weather’, a four-part BBC series covering rain, storms, wind and sunshine from all over the UK, is another project that involved us early in pre-production,” says Dave Britton. “Over nine months, we worked closely with the producers on story and script development, fact checking, and also got involved with the interactive side of the programme. Presenting alongside Alexander Armstrong and Chris Hollins, our very own Carol Kirkwood was one of the hosts.”



Photo: BBC

Countryfile

BBC One
(Various)

Springwatch

BBC TV
(Various)

Autumnwatch

BBC TV
(Various)

The Volcano That Stopped The World

Pioneer Productions
for Channel 4 (2010)

The Year Britain Froze

Pioneer Productions
for Channel 4 (2011)

Britain’s Big Freeze

Pioneer Productions
for Channel 4 (2010)

Floods — The Year Britain Went Under

Pioneer Productions
for Channel 4 (2007)

Snowstorm: Britain’s Big Freeze

Pioneer Productions
for Channel 4 (2009)

The series’ live, interactive dimension proved a great opportunity for the Met Office — processing observation data and pictures sent in by viewers in the studio, and contributing to the programme’s Twitter feed. Staff at the BBC Weather Centre and Met Office Media also took part.

But while some TV programmes are many months or even longer in the making, others are fast turn round in response to more immediate weather issues.

The BBC’s ‘Will It Snow?’ was one such show, broadcast in November 2011. This saw wildlife and science presenter Kate Humble interview the Met Office and other weather organisations about the likelihood of another harsh winter following the extreme conditions of the previous two years.

“At the time there was a lot of media hysteria about the possibility of ‘snow Armageddon’,” says Dave Britton, “so we were delighted to be able to work with the programme as the national weather organisation and inject a sense of realism into the debate. And it was another great chance for us to put our science to good use and celebrate the work we do.”

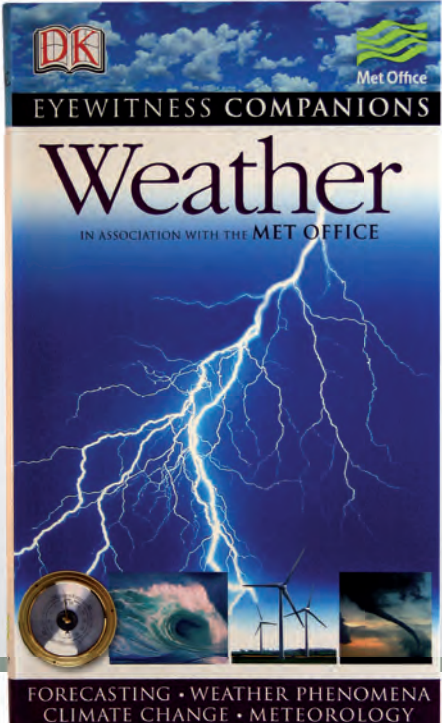
All things weather

But while contributing to TV programmes is especially high profile, other Met Office media projects are every bit as important for sharing our vast wealth of knowledge and expertise.

Dorling Kindersley’s ‘Eyewitness Guide: The Weather’ — authored in association with Met Office staff — James May’s ‘ManLab’, and climate change content for ‘The Times Atlas of the World’ are just some of the books which maintain the Met Office’s reputation as the UK source for all things weather.



Eyewitness Guide: The Weather (Dorling Kindersley)
The Cloud Book (David & Charles)



Extraordinary Clouds (David & Charles)
The Times Atlas of the World (contribution to spread on climate change)

Observations from space

"I don't think any forecaster would argue with the fact that satellite data and imagery are absolutely critical to every weather forecast we produce at the Met Office."



These are the words of Stewart Turner, Space Programme Manager. It's his job to coordinate Met Office activity relating to satellites, in collaboration with a large number of people across the Met Office, the UK and overseas.

There are a great many satellites orbiting Earth at any one time, taking pictures and collecting data — some of which are used by the Met Office to predict future weather patterns. In fact, satellites are behind a huge proportion of the information used in weather forecasting around the world today.

Essentially, forecasters use satellites in two different ways. The first involves measuring a range of different variables in the atmosphere such as wind, temperature, humidity and cloud, and also the temperature of the Earth's surface. Meteorologists use this information together with data from non space-based observing systems to develop the best possible understanding of the current state of the atmosphere. This is used to 'initialise' numerical models which are used to forecast future weather conditions.

The second use of satellite information is actual imagery — pictures of the weather. Forecasters use these to monitor rapidly developing weather events and to verify that weather systems are developing in the way predicted by the numerical models. The combined results are used to produce the forecasts that are communicated to the general public.

"Satellite data underpin everything we do," says Stewart. "In terms of contribution to the numerical modelling, they're responsible for something like 64% of the accuracy of the short-range forecast."

A worldwide effort

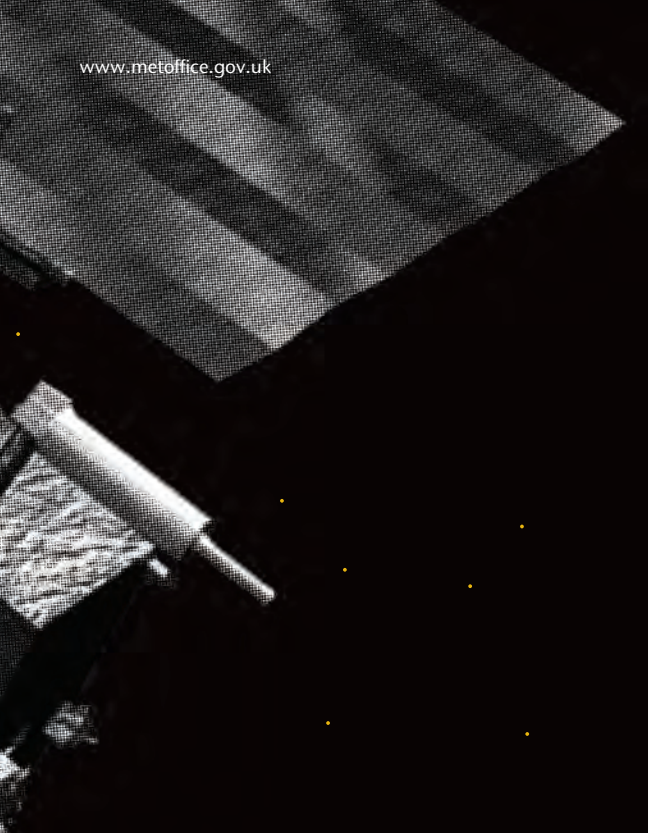
Satellite programmes are very expensive to run. So organisations that need satellite information often form partnerships. The Met Office, representing the UK as one of the 27 Member States of EUMETSAT (The European Organisation for the Exploitation of Meteorological Satellites), uses satellites from many different agencies around the world, including EUMETSAT and NOAA (the US National Oceanic and Atmospheric Administration).

