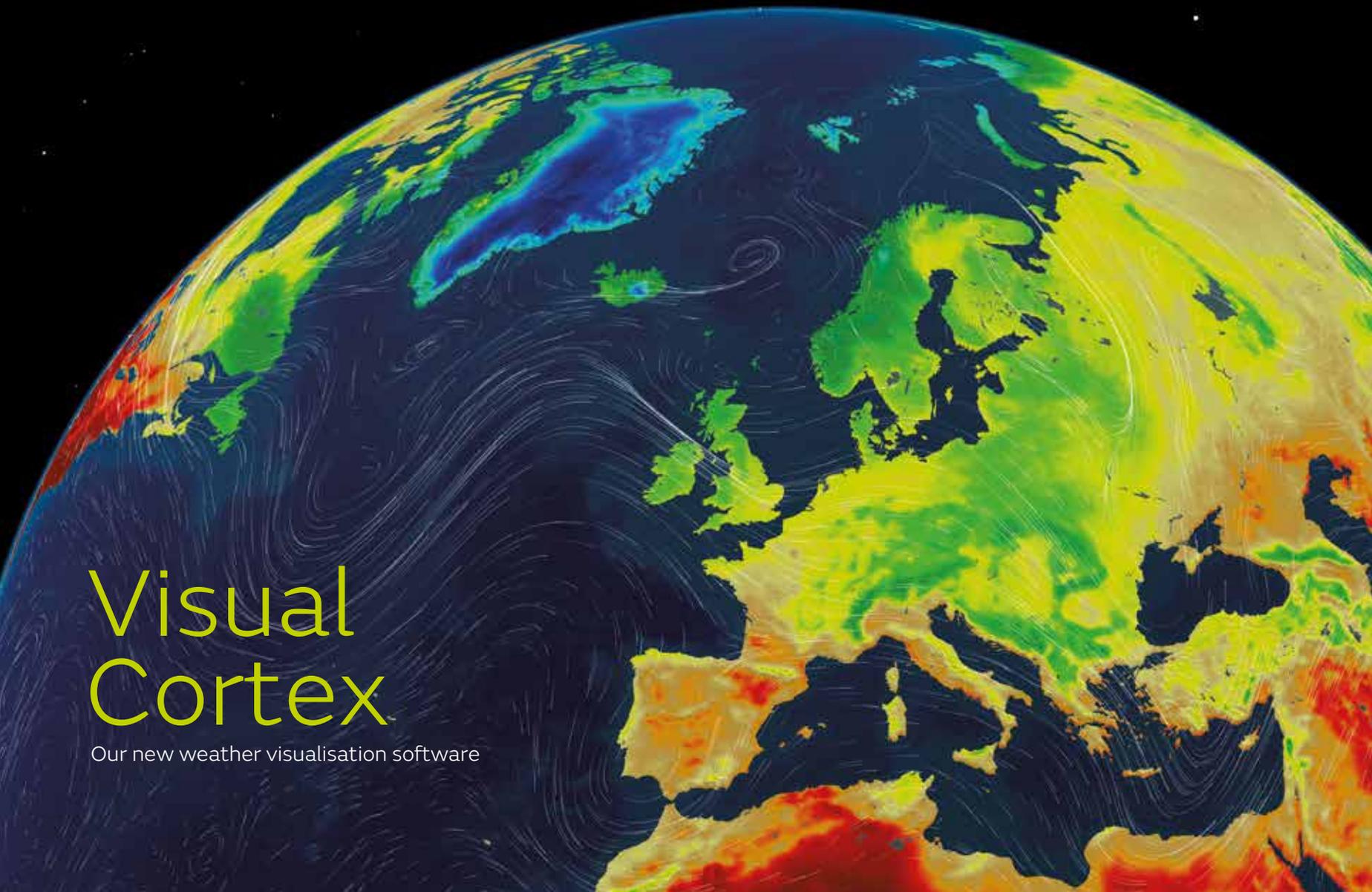


 Met Office

Barometer

Magazine issue 33 | www.metoffice.gov.uk



Visual
Cortex

Our new weather visualisation software



Charles Ewen, Director of Technology and Chief Information Officer,

describes how the role of technology has evolved at the Met Office.

From enabler to shared leadership

Everybody uses technology – from the seemingly simple emails we send every day to the incredibly complex supercomputer used to create weather forecasts and understand climate change – technology at the Met Office has a huge sphere of activity.

Since I started at the Met Office I have witnessed the role of technology at the Met Office evolve from being an enabler to adopting a position of shared leadership.

Journey of evolution

This journey has involved not only simplifying a complex IT infrastructure but also creating a clear hierarchy of leadership and responsibility within the Met Office Technology Directorate. Overall, when combined, these changes mean that technology at the Met Office is now more efficient and outcome-based. We manage development more effectively, and are also able to start and stop projects easily.

As the role of technology at the Met Office has grown, so has our technological expertise. Our implementation of the new supercomputer is the biggest example of this, but technology is pivotal in a variety of Met Office work – whether it's developing the new Met Office Weather app (page 5), launching the Met Office's highly sophisticated weather visualisation software, Visual Cortex (page 11), or offering an improved cloud-based solution for collecting and managing observations through WOW, our Weather Observations Website (page 19).

Technology is now better positioned to respond to what's required so there is much less of a gap between delivery and strategic intent. But, more importantly, technology is no longer just an enabler

or deliverer of services. Technology has a seat at the table, contributing right from the start with ideas at the early formulation stage. Crucially we are also now in a good shape to respond to the challenges ahead.

Multidisciplinary future

The Met Office deals with huge amounts of data every single day. In recognising and tackling the challenges of 'Big Data' it is essential that the Met Office is moving away from a fragmented structure, working in separate teams, to working closely together in multidisciplinary teams.

Over the last three years, the Met Office has changed the way that it works, using an 'agile' approach, bringing together people with different skills from around the Met Office and external partners to create multidisciplinary teams. This has reduced paperwork and improved efficiencies and outcomes as the approach has matured.

Another example of this is the Met Office Informatics Lab, a small team of programmers, designers and scientists that is exploring innovative ways of using data and making it available in ways that are most useful. This way of working is something that is increasingly being replicated across the Met Office, especially in service delivery teams – where the 'rubber hits the road'. In fact, the digital space is often where regular outputs or projects must be multidisciplinary to succeed.

This way of working is often more agile and is something that was first developed in the technological working environment. Subject matter experts, working in combination on common themes, can accomplish so much more than working in traditional silos. Of course, large parts of the Met Office still need to operate as consolidated groups of experts. However, to deliver successfully we must deliberately create unstructured, multidisciplinary teams. For me, this is the nature of a truly diverse workforce – one that values different ways of thinking and perspectives. I believe that in this way we are ahead of the game and ready for the complex challenges that we are sure to face in the future. 🌩️

July 2016

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Download the FREE Met Office weather app



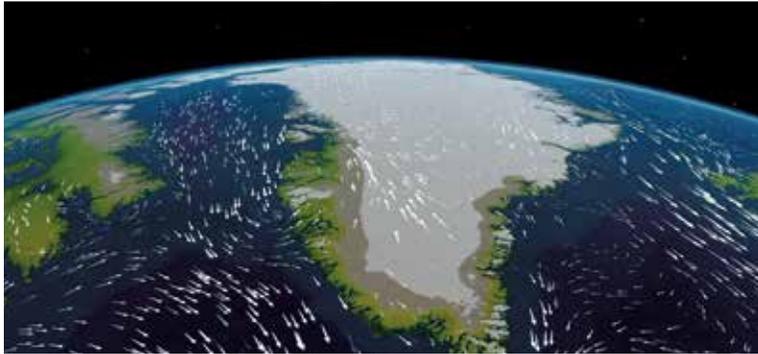
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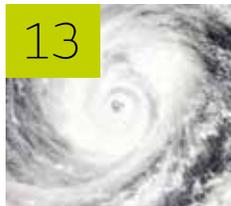
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The Met Office will be demonstrating the new capability of the WOW engine at several events over the summer.



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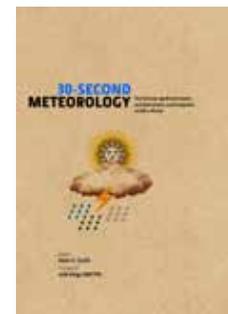
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30-Second Meteorology



In brief

A quick look at the news and updates from around the world of the Met Office.

Climate science and the Amazon

New research is focusing on interactions between the Brazilian Amazon rainforest and the world's climate.

The three-year £4 million programme, Climate Science for Service Partnership (CSSP) Brazil, will research factors affecting the forest such as land-use change and carbon stocks, to help improve global climate models. Ultimately the aim is to better understand relationships between the world's largest tropical forest and the rest of the planet.

This Newton Fund initiative is funded by the Department for Business, Innovation and Skills (BIS). The research aims to boost climate mitigation and adaptation strategies to support resilient economic



development and social welfare: factors which can be affected by severe weather and climate change.

The project brings together scientific researchers from Brazil's National Institute for Space Research (INPE), National Institute for Amazon Research (INPA),

National Centre for Monitoring and Early Warning of Natural Disasters (CEMADEN), and other key UK and Brazilian scientific institutes.

Professor Stephen Belcher, Director of the Met Office Hadley Centre for Climate Science and Services, which is leading the UK's contribution to the project, said: "The Amazon rainforest has a fascinating two-way relationship with the world's climate.