Partnerships such as these mean that a wide range of countries can benefit from the output of satellites, without having to invest in their own, individual programmes. "It's essentially a way of opening the technology up to many different parties, in a way that we can all afford and mutually benefit from," says Stewart.

This is especially true for developing countries. Due to their position, the best images that geostationary satellites provide are of the equatorial regions. For example, they're ideally placed to gain a perfect view of Africa. EUMETSAT and the European Commission are working together to help African countries benefit, working with local meteorological services to make use of the enhanced forecasting data and providing the relevant training to help get them up and running. In addition to the imagery, these satellite communications provide a wide range of information to forecasters and disaster managers in Africa, including forecast model products and surface-based observations.

"Satellite data underpin everything we do."



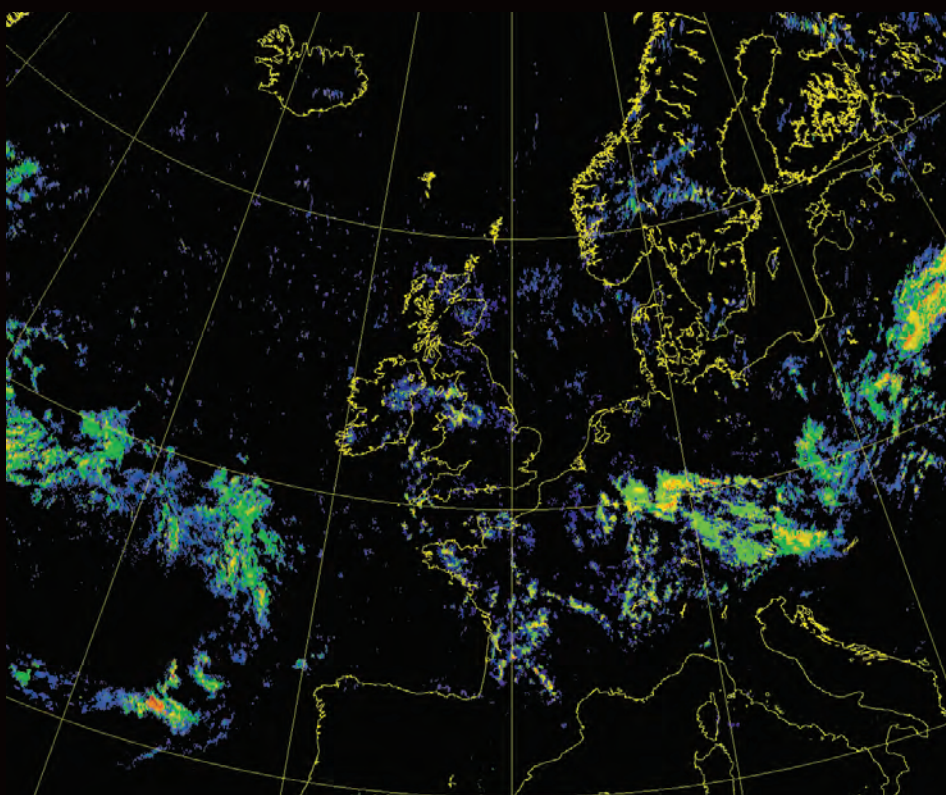
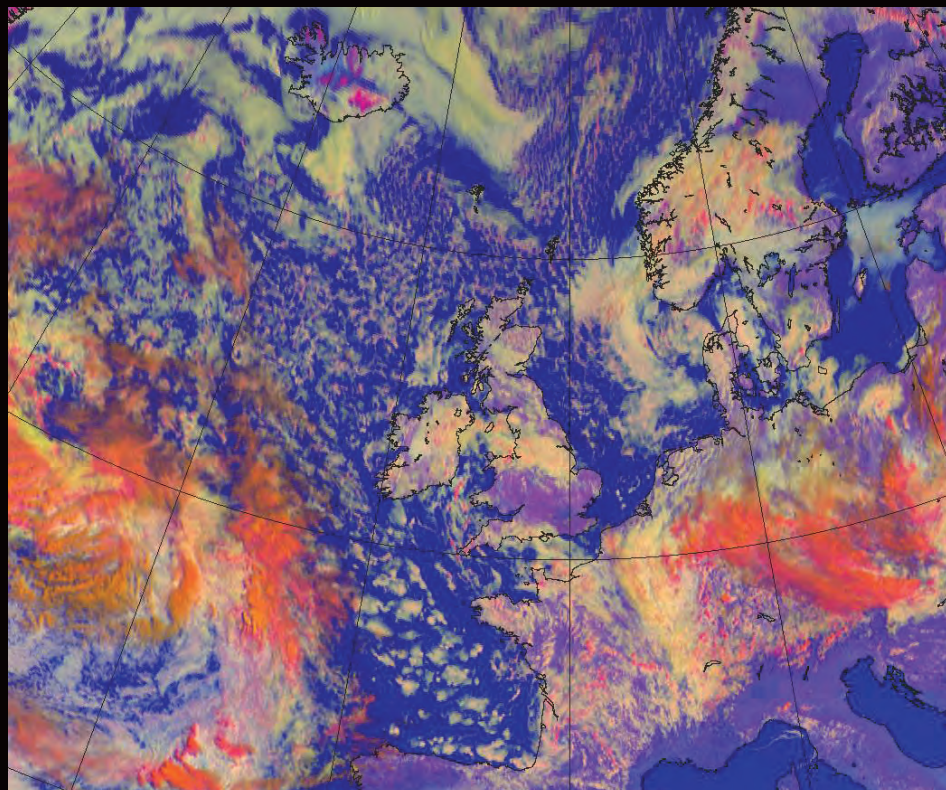


“Satellite images look through a lot of different spectral channels, or wavelengths of light, by adding and subtracting various spectral channels, meteorologists can identify vital information.”

Uses beyond everyday forecasting

Although satellites are primarily intended for weather forecasting, the images they produce can also be used for other purposes. “Satellite images look through a lot of different spectral channels, or wavelengths of light,” Stewart explains. “By adding and subtracting various spectral channels, meteorologists can identify vital information, such as the location of particular air masses — or volcanic ash, for example.” The images can also be tuned to highlight features such as ice on the Earth’s surface, which has a number of useful applications — including in the field of climate change.