The forest helps to regulate our climate by absorbing carbon dioxide, but it is also widely anticipated to be affected by increasing climate change. Another aspect of the project will investigate the risks of a changing and changeable climate for Brazil, improving monitoring and understanding of impacts and extreme weather, and projections of how they might change in the future." 🌿

National Partnership for OCEAN PREDICTION

Improving our understanding of the marine environment and how it affects us is the focus of a new collaboration, bringing together UK researchers with an interest in understanding the marine environment.

As an island nation, the sea has a deep and profound effect on the lives of many communities across the UK. The seas around the UK influence our weather, climate and local environments.

The National Partnership for Ocean Prediction (NPOP) – which comprises the Met Office, Plymouth Marine Laboratory (PML), the Centre for Environment, Fisheries and Aquaculture Science (Cefas) and the National Oceanography Centre (NOC)

– was formally launched earlier this year, with the signing of the Consortium Agreement.

The scientific collaboration will provide an improved understanding and prediction of many aspects of the marine environment, such as fisheries, safety at sea, maritime operations, marine renewable energy, coastal flood warning, and the achievement and maintenance of good environmental status.

Met Office Chief Scientist Professor Dame Julia Slingo, said: "This partnership is a demonstration of the fundamental role that oceans play in the weather and climate system from local to global scales. It is critically important that the Met Office models, which we use to predict weather and climate risk, represent the fundamental role that the ocean places across time and space scales." 🌿

Supporting humanitarian operations

Sometimes, weather can make all the difference, especially in the humanitarian sphere.

Earlier this year we supported UNHCR, the UN Refugee Agency, working in partnership with the World Meteorological Organization (WMO) and the met services of south-eastern Europe to evaluate the impact of weather on UNHCR operations in south-eastern Europe.

UNHCR's Winter Cell Chief Chris Earney said: "The Met Office has been an incredible partner to work with, both in terms of quality of staff and output but also just the speed at which they could respond."

More recently we provided meteorological support to the World Food Programme (WFP) during its air drops in Syria.



Sherif Georges, Deputy Chief Aviation Service at WFP, said: "Met Office services have been great and have been one of the main factors contributing to the success of this operation, delivering basic, urgent supplies to over 20,000 families that have been besieged for over two years." 🌿

When it matters

We recently launched our When it matters promotional campaign with visuals representing moments in time that really matter to you – whether you're avoiding showers while walking the dog, running in the park on a sunny day, jumping in muddy puddles, or picking the right time for taking those important wedding photographs.



The new When it matters campaign highlights that we know the weather is just as important in your everyday life as it is in times of severe weather and our new app can keep you up to date, whatever you are planning.

The first burst of the new When it matters campaign focussed on the new Met Office Weather app, which launched in June. The app has lots of new features including a seven-day forecast, snapshot weather summary page, a national weather video, a rainfall video and push notifications for severe weather and pollen alerts.

The national weather video is presented by our trained meteorologists and presenters and updated three times a day. It is the only weather app that features a UK national weather video forecast, so you can be weather wise, wherever you are.

Since launching the app we been adding new features based on feedback from users, making sure it delivers what you need when it matters.

See the weather across your favourite location in one simple view



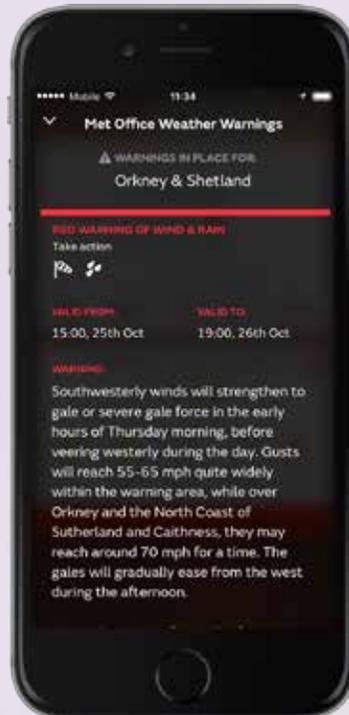
Get detailed forecast information for the next seven days



Subscribe to the latest pollen alerts and severe weather warnings



Stay safe in severe weather with full weather warning details

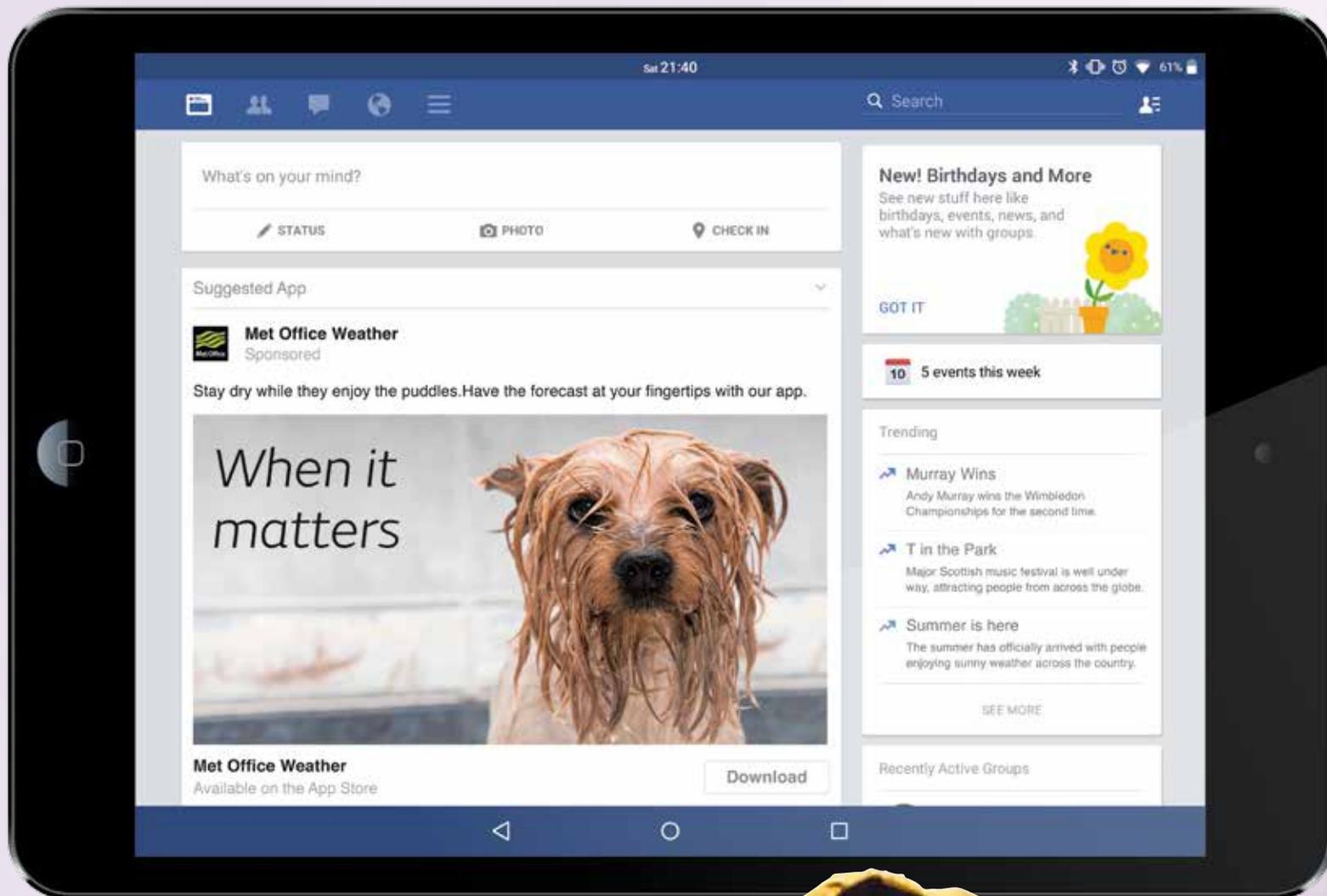


Plan ahead with a rainfall map for the next 24 hours



Visual Cortex graphics on National Weather forecast video





So far the When it matters campaign has focussed on digital channels so look out for the adverts and remember to download the new app so you can stay one step ahead of the weather.

Get our world leading forecasts, download our app



Boosting the bottom line



Recent landmark research by the Met Office and Department for Business, Innovation and Skills (BIS) has calculated the value of the Met Office's work for UK companies. The report concluded that the Met Office will add £30 billion of value to businesses between now and 2025 – at a benefit to cost ratio of 14:1.

The idea for the Met Office General Review was first explored by the Met Office Board in 2014. It forms part of the Government's on-going programme to better understand organisations that provide public value – and how they can improve their services.

The aim was not just to demonstrate the breadth of what the Met Office delivers and how it operates, but also analyse its economic value to the UK. So the review's remit was conceived to draw a complete picture of the organisation's role and impact in a way never before attempted.

"There has been previous economic analysis of the public weather service," explains Sophie Purdey, Executive Head – Strategy at the Met Office. "However, this project – which differs from the Government's formal triennial review process – went much further. By taking a unified approach, it pulled together the value of both weather and climate services, and projected their effect a full decade into the future."

Robust evidence

With the majority of the review taking place over winter 2014/15, the project was managed by a highly experienced Project Board comprised of senior staff from BIS and ShEx (The Shareholder Executive). A Met Office/ShEx working team then coordinated activities day-to-day. However, it was critical that the General Review process was transparent and objective.

"This came through the appointment of independent Board member Tera Allas, previously the Director for Strategic Advice at BIS," adds Sophie Purdey, "and a tender process that secured well-known external consultancy London Economics to conduct the in-depth analysis. Starting with a base case, their methodology applied various scenarios and sensitivity analyses – separating out sector value streams and applying market-based estimates of value."

The renowned US economist Jess Lazo from the National Oceanic and Atmospheric Administration (NOAA) then ensured further impartial scrutiny and

verification. This was supported by additional robust cross-government and external peer review.