So whether it’s using satellites to capture a high-resolution image of a striking pattern of weather, or compiling very rapidly detected data for fast-moving forecasting purposes, there’s no doubt satellites are here to stay as a vital part of meteorology.





Wind-borne virus

Assessing the risk



In summer 2011, a new wind-borne disease broke out in the town of Schmallerberg in Germany, affecting livestock in the region. Carried by midges, the virus has since spread and even hit the UK. **Laura Burgin**, Atmospheric Dispersion Research and Response Scientist at the Met Office, has been studying its reach — and helping farmers plan ahead.

“Schmallenberg is an orthobunya virus found in Germany, Belgium, Denmark, the Netherlands and now the UK,” says Laura. Transmitted by particular certain species of midges the disease produces mild cold symptoms in adult cattle, goats and ewes. However, the implications for their unborn calves and lambs are far more serious. In fact, when lambing season started in November, farmers across Germany and the Netherlands reported severe deformities in new-borns and, in some cases, late abortion.

Forecasting the spread

On their own, midges have limited ability to travel. Their normal patterns of flight mean they are usually restricted to moving only between fields in the same local region. But in warm, dry, light-wind conditions, they can cover much larger distances. With the right prevailing wind, they can even travel across the channel — thus making the leap from mainland Europe to the UK.

Predicting the spread of this kind of disease has, historically, been notoriously difficult. But Laura and the Met Office Atmospheric Dispersion team employed the Met Office’s Numerical Atmospheric-dispersion Modelling Environment (NAME) to help show how far, and in which direction, the midges are likely to travel — blown by the prevailing wind.

However, NAME is not used solely for tracing wind-borne diseases. It has previously been used to model volcanic ash — and during the Fukushima nuclear incident in Japan last year. But the principles of particles being spread by the wind (or in this case midges) are the same. The process involves using NAME to calculate the movement of particles when the conditions are right for midges to take off. The system then tracks their most probable movement.

Warnings in advance

The Met Office’s work in predicting the spread of wind-borne diseases is

used by a range of organisations — from farmers to the government.

“We’re trying to give advanced warning to the Department for Environment, Food and Rural Affairs (Defra). That way they can tell the vets in the field who will, hopefully, identify the symptoms quicker,” says Laura.

With enough warning, vets and farmers can start putting restrictions in place and, if vaccines are available, begin inoculating animals. The right information at the right time can influence decision-making at every stage of the chain, from government right down to local farmers.

What’s more, the Met Office has partnerships with various other organisations who, together, work to help stem the spread of wind-borne diseases. For example, the Met Office works closely with the Institute for Animal Health and Defra.

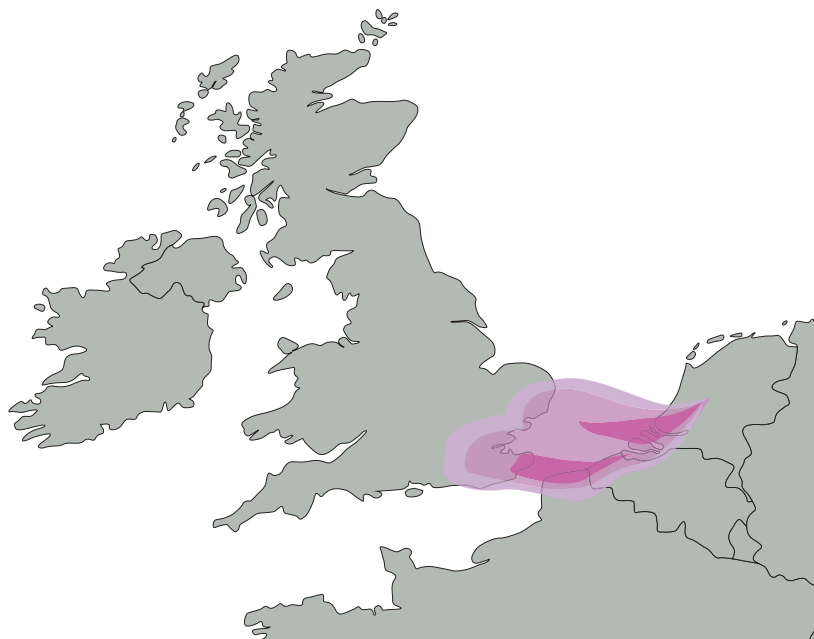
This collaborative way of working already proved successful during the bluetongue outbreak of 2007.

“By predicting when the virus was most likely to arrive, we were able to inform the government well ahead of time, enabling them to prevent widespread bluetongue,” Laura says.

The future for Schmallenberg

With wind-borne viruses such as Schmallenberg, there are several possible outcomes following an outbreak. A worst-case scenario could be the virus spreading into the local midge population in the UK, allowing it to move north from the affected areas, even as far as Scotland. Another, much more positive, possibility is that a vaccine will be developed quickly or animals could naturally become more immune to the virus, causing it to die out in a couple of years. Should this happen on a wider scale, with livestock across Europe also developing immunity, the virus could completely die out, alleviating future risk for the UK. Unfortunately, at this

The Met Office’s Numerical Atmospheric-dispersion Modelling Environment (NAME) helps to show how far, and in which direction, the midges are likely to travel — blown by the prevailing wind.



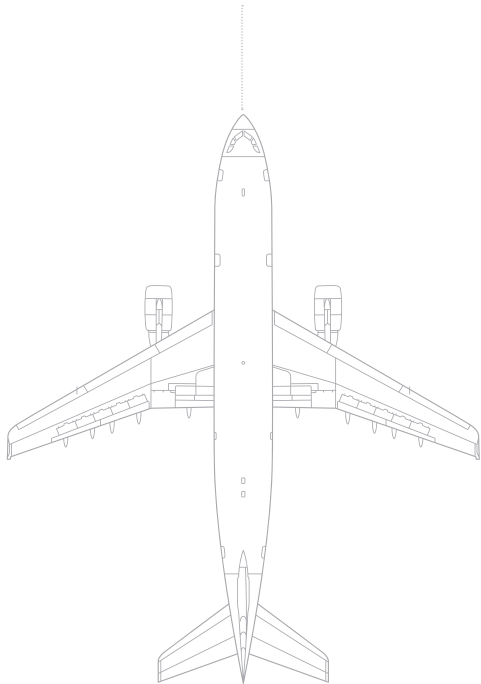
“We’re trying to give advanced warning to the Department for Environment, Food and Rural Affairs (Defra). That way they can tell the vets in the field who will, hopefully, identify the symptoms quicker.”

stage, it is not known which is the more likely outcome.

The good news about Schmallenberg is that the latest evidence suggests it is very unlikely to affect humans — either through direct infection or through eating affected meat. With that knowledge and the Met Office’s careful monitoring of the movement of the disease, the expectation is it will soon be contained and its impact will be minimised.

From Heathrow Airport to the Highways Agency, the Met Office has forecasters ‘embedded’ within organisations across the UK and abroad. Forecasters Dan Boon, Gordon McKinstry, Emily Gibson and Mark Sidaway explain how the close working relationships this forges make all the difference to customers’ operations.

Forecasters in residence



Dan Boon
Heathrow Airport
On-site forecaster in
Operational Efficiency Cell
(HOEC)



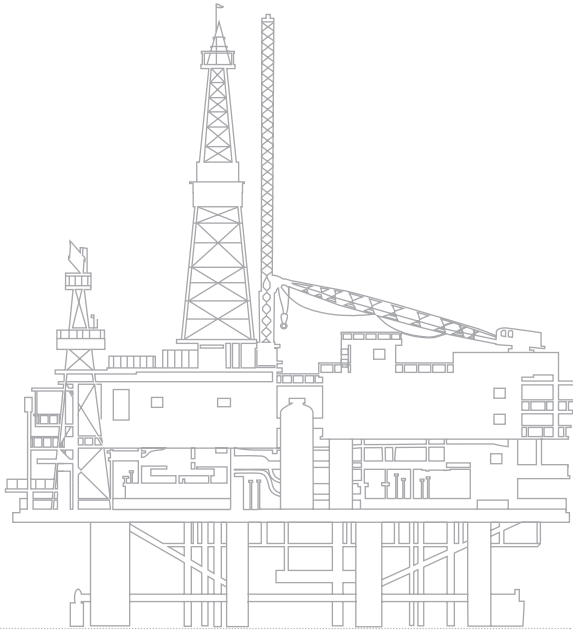
Gordon McKinstry
Crane vessel Saipem 7000,
North Sea
On-site forecaster for marine
operations

It’s a well-known fact that weather conditions can change in what seems like an instant. For some organisations, knowing exactly what the weather is doing, and how it’s shifting moment by moment, can be critical for day-to-day security and efficiency. This is where Met Office embedded forecasters come in.

“The on-site forecaster’s advice is immediate,” says Dan Boon, currently stationed at Heathrow Airport’s Operational Efficiency Cell (HOEC). “With some customers requiring fairly continuous, on-site support, having an embedded forecaster on board provides direct access to dedicated meteorological consultancy advice and guidance.”

Clear benefits

Similar stories emerge wherever Met Office’s forecasters are on-site. In the North Sea, Gordon McKinstry is helping one of the world’s largest crane vessels, the Saipem 7000, to successfully support oil rig construction. “The marine operation with Saipem S7000 can be very weather dependent,” says Gordon, “so we always look for weather windows that can save clients vast amounts of time and money.”



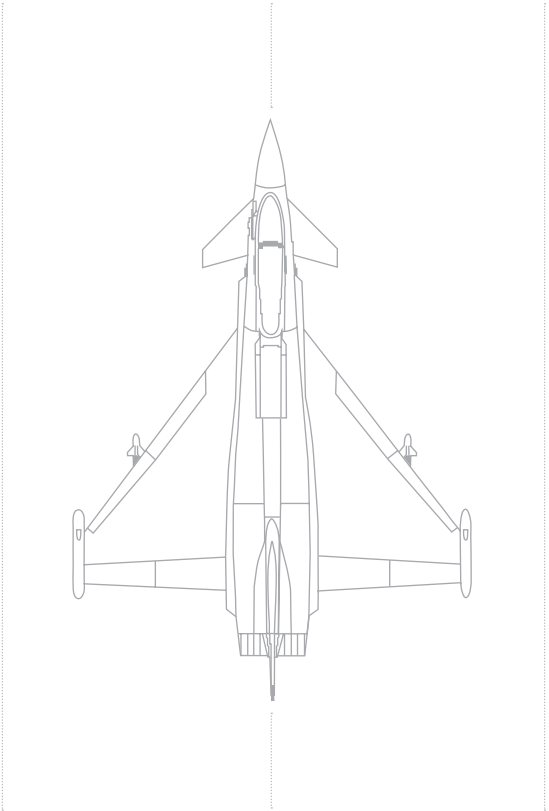
At the Highways Agency, Mark Sidaway and the Met Office team are making sure the road network is prepared for adverse conditions. “If there’s severe weather, like strong winds or heavy snowfall, it starts causing congestion and accidents on the network,” says Mark. “Our role is to give the Highways Agency and motorists as much warning as possible and hopefully alleviate some of the problems.”

“With some customers requiring fairly continuous, on-site support, having an embedded forecaster on board provides direct access to dedicated meteorological consultancy advice and guidance.”

Likewise at RAF Coningsby, direct access to forecaster Emily Gibson and the station’s Met Office team is helping pilots successfully pursue their training. “Being instantly available to the trainers means they can make quick decisions, allowing them to meet their objectives and keep to their training schedules,” explains Emily. “If the plan for the day is to go east, but we look at the forecast and recommend going west, we can show them the reasons behind the recommendation straightaway.”

Greater efficiency — and managing risk
Most importantly, having an embedded forecaster on board is not just helping increase efficiency and reduce costs. The timely advice is also managing risk — as Gordon explains when describing the risks of building an oil rig:
“When the Saipem 7000 is in the middle of putting a 10,000 ton topside module in place, or moving people across in a basket, if the wind suddenly comes up, the vessel could be in a position where it can’t move away from the oil rig quickly enough. That’s why what we do is critical — and a great responsibility too.”