Unique reach, unique capabilities

The Met Office's distinctive role comes through clearly in a London Economics General Review Final Report that was completed in April 2015 and published in March 2016. This highlights that the Met Office's unique characteristics make it 'difficult to compare with other National Meteorological Services (NMS)'.
These include the Met Office's:

- Unified weather and climate model that provides a critical national capability and a key component of the UK's defence, security and civil contingencies infrastructure.
- Dual function enabling both civil and military aviation.
- Role as one of only two World Area Forecast centres delivering forecasts globally – and one of few NMS collaborating with and selling services to government institutions overseas including Australia, South Africa, South Korea and the US Air Force.
- Bespoke forecast services to commercial and private users.
- Role supplying processed open data – enabling the UK-based commercial market.

The Met Office cost base also sets it apart, with core research and scientific capability accounting for two-thirds of requirements. Investment decisions are necessarily long-term, with the costs of contributing to global satellites, running the supercomputer and research typically spread over 5 to 30 years.

£30 billion in value to the UK to 2025 – plus important wider benefits

The General Review's primary goal was 'to identify the overall net economic value over the next ten years (2015 –2025) to the UK of having the planned weather and climate services delivered by the Met Office.'

The conclusion it delivered was that, taking into account investment already committed, the Met Office would bring some £30 billion of value to the UK over that period – at a benefit-cost ratio of 14:1. And around a quarter of this figure can be attributed to the UK having invested in 'world class' quality forecasts – an approach that has resulted in greater accuracy than any other national meteorological service. (See below for key benefit streams).

Although the General Review's remit was restricted to the UK only, it did point out significant non-quantifiable wider benefits. International respect for the Met Office's unified weather and climate model, forecasting accuracy and active support to build capacity in developing countries all add to Met Office global influence.

"The General Review's remit was conceived to draw a complete picture of the Met Office's role and impact in a way never before attempted."

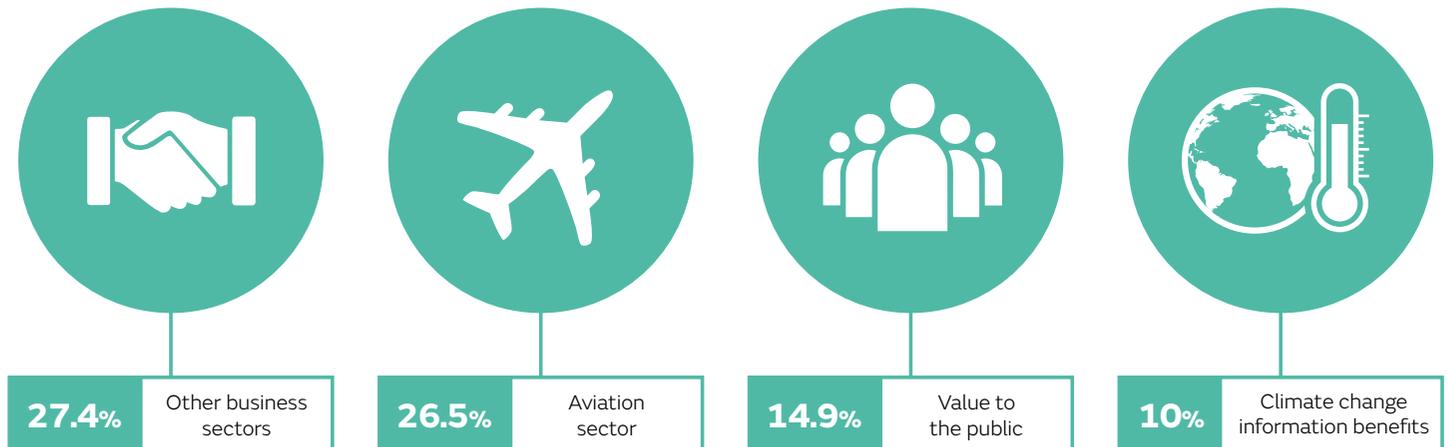
Informing the future

Two key developments show how the General Review is already positively shaping debate around the Met Office's plans for the years ahead.

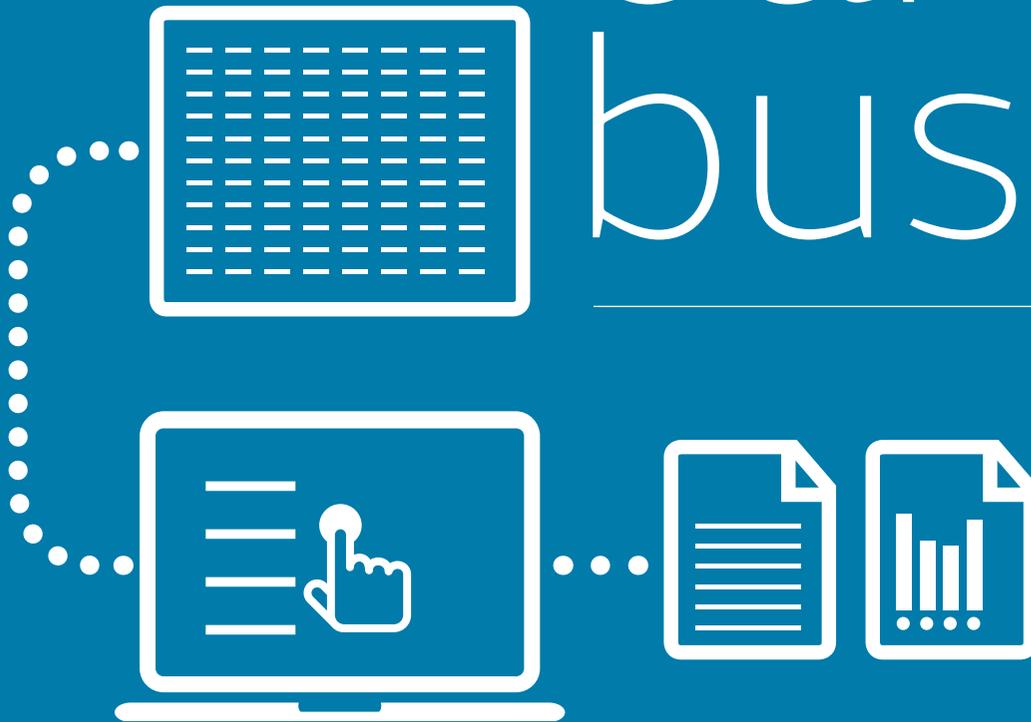
"A new Interdepartmental Met Office Strategy Group was established to discuss future funding requirements across government," explains Sophie Purdey. "Coming ahead of the Comprehensive Spending Review, this was a significant step that acknowledges the breadth of our activities – from supporting the Ministry of Defence through to cold weather payments for the Department for Work and Pensions."

The review process has also resulted in the first ever detailed statement of government requirements for the Met Office. Encapsulating its priorities for the UK, the document is in the final stages of agreement and will be an important reference point for future Met Office strategy. 

Four key benefits streams account for over 75% of the benefits identified including:



Taking care of business



As one of the Met Office's Business Group Senior Leaders, **John Harrison** is at the forefront of several innovative

business areas. Here he reveals how a head for business and spirit of collaboration is helping the group meet the needs of Met Office customers today – and into the future.

John Harrison's connection to the world of business began at university. A degree in Business and Modern Languages led to an overseas graduate scheme with a major European drinks company that owned breweries across the continent – a dream job for many young graduates. But after working for a few years in France, Spain and Portugal and sensing it was time to return to the UK, a role at the Met Office beckoned.

"I spend a lot of time outdoors and enjoy surfing, so I've always had a natural interest in the weather and environment," says John. "I was drawn to the way the Met Office links scientific expertise with public and business needs – whether that's improving road safety or simply helping people decide whether or not to hang their washing out to dry."

Supporting industry – from shopping to sports

John's now part of the Business Group Senior Leadership Team, following roles in the Met Office's Commercial, Aviation and Products divisions. His wide-ranging background is proving invaluable. "It helps to have a broad knowledge of different industries, the various customers we serve and the capabilities we've got that could support them," John says.

The Group's focus is on services to industry, spanning air transport and energy alongside the two areas John heads up – surface transport, and innovation and emerging markets. "In a nutshell, we're trying to better understand our customers' needs so we can shape our services to benefit them into the future."

That means John's time is split roughly three ways: managing and leading his teams, developing new opportunities and products, and getting out meeting customers and partners.

"I'm working closely with our current customers, such as county councils, but I'm also forging relationships with potential partners and new industries – including intelligent transport systems providers."

Right now, John's Innovation and Emerging Markets team is concentrating amongst others things on the retail sector, to better understand how weather and

climate affects shopping behaviour and the supply chain. They're also working with water companies to strengthen their operations. While Met Office services already benefit major events like Wimbledon and the Open Golf Championships, John's excited about opportunities to take support for the sports world further.

The spirit of innovation

Many of these businesses have been Met Office customers for decades. In fact, some county councils and highways agencies John works with have been accessing Met Office services for over 30 years. But as technology advances at lightning speed and the move towards a digital economy continues apace, John sees how those services must evolve to continue to meet the shifting needs of today's businesses. John points to the Internet of Things – where physical objects are interconnected and exchange information – as a source of inspiration.

"Rather than thinking of what we do at the Met Office as a one-way process, delivering forecasts to a county council gritter, for example, we're looking at how our weather information and expertise could be integrated throughout the whole transport system – making things even more efficient for our customers."