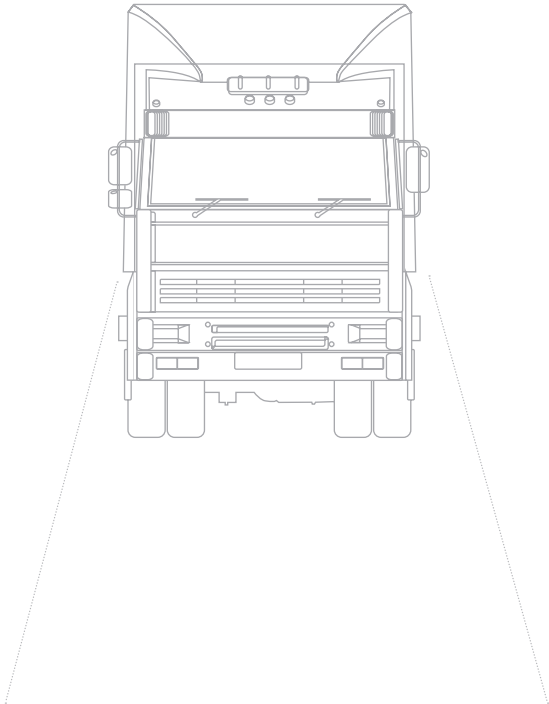
It’s a sentiment all four embedded forecasters share — alongside the satisfaction of instant feedback and appreciation from clients who know they play such a vital role.



Emily Gibson
RAF Coningsby
Part of the station’s
Met Office team



Mark Sidaway
West Midlands
On-site forecaster at the
Highways Agency’s National
Traffic Control Centre



Stronger together

Weather and climate change affect everyone, everywhere. As a world leading expert in both areas, the Met Office is forging international relationships to improve its science — and use this knowledge to help vulnerable communities.

This link between science and humanitarian issues is the very reason Tom Butcher, Head of International Business Development at the Met Office, began his career.

“Like many of my colleagues, I joined the Met Office to develop and apply science for the benefit of humanity,” says Tom. “By understanding weather and climate, we can start to help communities strengthen their resilience — and adapt to a future climate too.”

Climate variability and change have huge impacts on food security, water availability, human health and social and economic infrastructures. This is particularly so in Africa, where vulnerability to hazardous weather and the natural vagaries of the climate is already high.

Improving capabilities

The African Climate Science Research Partnership (CSRП), involving the UK Department for International Development (DFID), Met Office Hadley Centre, and African partners, is working to improve understanding and modeling of Africa’s climate. The project is looking at how climate science can improve decision-making, livelihoods and, in turn, safety.

“Climate change isn’t just about 50 years ahead. The CSRП is helping scientists in Africa to apply predictions of the coming rainy season across their countries. If you can help a community improve its climate resilience now then it will help it to build resilience in the face of climate change in the future,” says Tom.

Over the years, the Met Office has helped many National Meteorological Services — especially in Africa — set up TV studios and train staff to produce their own national TV weather bulletins. After seeing what a difference these have made to improving the communication of weather and climate information, the Foreign and Commonwealth Office (FCO) is now helping them to go digital.

“To date, the weather bulletins have been recorded on video tape, which presents some problems. Tapes often have to be delivered across town to the TV station. So delays caused by extreme weather conditions and travel problems are all too common,” says Tom.

With funds from the FCO, over 25 national meteorological services in Africa will each receive a digital hard disk. This means that video files can be sent quickly and safely over the internet — and the image and sound quality is also improved.

“By understanding weather and climate, we can start to help communities strengthen their resilience — and adapt to a future climate too.”



Continuing work in Rwanda and Uganda

The Met Office continues to work with the Rwandan Weather Service — as previously reported in *Barometer*. A two-year extension to the Met Office project has now been signed, which will help to further improve weather and climate service delivery. The new project will include enhancements to observations processing; as well as the integration of the activities of the weather forecast office at the airport with those at headquarters in central Kigali.

Also previously featured in *Barometer*, the Met Office is working in partnership with the World Meteorological Organization and National Meteorological Services across East Africa to help improve forecasting of severe weather events over Lake Victoria. Our contribution has included establishing a 4 km weather forecasting model over the lake.

“Together with the Ugandan Department of Meteorology, we’re currently studying the benefits of this model to forecasters. We’re also installing an observing system on a ferry to measure water temperatures on Lake Victoria” says Tom.

“The difference between the temperature of the water and that of the surrounding land surface is one of the key factors causing severe weather patterns over the lake. These new observations will increase forecasting accuracy, which in turn will help to improve safety for fishermen and other users of the lake.”

Collaborating in the Far East and Australia

The Met Office is always looking at ways to strengthen its science. International collaborations with countries such as Singapore, South Korea and Australia are vital for sharing knowledge, expertise and technology.

In 2011 we signed a Memorandum of Understanding with the Singapore National Environment Agency to build up the climate science capabilities of its national weather service to help prepare Singapore for climate change. It’s a mutually beneficial partnership that will not only improve decision making around climate change for Singapore, but also for the surrounding region.

“This partnership has so much potential,” says Tom. “And it’s just one of a number of collaborations going on across the globe. After all, the best possible science creates the best possible forecasts — it’s exactly what these collaborations are all about.”



Met Office Chief Executive helps take WMO forward

In June 2011, the 189 countries that make up the World Meteorological Organization (WMO) met in Geneva to make decisions on the global priorities for the next four years. As well as agreeing to the establishment of the Global Framework for Climate Services, countries also agreed to explore ways for WMO to deliver more for global citizens by carrying out activities more efficiently.

All countries agreed that there is a real need for reform as the demand for effective weather and climate services is dramatically increasing while in many countries the funding provided by governments is static or declining.

The Met Office is delighted that the Met Office Chief Executive, John Hirst, was re-elected as a member of the WMO Executive Council and asked to lead the work. John plans to work with other countries to identify ways to make better use of resources and embed a culture of continuous improvement within the organisation. Concrete proposals will be discussed at the next meeting of the WMO Executive Council this summer.



The aim of the Natural Hazards Partnership is to be a one-stop-shop that provides early warning of extreme weather events and natural hazards.



Natural Hazards Partnership

In this article, **Virginia Murray**, Head of Extreme Events and Health Protection at the Health Protection Agency, describes the origins, development and vision of the partnership.

The idea for a Natural Hazards Partnership (NHP) was put forward in January 2011 by the Met Office. As it happens, this coincided with my own organisation, the Health Protection Agency (HPA), recognising the need for a focal point for possible health impacts of extreme events and appointing me as the first Head of Extreme Events and Health Protection.

The NHP has grown into a strong group of over ten possible partners with a shared vision for cross-organisational working:

“To provide information, research and analysis on natural hazards for the development of more effective policies, communications and services for Government and the emergency responder community.”

We are learning how to work together to produce early warnings for heat, cold, snow, blizzards, floods, droughts, space hazards, earthquakes, volcanic ash, landslides, wildfires, fog, pollen, thunderstorms, windstorms and other natural hazards.