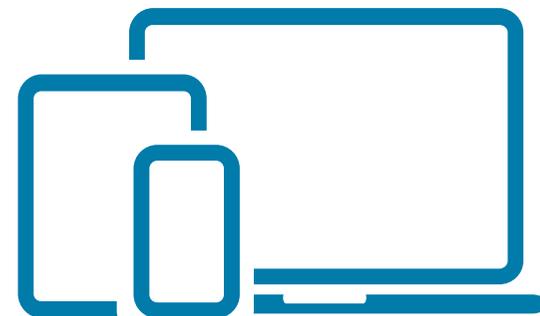
That idea has already begun to filter into the new Transport Weather Manager product which we are currently developing. "We're now going beyond data delivery and actually supporting our customers in the decision-making process, helping them make a choice that will ultimately have a positive impact on their operations."

A once-in-a-generation opportunity

John believes what's happening in the Business Group is a pivotal moment. "We're at a point where we've got both the mandate and the momentum to explore and develop new technologies, and deliver enhanced services that we know can help our customers – so things are coming together at the right time," he says.

Having worked across various Met Office divisions in his career, John points to the organisation's multi-disciplinary strengths and collaborative culture as crucial to Group's success. The swift benefits they've already brought to customers mean the future is looking bright.

"I don't want to work somewhere that is slow and ponderous. I want to work somewhere that moves fast and is always looking to improve. I can already see that what we're doing in the Business Group has upped the pace – and the energy here is invigorating. 🌊"



"As an organisation, collaboration is a cornerstone of our culture."

The Public Weather Media Service

Heralding a new horizon of weather broadcasts

Times are changing in broadcast media. Audiences demand instant, easily accessible and compelling weather information – but so do the broadcasters delivering forecasts. For the Met Office, this presented an exciting opportunity to introduce two new, cutting-edge services.

Television remains the main source of weather information for most of us. But the popularity of apps and social media is altering our interaction with it. Attention spans are shortening. Impressive visual content is a must.

As an organisation with a long relationship with the media industry, and a commitment to circulating weather information to as wide an audience as possible, the Met Office saw its chance to take forecasting to the next level.

The Public Weather Media Service

Launching on 1 July following 18 months of development, the Public Weather Media Service (PWMS) offers UK broadcasters a comprehensive package of Met Office data – from forecasts and observations to weather warnings and general guidance – all delivered by Met Office meteorologists with expert knowledge of broadcast media. As Claire Goldstraw, Met Office Strategic Head of Broadcast Media explains: “In a nutshell, we’ve pulled together every bit of weather information a broadcaster might need to be able to put out a bulletin.”

The service is free at the point of use for any UK broadcaster. The only stipulation is a license. However, a broadcaster doesn’t actually have to be a licensee to have a say in its development. As well as consulting with broadcasters during its creation, the Public Weather Service Customer Group, the body responsible for overseeing the Public Weather Service on behalf of the public, reporting to and advising the Minister of State for Universities and Science, has established a sub-group dedicated to PWMS. That group met in April for the first time, bringing together the BBC, ITV, STV, Channel 4, Sky and S4C representatives. “Licensing PWMS isn’t a prerequisite for being involved – any broadcaster who wants to join the customer group and give us feedback is welcome,” says Claire.

The continuing collaboration between the Met Office and broadcasters is crucial to the future success of PWMS in Claire’s opinion – and there are already plans afoot to enhance the functionality it offers and the benefits it brings. “We see it as a living thing, an evolving service that responds to the shifting ways in which people consume information nowadays,” she explains.

“It’s not so much about leading the market; it’s about being led by what the market needs.”

PWMS was born out of a deep understanding of what contemporary broadcasters need – and what today’s audiences demand. “Things need to be turned around very quickly,” explains Claire. “At the same time, presenters look for specific facts – when it last snowed in May or the wettest March on record, for example – that help them tell the story of the weather on that particular day.” PWMS will have a huge role to play in that, but it’s not alone.

Visual Cortex

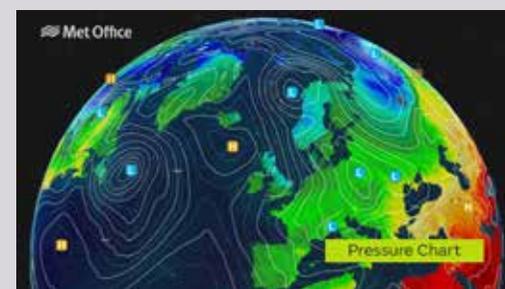
2016 also saw the launch of Visual Cortex, the Met Office’s highly sophisticated weather visualisation software. It puts an exciting range of tools at broadcasters’ fingertips – from fly-throughs and 3D visuals to touchscreen capabilities that let presenters manipulate imagery during a broadcast, just like sports pundits do. Links with social media enable direct, on-the-spot engagement with the public: if someone has tweeted a picture of heavy snow in Leicester, the weather presenter can immediately pull up that image, which automatically geolocates, on to the screen. There’s an exciting development roadmap ahead, with virtual reality just one idea that’s on the table.

“For broadcasters Visual Cortex is highly efficient – and for audiences it’s hugely engaging.”

“The beauty of Visual Cortex is how it creates graphics that are incredibly attractive and compelling, but using a technical platform that’s also highly flexible,” Claire says. “Different broadcasters will be using the same software, but each will produce something very different, because they can configure the visuals to fit their brand’s look and feel.”

The next step for Visual Cortex is exploring how it can be utilised in other parts of the Met Office to upgrade our weather visualisation. “While it was conceived for broadcast media, the simple yet powerful way in which it communicates the weather could significantly enhance things like weather warnings,” says Claire. And that could impact on everything from transport to retail. ☞

Visual Cortex graphics are both engaging and informative. The new graphic software is used daily for our public output such as the National Weather video forecasts on our website and new app. See page 5 for more on the new app features.



The power of a name

What happens
when you invite
the public to
suggest storm
names?
More than you
might expect.

With



Naming storms is nothing new. The practice of giving tropical cyclones names goes back to before the Second World War, and several prominent naming systems across Europe have been around for decades. However, there has never been a definitive system for the UK or Ireland – until now.

Last autumn, the Met Office partnered with Ireland’s meteorological service Met Éireann to launch a pilot project inviting members of the public to suggest storm names. The reasoning behind the project was twofold.

It had become apparent over the stormy winter of 2013-14 that not having a single authoritative system was causing confusion, with the media using names from different schemes to describe the same storms. Most concerning was the risk that this confusion would undermine the effectiveness of the Met Office’s National Severe Weather Warning Service. As Dee Cotgrove, Executive Head of Media and Communications, explains: “By inviting the public to contribute to a new system, we hoped to eliminate the potential for confusion, as well as support the National Severe Weather Warning Service and increase awareness of the impacts of severe weather.”

This alignment with the National Weather Warning Service is significant. Other schemes name storms once they hit a defined meteorological threshold such as a certain wind speed or central pressure. The Met Office and Met Éireann’s scheme was designed to follow the National Weather Warning Service’s impact-based approach, naming storms according to how much damage they are expected to cause.

Changing behaviour

The project launched in September 2015, with a series of press releases inviting the public to submit ideas for names via email or social media. The response was tremendous: over 4,000 names

“Bringing seemingly disparate factors such as traffic issues and school closures under one name creates coherence.”

were submitted, generating conversations around the weather across platforms such as Facebook and Twitter. The Met Office and Met Éireann then created a joint list from the submissions, choosing names such as Abigail, Clodagh and Henry. These were consistently adopted across the media and other communications, effectively making the Met Office and Met Éireann’s new system an authoritative standard – just as was hoped.

What was perhaps even more encouraging was the impact on people’s behaviour. Preliminary evidence indicates that the naming pilot has improved people’s ability to understand the risks of severe weather and what it means for them. There’s also evidence to suggest that the project made people more likely to take action.

Hashtag culture

So why did naming storms have such a tangible effect? “I think it’s to do with the ‘hashtag culture’,” explains Will Lang, Chief Operational Meteorologist at the Met Office. “Bringing seemingly disparate factors such as traffic issues and school closures under one name creates coherence, and with that comes greater understanding of how these things are connected.”

Met Office partners such as emergency services and the Environment Agency were also able to take advantage of this effect, applying storm names as hashtags to get their own messages about severe weather out to the people that mattered.

Gerald Fleming, Head of Forecasting with Met Éireann, said: “Naming storms brings many benefits; the public latch on to the name and assimilate the warnings messages far more easily. The media get ready-made headlines for more punchy communication. The storm can be easily searched online or via social media. And when the storms follow quickly one after the other, as happened last December, even professional meteorologists find it hard to keep track of what storm produced this wind or that rainfall; the names bring clarity for us all.”

The pilot continues for a second year starting this September. Before the launch, the Met Office is investigating whether to introduce new rules in the second half of the season that would incorporate other kinds of weather, such as less severe storms that have a high flood risk. Either way, the objective remains the same: to engage the public and help both meteorological services and their partners raise awareness of severe weather impacts. ☘



Campaign effectiveness in detail

- Greater authority for our single voice around severe weather which will have a positive effect on public safety.
- Consistency of European thinking on the integration of severe weather messaging.
- According to research commission by YouGov after the first seven storms of the season, the majority of people took action in some way upon hearing about a named storm:

39% Assessed the local weather forecast 

15% Warned their family and/or friends about the storm 

12% Prepared for longer journey times 

9% Followed further advice from a local authority and/or emergency services 

1% Took steps to protect their homes (sandbags, boarding up windows) 

Getting wise to an unpredictable climate

Rising temperatures, changing rainfall and prolonged drought, are increasing the vulnerability of people in Africa. Many livelihoods hang in the balance. But, with a new, large-scale project, the Met Office is helping change the outlook for some of the world's most vulnerable communities.