The NHP brings together knowledgeable and enthusiastic scientists from the partner organisations to develop new tools and ways of working. The first of these is a pilot daily Natural Hazards Partnership Hazard Assessment. Initially it was shared only amongst partners so that it could be tested for content, accuracy and value.

Real value

The value of these daily alerts and their early warning value became instantly apparent to me. I was sitting on a train platform in Australia on Sunday 22 May at 06.00 hours returning from an Intergovernmental Panel on Climate Change meeting when my BlackBerry buzzed with a NHP Hazard Assessment. It contained the warning that the Grímsvötn volcano in Iceland had erupted and was apparently the most powerful Icelandic eruption in over 50 years.

Immediately, I was able to forward this warning to colleagues on call for HPA in the UK to check that they were already aware and had the information to develop the health response

that was needed. As the situation developed, information suggested that the plume from the Grímsvötn volcano had reached ground level in some parts of UK but, reassuringly, concentrations of particles were unlikely to be sufficient to cause significant health effects. However the HPA was able to warn that as a precaution people suffering from asthma should carry their inhalers as they are more likely to experience irritation of the lungs and upper respiratory tract should they be exposed to any ash.

So the Natural Hazards Partnership is of real value to HPA. With the help of our partners we were able to make sure that our frontline responders could also receive the pilot NHP daily Hazards Assessments who were very grateful for the early warning these provide.

In my role as the Head of Extreme Events and Health Protection at the HPA, I'm well aware that early warnings about extreme weather events and other natural hazards are vital if we are to inform and warn about potential health impacts effectively.

Bringing together a group of committed partners to work together to improve early warnings of extreme weather events and other natural hazards is a really important development and a wonderful opportunity. I enjoy and look forward to future progression, learning and scientific interaction with the Natural Hazards Partnership at our meetings.

The Health Protection Agency

The Health Protection Agency's role is to provide an integrated approach to protecting UK public health through the provision of support and advice to the NHS, local authorities, emergency services, other arms length bodies, the Department of Health and the devolved administrations. The functions of the Agency are “to protect the community (or any part of the community) against infectious diseases and other dangers to health”. (HPA Act 2004).

Making a difference



For the Met Office, a commitment to sustainability is a principle of good business that inspires activity right across the organisation.

'Sustainability' is word we often hear these days, as evidence for man's impact on the planet mounts up. At the Met Office, 'sustainability' encompasses the work we do to minimise our environmental impact, act in a positive way in our dealings with our staff, customers and suppliers while maximising our contribution to the wider community.

"Our aim is to encourage staff to contribute to activities that are tangible and achievable," explains Met Office Sustainability Coordinator, Kathy Gray. "It's about looking for ways in which we can all make a difference — whether it's finding innovative ways to save energy, recycling our waste or volunteering our time."

Kathy coordinates a sustainability agenda that covers environment, community, suppliers and customers, and employees. It's a wide ranging role which involves working closely with colleagues across the office.

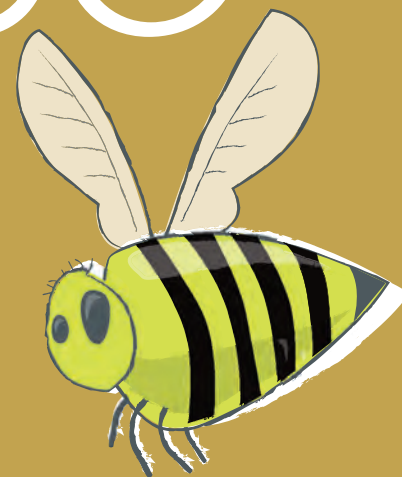
"I'm able to be involved in a variety of work", says Kathy. "Our chosen Met Office charity, ShelterBox, is coming to the end of a successful three-year term and I'm involved in the process of choosing our next

charity. Working to increase the number of Met Office Science, Technology, Engineering & Maths (STEM) ambassadors is another exciting project. Our staff are keen to share their enthusiasm for their work and we now have over 45 ambassadors working to inspire young people in STEM subjects and promote STEM careers."

Creative thinking

Waste and recycling continue to be a priority for the Met Office. At our Exeter HQ, where 1,400 employees are based, individual desk bins have made way for dedicated recycling bins that actively encourage staff to recycle waste such as paper and cardboard coffee cups, while new ideas such as recycling yoghurt pots are continually being explored.

"In 2011, we recycled 78.9% of all waste," says Kathy, "exceeding our target of 77% and nearing the 80% target set for 2014/15. A next step is to work with our facilities contractor G4S to check how effectively waste bins are used. We can then reduce landfill further by encouraging staff to recycle more."



2011

78.9%

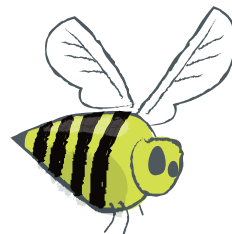
of all waste recycled, exceeding the 77% target.

2.3 tonnes

of redundant electrical items recycled by IT disposal companies.



“It’s about looking for ways in which we can all make a difference — whether it’s finding innovative ways to save energy, recycling our waste or volunteering our time.”



Other projects highlight the Met Office’s innovative approach to doing more with waste.

One example is the first ‘Eco Day’ in 2011 that saw staff bring in over 2.3 tonnes of their own redundant electrical items for recycling by IT disposal companies. Another idea is helping to reduce paper consumption. Newly installed printers ensure only those documents staff require are printed resulting in less paper wastage.

Further afield, securing a new waste management contract at the Met Office in Belfast means that less than 10% of waste is now going to landfill.

Campaign on many fronts

Managing waste is of course just one highly visible way to promote sustainability. Behind the scenes, the Met Office is hard at work pursuing many more ideas, minimising energy consumption and costs, as well as influencing ideas.

One example is cold aisle containment — putting plastic curtains up around the IT cabinets and servers so we cool the computers but not the whole IT hall. Careful water management, including the use of evaporative free cooling as described in the box below, also offers significant sustainability benefits.

Outside the organisation, we work closely to source suppliers who share our sustainability focus. We conduct detailed sustainability risk assessments for all contracts worth over £100,000, as well as supporting small and medium enterprises to overcome any barriers which prevent them from tendering for lower value work.

Our success in achieving the Wildlife Trust’s Biodiversity Benchmark would not have been possible without the commitment and hard work of staff volunteers who have given their time and knowledge to enhance our biodiversity work, planting home grown wild flowers and assisting with native breed tree planting in their own time.

“It’s this staff energy and enthusiasm,” says Kathy, “that drive our sustainability projects forward. The fact that we only sell Fair Trade beverages in our cafeterias and vending machines is all down to requests from staff.”

Supportive, committed employees. They’re one powerful influence that no sustainability agenda can afford to be without.

➔ For more information on STEM ambassadors see www.stemnet.org.uk/content/stem-ambassadors

➔ For more information on our sustainability work see www.metoffice.gov.uk/about-us/who/sustainability



Water, water everywhere...

In spite of the wettest April since records began, we continue to use water wisely. Water, and the way we manage it, have been top priorities since our Exeter building first opened in 2003.

We reduce our demand on mains supply water in a number of ways — rain water filtrates through a porous paving system and flows to our two ponds. Any oil or petrol which may have split is caught by a special membrane. Rainwater from our roof goes directly to the ponds. This ‘grey water’ is then used for flushing our toilets.

Water cooling is currently the most effective way to cool our supercomputers and water from our on-site bore hole is softened before being used in our free cooling system. Water drained from our cooling towers during this process is then recycled as ‘grey water’ for toilet flushing.

But although Met Office water management is well established, there are always new ideas to try. For example, a recent modification to our employee changing room showers reduces the flow rate from 23 litres a minute to just 12 — meaning staff can still stay clean by showering green.



Met Office awards for sustainability

- > Business in the Community 2011 (Gold)
- > Public Sector Sustainability Award 2011
- > Wildlife Trust Biodiversity Award 2011
- > BREEAM ‘In Use’ Award 2011

Pollution, ocean temperature and 'natural' disasters

Met Office research suggests links between industrial pollution, Atlantic sea-surface temperatures and disasters such as drought, flooding and storm damage.



Published in the journal *Nature*, the study is the first to identify mechanisms that may link human emissions to temperature variations in the Atlantic Ocean.

Previously it was thought that the changes were down to natural variability, in a large part because no physically

based models have reproduced Atlantic changes, consistent with observations, in response to historical emissions. There are well established links between this historical Atlantic variability and past climate changes and 'natural' disasters.

Now, using a state-of-the-art climate model, Met Office scientists have demonstrated a link between man-made pollution and changes in the Atlantic.

Temperature fluctuations

Changes in the temperature of the Atlantic affect rainfall in parts of Africa, South America and India, as well as hurricane activity in the North Atlantic. In some cases, extreme weather has caused drought, flooding and storm damage.

Dr Ben Booth, a Met Office Climate Scientist and lead author of the research, explains: "Until now, no one has been able to demonstrate a physical link to what is causing these observed Atlantic Ocean fluctuations, so it was assumed they must be caused by natural variability.

"Our research implies that far from being natural, these changes could have been largely driven by dirty pollution and volcanoes. If so, this means a number of natural disasters linked to these ocean fluctuations, such as persistent African drought during the 1970s and 80s, may not be so natural after all."

Findings suggest industrial air pollution may have driven large-scale, long-term changes in Atlantic Ocean temperatures which may have had widespread impacts on climate. This means that human activity may have, and may continue to have, the potential to drive large-scale impacts on regional climate.

Aerosols and the Atlantic

This research explores the complex interactions between aerosols and clouds. Aerosols are tiny particles suspended in the air which have a direct impact on sunlight, scattering or absorbing part of it before it reaches the surface of the Earth, leading to cooler surface conditions.

Increased numbers of aerosols make clouds brighter and longer-lasting so they reflect more energy from the Sun, further reducing surface temperatures. Over the past 10 years, scientists have started to understand and quantify the impact of aerosol-cloud interactions and how they respond to other factors like temperature, relative humidity and air currents. It is only now that we are starting to see widespread inclusions of these processes in current state of the art climate models.

Sulphates, soot and black carbon were included in the study, but the sulphates are by far the largest group of aerosols. There are both natural and human sources of sulphates. Marine biology and active volcanoes represent a consistent natural source of emission that determines the background level of aerosols in the atmosphere.

Sulphur dioxide, the precursor to sulphates, is an industrial pollutant. Most of the sulphate variability seen in the past comes from this source. Volcanoes can have an important impact on the atmosphere by emitting with enough force to put material in the upper atmosphere. With volcanoes, sulphates make up an important component but, unlike lower-level emissions, the high level nature of these aerosols from big volcanic events put them above the level of the clouds.

Knock-on impacts

The research revealed that sulphate particles attract water vapour creating lots of tiny droplets within clouds, making clouds brighter. Bright clouds reduce the amount of sunlight that reaches the sea surface which has a large effect on North Atlantic sea surface temperatures. The new work shows that inclusion of these processes highlights a much more enhanced role of aerosols on the climate, compared to previous assessments.

Highs and lows in industrial air pollution have exerted a large influence over the Atlantic, either cooling or warming the surface of the ocean. These changes have led to significant regional climate changes and associated human and ecological impacts.

Further understanding of the relationship between pollution and ocean temperatures could help to predict and potentially avoid future changes in the Atlantic region. It could also help to reduce the impact of the knock-on impacts such as drought, flooding and storm damage.

The work opens up the potential that man's emissions played a large role in past regional climate changes. There will now be an emphasis on how other next-generation climate models reproduce this result, and thoughts will turn to novel ways of using satellite data to confirm these processes.



Science profile



Dr Ben Booth
Climate Scientist

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

Understanding our changing climate

Making sense of the highly complex phenomenon of climate change is no small task. But it's one that Met Office Climate Scientist, Dr Ben Booth, is tackling head on.

Ben works as part of a group in the Met Office Hadley Centre that delivers climate projection information. A big part of his work involves trying to quantify the plausible spread of future changes that are consistent with the current knowledge of climate processes.

A visible example of this work is UKCP09, a set of future climate change projections providing probabilities of different levels of climate change for the UK during the 21st Century. This work is based on extensive research exploring the implications of current uncertainties about the spread of future changes and systematic comparison with our observations of how the world has changed in the past.

Climate projections

People use climate projection data in different ways, as Ben explains: "Some people are interested in the most likely projected changes. Other people are interested in high end, but plausible change (what is the worst they need to make their decisions robust to) whilst others are interested in low end change (what is the minimum level of change that they are likely to need to deal with). In many ways, ruling out which future changes are inconsistent with current knowledge is as important as information about what the more likely changes will be."

Ben's role involves looking at implications of uncertainties in climate feedbacks to determine the spread of future climate projections.