In the last 25 years, over 420,000 Africans have died as a result of extreme weather while, economically, the cost to the continent has totalled USD 9 billion since 1980 alone. But change is on the horizon. Backed by an investment of £35 million from the Department for International Development (DFID), the Met Office and a range of international partners are working to build the resilience of African people.

Getting WISER

Launched in June 2015, the Weather and Climate Information SERVICES for Africa (WISER) programme is now approaching the end of its first year of a planned four. The initiative aims to empower local communities and regional decision-makers through a better understanding of weather and climate.

From village farmers considering which crop to plant next season, to governments developing long-term infrastructure policies, WISER is focused on putting users at the heart of its projects. As WISER Fund Management Technical Lead, Bill Leathes explains: “It’s not about a meteorological agency deciding what people want to know. It’s about developing an understanding of what’s required.”



“UK aid is there to help the most vulnerable people. But in Africa, it’s entire countries that are vulnerable.”

The programme aims to improve the generation and dissemination of new and improved products and services, promote collaboration between service providers and users – and put weather and climate firmly on the policy map. From delivering early warning systems to explaining the benefits of robust long-range forecasting, WISER will give Africa better tools and knowledge to manage the uncertainties of climate variability and change.

The East African component of WISER, which the Met Office is fund-managing, is initially focusing on six countries in the region: Uganda, Rwanda, Burundi, Tanzania, Kenya and Ethiopia. A range of international and national institutions and universities are working together to deliver five ‘quick-start’ projects across the region. With a long history of supporting local meteorological agencies in East Africa, the Met Office is perfectly placed to lead four of these five projects. The Met Office is working closely with the Africa Climate Policy Centre which is managing pan-African aspects of WISER. If successful, the regional approach being tested may be rolled out elsewhere in Africa.

As WISER Fund Management Technical Lead Bill Leathes explains: “Sub-Saharan Africa has been a primary area of focus for the Met Office’s international development programme for many years. The projects we’re running under WISER are very much a continuation of our work in the region – building on the experience we’ve gained and relationships we’ve nurtured in previous ventures.”

The case of Tanzania

One of the projects builds on a long standing partnership between the Met Office and the Tanzanian Meteorological Agency (TMA). The project aims to develop a Multi Hazard Early Warning Service to enable Tanzanian citizens become more resilient to high impact weather events.

“It’s not just about developing the service that will deliver better weather and climate information. It’s about making the connections between the TMA and its stakeholders that will enable the right

information to get to the right people in a timely manner,” explains Bill.

Still in its initial stages, the Multi Hazard Early Warning System will service Tanzania’s coastal regions – helping to mitigate the impact of extreme weather through high-quality, timely weather services. Through the Met Office’s experience of delivering world-leading science to multi hazard early warning services and the TMA’s local knowledge, the project will deliver real benefit to the most vulnerable citizens in Tanzania as well as government and industry.

The shape of services to come

Along with leading individual WISER projects, the Met Office is the designated fund manager for the whole East African initiative. Bill explains:

“We’re responsible for managing the fund on behalf of DFID to make sure its investment is handled properly. We monitor and evaluate all the projects under the programme to ensure they demonstrate value for money. And we disseminate the knowledge gained from each to our project partners.”

Since WISER is the test case for a wider roll out, sharing information and learning from experience is central to the ethos of the programme. The five projects underway today won’t just inform what the next few years look like – they’ll help shape the future of weather and climate services across the whole continent, and beyond.

A WISER future

“Weather and climate has really come up the development agenda in the last five years,” says Bill. “Governments and agencies are beginning to realise that if we don’t mitigate the risks posed by extreme weather now, we’re going to set back the development progress that many countries have made in the last twenty years.”

The products and services under development with WISER will help East Africa protect its most vulnerable people. They’ll boost economic development and give these countries the chance to compete on the international stage. From agriculture to infrastructure, energy services to health providers, WISER aims to deliver the knowledge and understanding needed to secure the future of generations. ☞

Insur[!]ing for resilience

Being able to predict the impact of natural hazards is fundamental to the global insurance industry – especially in high-risk areas of the world. Which is why the Met Office has recently developed new applications for its weather and climate science targeted at both insurers and the people they serve in vulnerable, emerging economies.



The UK's Great Storm of '87. The San Francisco quake of '89. Hurricane Andrew that hit the US in '92. These are just some of the extreme events that caused the insurance industry to rethink risk – and how much capital they held in reserve as a result. 'Because of this, two important capabilities emerged,' explains Nick Moody, Head of Disaster Risk for Finance and Insurance at the Met Office.

"One was catastrophe modelling coming out of academic centres in Boston and Stanford as a response to insurance loss. At the same time, GIS mapping was being developed. Combining these two capabilities provides a much more scientific approach to understanding risk."

This type of modelling involves calculating three variables. The 'vulnerability' – of a property or crop, for example. The 'exposure' – which means the number of properties or crops potentially at risk. And the 'start point' – or natural hazard itself. This is where the expertise of Met Office Insurance and Capital Markets experts – alongside other applied science colleagues – comes into its own. Adding weather and climate expertise into the modelling process helps insurers – and reinsurers – understand the 'start points' in much greater detail.

Vulnerable emerging economies

Figures from the world's largest reinsurer Munich Re show around a 60% discrepancy between what is insured and average annual loss for the developed world. However, the gap in emerging economies – such as some countries in Latin America, Africa and Asia – is even more stark, where around 90% of annual loss remains uninsured. Lloyd's of London estimates this large-scale underinsurance compromises the reduction of poverty.

As part of the global disaster risk reduction community, we are well placed to help to

address under insurance in emerging economies. Governments and the private sector are now working together to build financial resilience where it is most needed, as a key component of broader Disaster Risk Reduction efforts. Disaster Risk Finance and Insurance (DRFI) presents an opportunity for public-private partnership.

As Nick says: “UN agencies and aid organisations see financial resilience as an essential precondition for economic growth. For example if an agricultural community is dependent on unpredictable emergency aid after a tropical storm or prolonged drought, economic growth is impossible. The global insurance industry can help governments implement regional safety net schemes, while the Met Office can help in the risk modelling process that makes this possible.”

Partnering with Lloyd's

In November 2015 eight Lloyd's syndicates launched a \$400 million Disaster Risk Facility (DRF) with a focus on South East Asia. It's a good example of a growing international commitment to use reinsurance to build resilience.

The aim of DRF is to offer rapid payouts to people affected by floods, crop failure and other disasters. To do this, it draws together a range of organisations including World Bank, national governments, municipalities and NGOs. Recent events, such as the Nepal earthquake, highlight how slow and ineffective the international and local response can be without this kind of concerted and coordinated effort.

In late May 2016, Lloyd's and world leading reinsurance broker Guy Carpenter plc hosted a major Met Office event in London where they explored the Met Office's relevant expertise in detail. Senior technical experts from Lloyd's reinsurance syndicates attended the event, 'Weather and Climate Analysis for Insurance'. We also welcomed representatives from government agencies such as the Department for International Development

“UN agencies and aid organisations see financial resilience as an essential precondition for economic growth.”

(DFID), the Environment Agency and Defra, the Bank of England, major re-insurance brokers, academia and others.

Trevor Maynard, Head of Exposure Management and Reinsurance, Lloyd's, said: “Lloyd's was delighted to host an event showcasing the Met Office's capabilities to model natural hazards. Our year-long study with them on global teleconnections was very illuminating and confirmed our prior modelling assumptions were appropriate.”

Met Office showcase

At the event, the Met Office showcased cross-industry capabilities in measuring the frequency, severity and location of extreme natural events. We also presented our latest forecasting resources that draw on the huge increase in our in-house High Performance Computing (HPC) capacity.

“A case study then shared the potential of a new agricultural weather index designed for Vietnam, Cambodia, Thailand and Laos PDR,” explains Nick. “This draws on the Met Office's understanding of the meteorology of the region and models the likelihood of extreme drought that could cause rice crop failure.”

Developed in partnership with Lloyd's and Guy Carpenter plc, the Southeast Asia Agricultural Weather Index is a concrete illustration of how reinsurers can better understand their risk. But it also demonstrates how country agricultural or finance ministries could use reinsurance backing to make sure those affected receive a pay-out when conditions exceed the threshold determined by the index.

The Lloyd's event also saw a preview of the 'Global Teleconnections Report' due to be published this summer, which will outline additional groundbreaking work in this field. The consultancy was commissioned by Lloyd's and carried out by the Met Office. It was prompted when the regulator questioned the industry's assumption that extreme global weather events occur 'independently' of each other.

The Report analyses the interactions of global climate drivers and regional hazards to uncover possible 'dependencies' – how one phenomenon may affect another. It's significant because it could have important implications for how solvency risk is assessed – and how the capital reserves that cover it are calculated.

Where next for meteorological science and risk modelling?

At the moment, the risk modelling techniques that are being used are the best available. But with the world's top three risk consultancies turning over around half a billion dollars each year, it's clear that their application has much further to go. As Met Office HPC continues to generate more data, for example, it can be used to assess insurance risk at increasingly local levels – as well as in new areas altogether.

Professor Dame Julia Slingo, Met Office Chief Scientist said: “The global reinsurance sector has been at the leading edge of risk modelling for many years. It has developed techniques and platforms that could be applicable to sectors beyond insurance and regions beyond traditional markets, not the least in disaster risk research in vulnerable regions. Understanding the risk problem starts with a probabilistic understanding of the hazard; the Met Office is very well placed to offer this view based on simulations of extreme events that are in the 'tail' of the distribution curve but are still physically plausible.”