"When something changes in our climate, it's very likely to cause a knock on effect that alters our climate further," says Ben. "These are called climate feedbacks. And they are crucially important in understanding the future of climate change," he adds.

These feedbacks can offset the prevailing change in climate (negative feedback) or increase it (positive feedback). So with global warming, a negative feedback would have a cooling effect. Conversely, a positive feedback would create further heating.

Keeping tabs on the climate

Ben's research involves running not one climate simulation of the past and future, but many such simulations, each of which explores different plausible ways of representing climate processes.

"The resultant spread from these models tells us something about what climate change messages are likely to be robust," says Ben.

Given the delicate balance of our climate, a lot of Ben's work means dealing with a high level of uncertainty. His particular interest is in exploring uncertainties within the Earth System processes and how they are included in the climate projection advice that his team provides.

As Ben explains: "Exploring uncertainties within the Earth System involves understanding the role that vegetation will play in taking up carbon emissions in the future and how aerosols emissions drive global and regional climate changes."

This understanding of how aerosols (tiny atmospheric particles) emissions drive global and regional climate changes is related to Ben's research that was recently published in the journal *Nature*.

As the planet moves further away from its current climate, this will change the way things in our world respond. But for Ben, this is what's great about the work he does.

"It cuts across a lot of different themes and I get this unique perspective on the world's climate. What then emerges from seeing things from this vantage point can change how you see the role of every individual process," he says.

For someone whose job involves looking at the impact of uncertainties, Ben is certain about one thing: "As we go further into uncharted territory, we'll need to push our science on from what could happen and put greater emphasis on identifying robust messages about future changes."

For more information on UKCP09 see <http://ukclimateprojections.defra.gov.uk>



Extraordinary weather

Working with experts from the Met Office, author Richard Hamblyn has gathered a compelling collection of images in a stunning new book, 'Extraordinary Weather'.

The six themed chapters present a beautiful and dramatic perspective of the ever-changing weather. As the foreword of the book by Rob Varley, the Met Office's Operations and Services Director describes:

"As the striking photographs in this book attest, the weather in all its guises equally fascinates people around the world. From the simple act of raising an umbrella, to an aircraft that changes course to avoid a thunderstorm, every day the weather touches all our lives."

➤ For your chance to win a copy of 'Extraordinary Weather' simply complete the pre-paid card opposite.

➤ *Barometer* readers can order Extraordinary Weather for the special price of £7.99 (rrp £9.99 with free p&p (UK only). To order please visit www.thehobbywarehouse.co.uk/R3114 and quote code R3114 or call The Hobby Warehouse on 0844 8805851

Professor Jim Al-Khalili

Making sense of science

As a frequent presenter on radio and television, the theoretical physicist Professor Jim Al-Khalili OBE is no stranger to communicating complicated concepts to a diverse audience. Here he tells *Barometer* why he got hooked on physics, how chaos theory has its roots in weather forecasting — and why he's still awaiting a call from Leeds United.

When Jim Al-Khalili was a child he didn't just dream about growing up to pursue one profession — but three. "As a 10 or 11 year-old I was mad on football, but also wanted to do something brainy. So I decided I'd be a brain surgeon in the week, play for

Leeds United on the weekend, and be a rock star in the evenings. It wasn't until I was about 14 that I got hooked on physics having done well in a school test — and started pondering questions like 'do the stars go on forever?'," recalls Jim.

Al-Khalili was right about being multi-talented. Today he combines the posts of Professor of Theoretical Physics and Chair in the Public Engagement in Science at the University of Surrey. He also regularly hosts 'The Life Scientific' on BBC Radio 4, and has presented other BBC programmes including the BAFTA-nominated 'Chemistry: A Volatile History', 'The Secret Life of

Chaos' and a recent BBC 2 Horizon special on the Higgs boson particle.

Forecasting the unpredictable

"Interestingly, chaos theory came about through study of the weather," says Jim, "when it was discovered how tiny changes in one place can have a much bigger future effect elsewhere.

"That's why weather forecasting is so difficult. The Earth and its atmosphere are so complex that you can never possibly know exactly how every molecule of air moves or where it is. It's an idea now applied in many other areas of science. And it began with scientists realising that although the weather may be completely predictable in principle, it can never be so in practice."

As a nuclear physicist, much of Jim's work involves considering the nuclear power issue and he's come to believe that any worries about nuclear waste are overridden by greater concerns about climate change.

"I have the greatest respect for climatologists because of the sophisticated and complex field in which they work. And yet they're producing ever more reliable predictions. Climate means a lot to me. I have kids and want them to have a future — so I am very interested in potential solutions!"

Jim now sees huge potential for furthering climate science through collaboration between different scientific disciplines.

"There's increasing cross-over, especially in climate. You need chemists to talk about the molecules and elements in the atmosphere. You need geologists to talk about weather systems around the earth.

You need biologists too — because we're learning that our atmosphere is part of the biosphere and that species change climate too, through carbon dioxide emissions and other gases. We can no longer have all these people in silos — they're going to have to work together on the big issues."

Getting the message across

Alongside 'broadcaster' and 'theoretical physicist', Al-Khalili's bio also lists 'science communicator'. As he explains, "Science communication means taking the science out of the lab and the university classroom and bringing it to the general public — just like the Met Office does."

For Jim, the key is empathy. "You need to be able to put yourself in the audience's shoes and ask 'what do they already know?' They're not any less clever. They just haven't spent their whole career immersed in the subject. The term 'dumbing down' is unhelpful in suggesting that the only way to explain science is by getting it wrong."

Despite enjoying success as a television and radio presenter, Al-Khalili still teaches, carries out research and handles academic admin — like managing undergraduate admissions for his University of Surrey department. "I've got a nice balance that keeps me very busy."

Next projects include further episodes of his Tuesday morning Radio 4 show 'The Life Scientific', and a two-part documentary for BBC Four.

Even with a hectic schedule, there's a part of Jim that's still waiting for that phone call. "I still harbour hopes that Leeds United will call me up!", he jokes.



Global rainbow by Yvette Mattern

Global Rainbow is a large scale, spectacular outdoor laser projection which stretches five miles into the sky. Created by American artist, Yvette Mattern, the seven beams of light represent the colours of the rainbow and are intended to symbolise hope.

The light installation was shown in two venues in the north of England and one in Northern Ireland earlier this year. It celebrated the Cultural Olympiad, a series of arts events throughout the country in the run-up to the Olympic Games.