WOW!



The original Weather Observations Website (WOW) was launched in 2011 in partnership with the Department for Education and the Royal Meteorological Society. Since then, the platform has become extremely popular and now contains over 850 million observations from 200 countries around the world. Recent improvements to WOW mean that even more people can make a wider range of observations.

As well as contributions from people worldwide, WOW is also the main operational system for climate observers to submit their daily observations to the Met Office. The original WOW technology was built by a third party, and hosted on a cloud platform. At the time this innovative use of technology for Government received several industry awards.

Technological refresh

Over the past year there has been a complete technological refresh of WOW with development of the WOW engine – a new and improved cloud-based solution for managing and collecting observations from all sorts of different sources. This includes the ‘citizen scientists’ and climate observers who have been using WOW for the last few years, as well as enabling the Met Office access to observations from new sources.

Technology is enabling us to capture non-standard observations, for example those provided automatically from moving platforms such as cars or ships. It is also possible to define new variables that have not been foreseen, so we can respond to changing requirements.

Capturing ‘ground truth’

The ability of our supercomputer to accurately forecast the weather is built on the foundation of high-quality global observations, together with our ability to understand the impacts of the resulting weather. Our partners in civil contingencies and the Natural Hazard Partnership are increasingly seeking to quantify the impacts of severe weather on infrastructure and people. Working with the Environment Agency we’re investigating how best to collect and use public reports of flooding and other impacts of severe weather to improve future forecasts and warnings. The ability of the next generation of WOW to capture ‘ground truth’ through photographs, video and social media will be a powerful tool to enable us to do this.

WOW is also used by Australia, New Zealand and the Netherlands to increase their engagement with citizen scientists. The new infrastructure enables the easy addition of new collaborators and data types, and also opens up access to well-documented and well-managed application programming interfaces (APIs) enabling collaborators to make maximum use of WOW. A ‘white label’ WOW template is now available for other national meteorological services so they can quickly manage third party observations.

Inspiring and educating

The next generation of WOW is also inspiring and educating a new generation of scientists through our WOW Schools pilot project. We have provided ten schools across the country with automatic

weather stations and bespoke education materials so students can develop their skills relating to the meteorological data they are collecting. Using a combination of physical observation methods and automated technology students can record weather observations, make practical measurements, analyse information and share data via WOW. 📱



“The ability of our supercomputer to accurately forecast the weather is built on the foundation of high-quality global observations...”

Amateur Meteorologists' Conference



The Met Office will be demonstrating the new capability of the WOW engine at several events over the summer including the Royal Meteorological Society's Amateur Meteorologists Conference.



The Royal Meteorological Society's third Amateur Meteorologists' Conference will be held on the weekend of 10 and 11 September at the University of Reading. Over the two days, seven sessions involving more than 15 speakers will explore how weather impacts our lives. If you have a passion for meteorology then this is the place to come to discuss the weather, exchange data and learn new skills.

The Saturday session will open with 'Weather and Photography'. Three talks will include a look at how to capture the perfect weather shot and create beautiful time-lapse photography. 'Life in the Clouds' in the afternoon will be a calm yet packed session covering art, literature and nature, explaining how our skies are represented through art and the best weather if you're a bird watcher.

The day will close with 'Observations and Instruments' where Felicity Liggins and Geoff Jenkins, current and former Met Office employees will guide you through how to set-up your home weather station to ensure it gives you the most accurate observations.

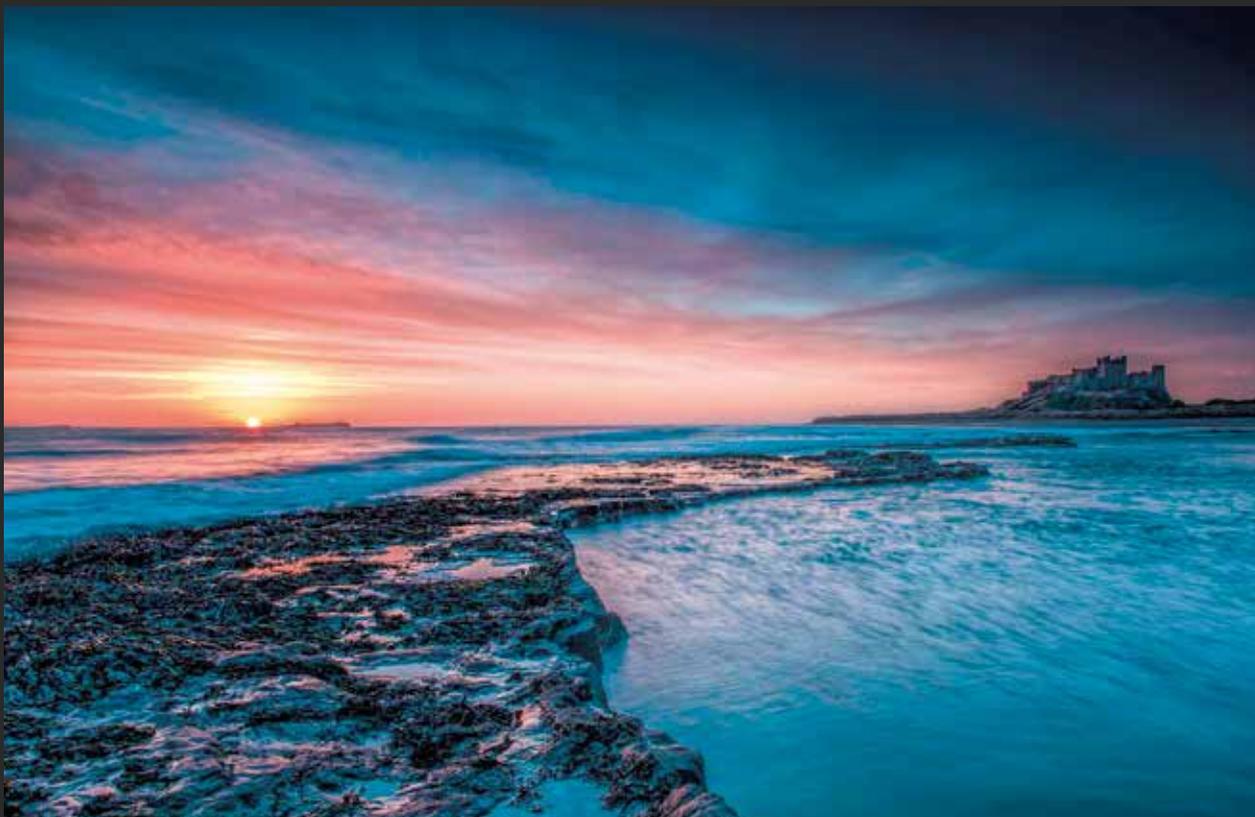
There will also be the opportunity to find out how to share your valuable and insightful data to support the UK's weather station network. A hot buffet dinner in the evening will provide the opportunity to share your passion of meteorology with fellow weather enthusiasts, before Peter Stott, leader of the

Climate Monitoring and Attribution team at the Met Office gives an exciting lecture on extreme weather.

On Sunday, the conference looks at the range of weather instruments, from observing the weather on a budget to more technical apparatus, such as the Rotronic logger. After that, Peter Gibbs, BBC broadcast meteorologist and host of Gardeners' World Question Time will give a 30-minute talk, 'Return to the Ice'. In 2016 Peter travelled to Antarctica, 36 years after working there as a young meteorologist. Peter will talk about his experience travelling to the British Antarctic Survey's research station based at Halley and give a glimpse into the life and discoveries being made at Britain's most remote scientific station.

Three more meteorologists will join Peter to share their careers as meteorologists, with a panel discussion providing the audience the chance to ask those unanswered questions. A fascinating final session of the weekend on 'Clouds and Storms' will focus on extreme weather covering supercells, hails storms and tornadoes.

In addition, the winners of the Weather Photographer of the Year competition, held jointly between the Royal Meteorological Society and Royal Photographic Society, will be announced. Conference attendees will be the first to view the winning photographs, as well as the other best entries that will be a part of this exhibition. ☞



A selection of photographs from The Royal Meteorological Society's Weather Photographer of the Year competition that will be on show at the Amateur Meteorologists Conference.

Photography credits:

Top left: Steve Ball

Top right: Ben Cherry

Left: Jonathan Cruickshank

i The conference is open to everyone. Registration is now open, so don't miss out and book your place at: www.rmets.org/amateur2016

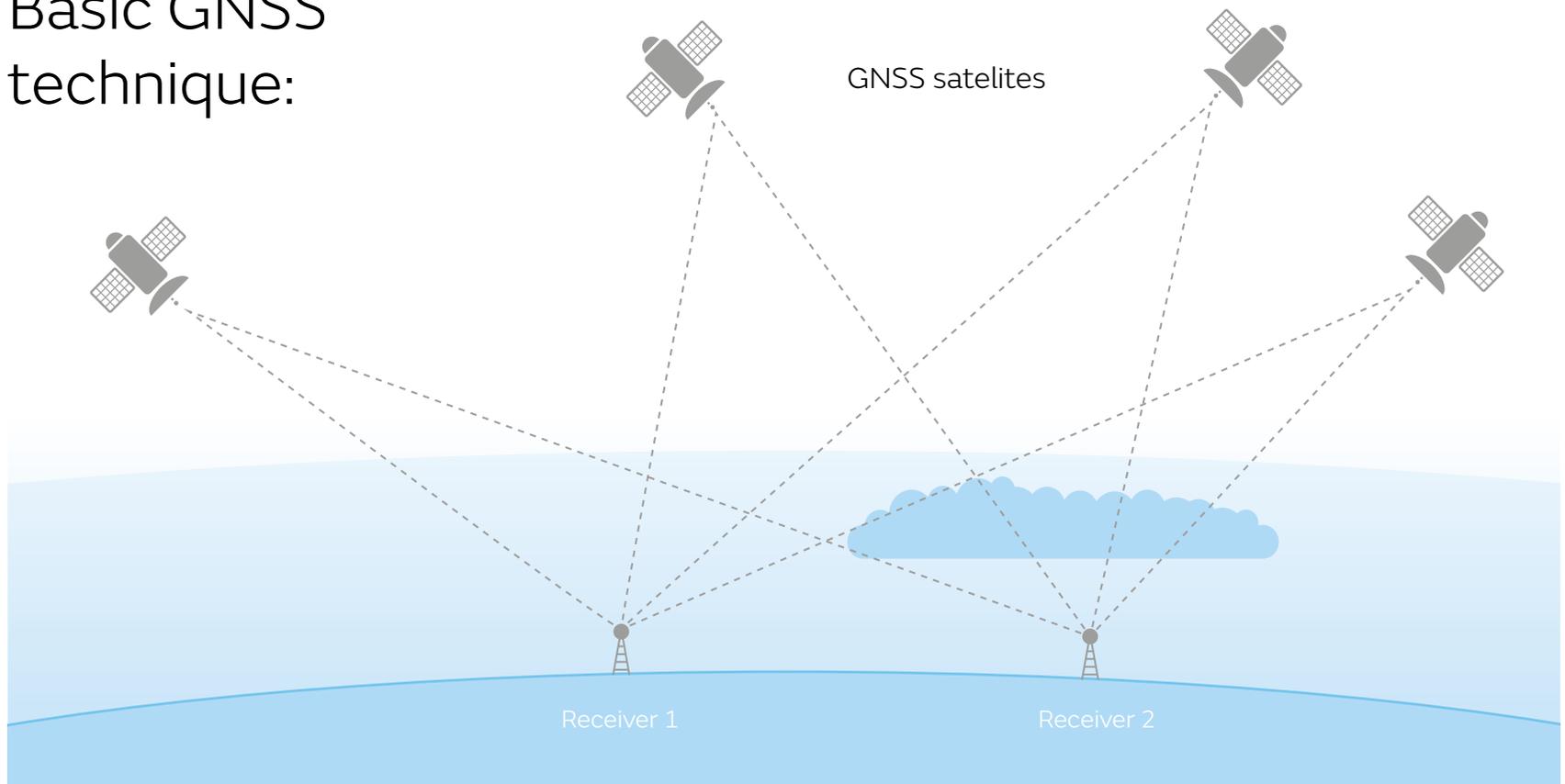
Making the most of errors

Most of us are familiar with using the Global Positioning System (GPS) whether it is in our cars or on our mobile phones. However, what most people don't realise is that the Met Office makes use of the same system for weather and climate observations.



Dr Jonathan Jones
Met Office Senior Scientist,
Observations R&D

Basic GNSS technique:



The Global Positioning Systems (GPS) is one type of GNSS (Global Navigation Satellite System) which uses networks of ground sensors and a constellation of satellites for position, navigation and timing applications. Most people use GPS for position information, for example on sat navs, benefitting from measurements that are accurate to within a few metres.

Most of us would rarely if ever consider that when using GNSS there are lots of hugely complex factors to consider, including solar radiation, flexing of the Earth's surface and special relativity. What's more, GNSS signals are affected by the medium they encounter on their journey from satellite transmitter to ground-based receiver.

For instance, several different frequencies of GNSS are used to eliminate the effect of the ionosphere, part of Earth's upper atmosphere. Water vapour in the atmosphere also affects the satellite signal.

When using GNSS for positioning, these different mediums are sources of errors. But, understanding and accurately estimating these error sources can actually be useful information for the meteorological community – and, in turn, can help the positioning community too.

How do we use GNSS?

Electromagnetic radiation (including GNSS) travels more slowly through water vapour than air. This leads to a delay in the arrival of the signal, using this signal delay plus surface observations of pressure and temperature it is possible to estimate the Integrated Water Vapour (IWV) of the atmosphere.

As Dr Jonathan Jones, Met Office Senior Scientist from Observations R&D describes: "IWV is a measure of atmospheric humidity, which is of value to numerical weather prediction models and in particular to 'nowcasting' (very short-term forecasts), and as such observations of humidity in real or near real-time help weather forecasters and is also useful for climate science."

Programmes and partnerships

To gather GNSS data, we have a resource sharing agreement with Ordnance Survey GB, which permits the Met Office access to a network of over 100 ground-based GNSS sensors. We are also part of the EUMETNET E-GVAP GPS water vapour project, ensuring access to a dense network European GNSS observing sites, which provides access to around 16 million observations per month.

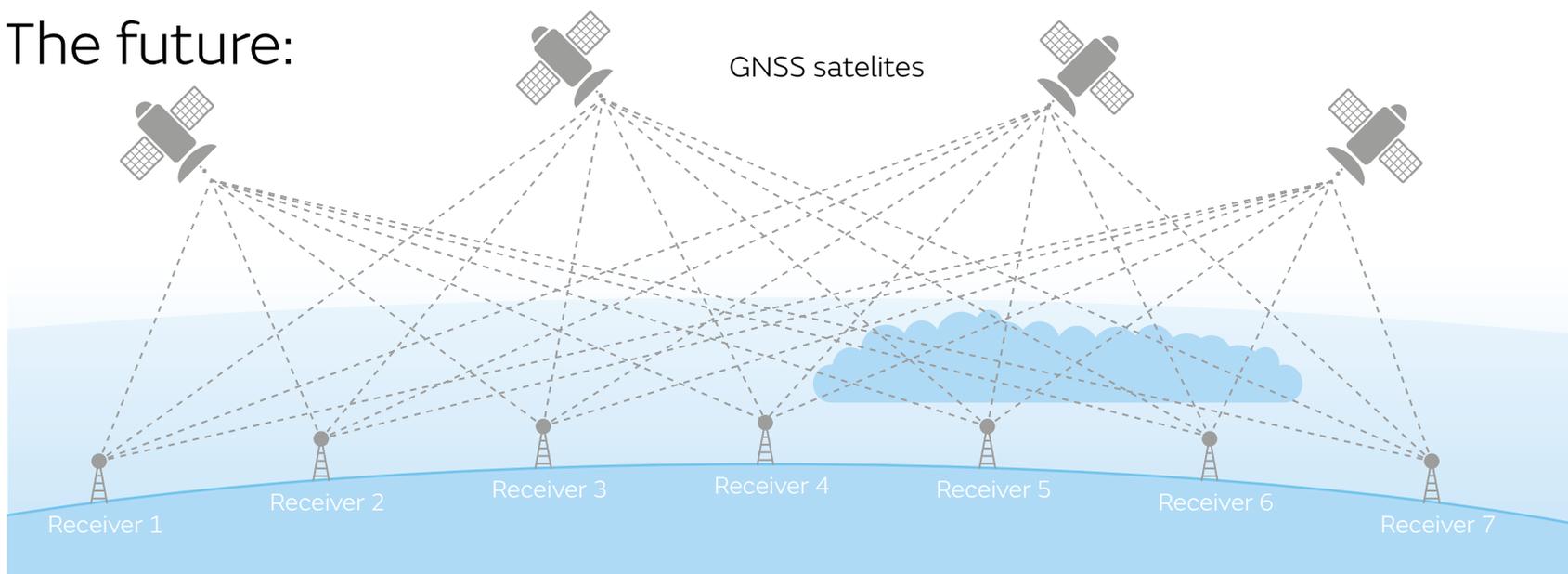
COST (European Cooperation in Science and Technology) is the longest-running European framework supporting trans-national cooperation among researchers, engineers and scholars across Europe. Jonathan is Chair of the Management Committee of COST Action ES1206: Advanced GNSS tropospheric products for severe weather and climate. The project involves over 150 scientists from around 40 countries, and aims to improve existing, and develop new GNSS products, specifically for nowcasting of severe weather and for climate applications as well as improving GNSS accuracy through enhanced atmospheric modelling.

What next?

The Met Office has used GNSS in operational weather forecasting since 2007. We also use it to keep an eye on space weather – focussing on the ionosphere and measuring solar radiation and looking for abnormal activity.

"However, there is still scope to develop it the way we use it to provide even more benefits," says Jonathan. "For instance, it is possible to measure reflected signals to measure soil moisture and snow depth or even to use tomographic reconstruction to potentially develop real-time 3D humidity fields."

The future:



Take a swim on the wild side



In the warm morning sun. Under the light of the moon. After the first frost of winter. There's rarely a time – or weather type – that dampens **Kate Rew's** swimming spirit. As co-founder of the Outdoor Swimming Society, she invites the nation to dip into the great outdoors – from great lakes to forgotten rivers.

Kate Rew was a wild (swimming) child. Growing up on a Devonshire farm that had a river running through it, she spent a good deal of time on watery escapades. "We had this favourite downstream journey," she remembers. "From the waterfall at one end, we'd wiggle our way through a mile-and-a-half of water, past places like 'eel corner' and 'red willow alley' – as we called them."

On rediscovering it as an adult, Kate realised she'd never lost that love of A-to-B swimming outdoors: "I still see it as going on adventure, and carving my way through a landscape."

The Outdoor Swimming Society

On an atmospheric Halloween dip, the idea of starting an outdoor swimming organisation first came to Kate. She arrived in Buttermere after dark and during a downpour. "But when we got to the shore the rain stopped, the clouds parted and stars appeared," she remembers. "We forgot about spending half a day on a hellish motorway, because of this magical swim beneath the moon and mountains." Later, Kate decided to inspire more people to swim outdoors.

First came a charity swim – Breaststrokes. Then, in 2006, Kate co-founded the Outdoor Swimming Society (OSS). In its inaugural year the Society drew 300 members. "We were the first to invite the general public out for a swim – non-competitively – and we found open water swimmers everywhere," Kate explains. A book, *Wild Swim*, followed and the OSS grew.

"I still see it as going on adventure, and carving my way through a landscape."

Lakes and lidos, streams and seas

Today, Kate sees the OSS as "a lovely community of people who come together simply to appreciate the beauty of a place." Along with plenty of positive press, it's transforming perceptions of wild swimming from being "dirty, dangerous, cold and illegal" to invigorating and inspiring.

But people need to know where to swim – and how to do it safely. So Kate and the OSS have created the Wild Swim Map at www.wildswim.com. Its mission is to plot the nation's best-loved outdoor swim locations.

Top of the swimming spots

Picking her own favourite wild swim location is impossible for Kate. At the moment, however, the Dart is near the top of her list. "I'm a big fan of big rivers like the Dart and the Thames, which have a nice pull and pretty banks lined with trees."

For family adventures, Kate's a fan of Blackmoss Pot in the Cumbrian hills. This sheltered clear-water river pool, surrounded by steep rock, even has a waterfall. Or, to step back in time, Farleigh and District Swimming

Club is a must-visit. "There used to be river clubs across the country, but this is the only survivor," she says.

Swimming in the rain

In Kate's world, 'bad weather' can be a good thing. "You're already wet, so swimming feels a perfectly sensible thing to do in the rain," she points out. "You see a delicate layer of mist and raindrops bouncing off the water – something you'll only appreciate when wild swimming."

In fact, the weather rarely puts her off. "I swim in the moonlight, early morning and I love mist. Mist can make a familiar place feel quite mystical," she says. The same goes for midwinter. A short, sharp dunk each Christmas leaves Kate "completed elated."

At the same time, Kate's mindful of the weather's power to surprise. "I remember being halfway between two Scilly Isles when the sea mist came in. Suddenly we couldn't see where to go." Luckily, a kayaker had joined Kate and her friend – along with his trusty compass.

Kate believes outdoor swimmers aren't only hyper-aware of the weather, but in tune with it. "You become somebody who's interested in the ground temperature, wind speeds and phases of the moon – and very sensitive to shifts in seasons," she explains. "I feel part of that turn from summer to autumn in a way I didn't before – and that's lovely." 🌊

30-Second Meteorology

A brilliant, beautiful new book of brief meteorological explanations.

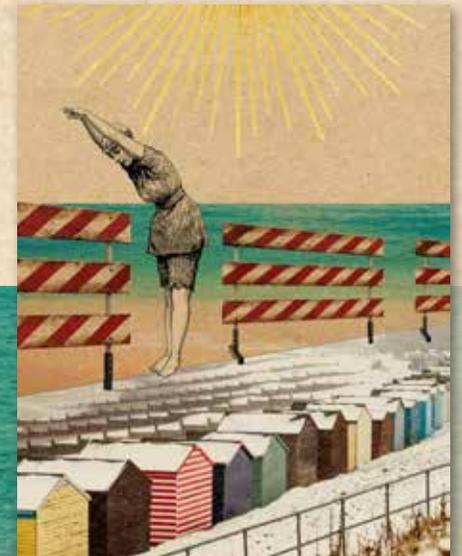
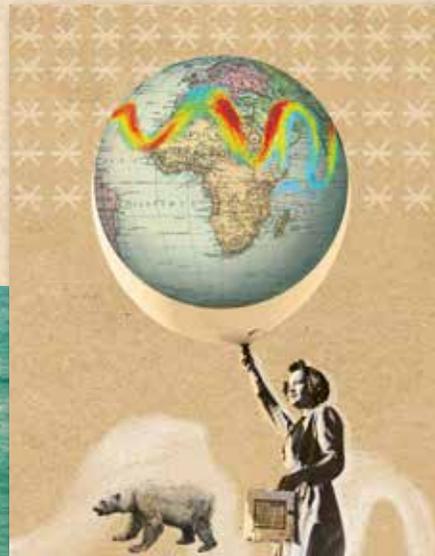
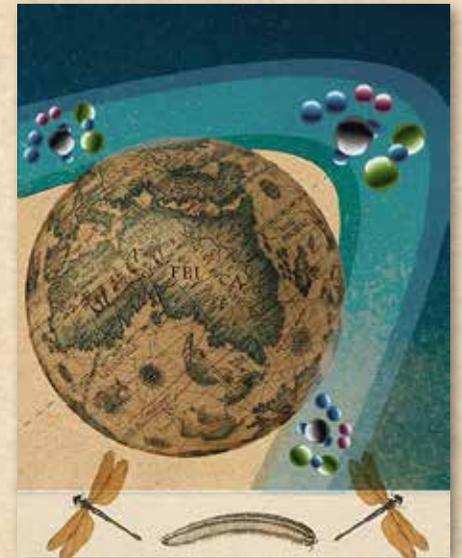
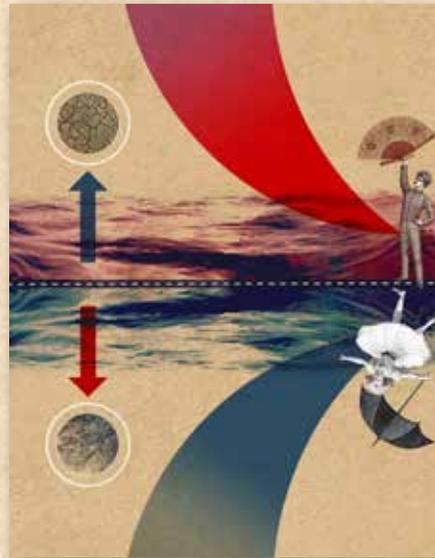
30-Second Meteorology explains the 50 most significant worldwide weather phenomena including interesting facts, and biographies of pioneering scientists who made milestone meteorological discoveries.

From everyday drizzle to the most extreme of hurricanes, the book's lead editor is Professor Adam Scaife, an expert in climate prediction and Head of Long-range Forecasting at the Met Office. 30-Second Meteorology also includes a foreword by Met Office Chief Scientist, Professor Dame Julia Slingo.

With more than 20 years of experience, Adam investigates mechanisms and predictability of weather and climate. Having published over 100 peer reviewed papers, his recent studies include exciting new evidence for long-range predictability of winter weather.

Adam says: "Given the growing importance of weather and climate to modern society, this book provides a grounding in the fascinating science that explains worldwide weather, ranging from daily weather to the future of the planet under climate change."

i Published by Ivy Press, 30-Second Meteorology is available online or from good bookshops.

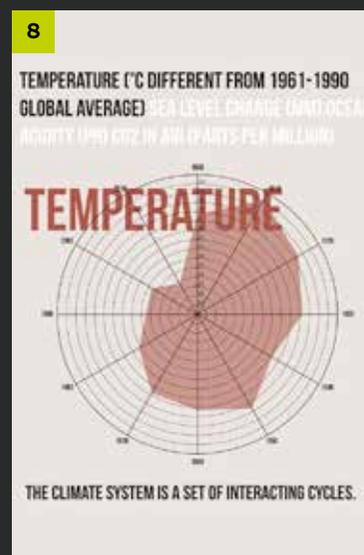
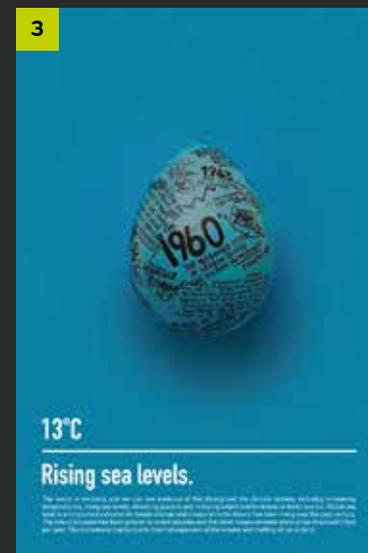
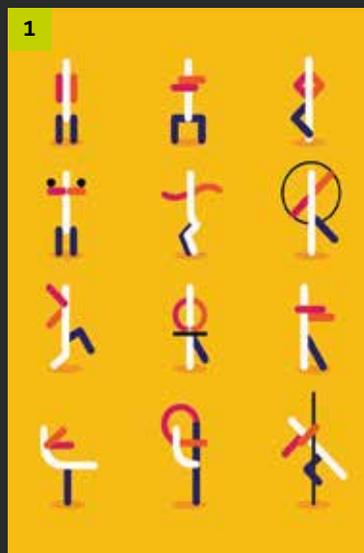


A bright outlook

Following the success of Design Storm last year, we've continued building links with universities and colleges. We've helped to mentor students, sharing our knowledge and discussing projects, as well as helping to inspire Met Office staff by showcasing the creativity of students.

Recently we helped inform a data visualisation module for the Graphic Communication with Typography degree course at Plymouth University, including setting challenges around the presentation and communication of weather and climate data. Some of the responses are shown here.

We were excited to run Design Storm 2016 as part of the Design and Art Direction (D&AD) New Blood Festival, bringing together university students and creatives both from agencies and across Government to inspire, connect and create. 🌩️



1. Jack Breedon
2. Kiera Needham
3. Ellen Roberts
4. Kaisa Koisti
5. Danielle Bennett
6. Emma Burton
7. Eve Whitehead
8. Katie Hanson
9. Ernest Townsend