Met Office

Barometer

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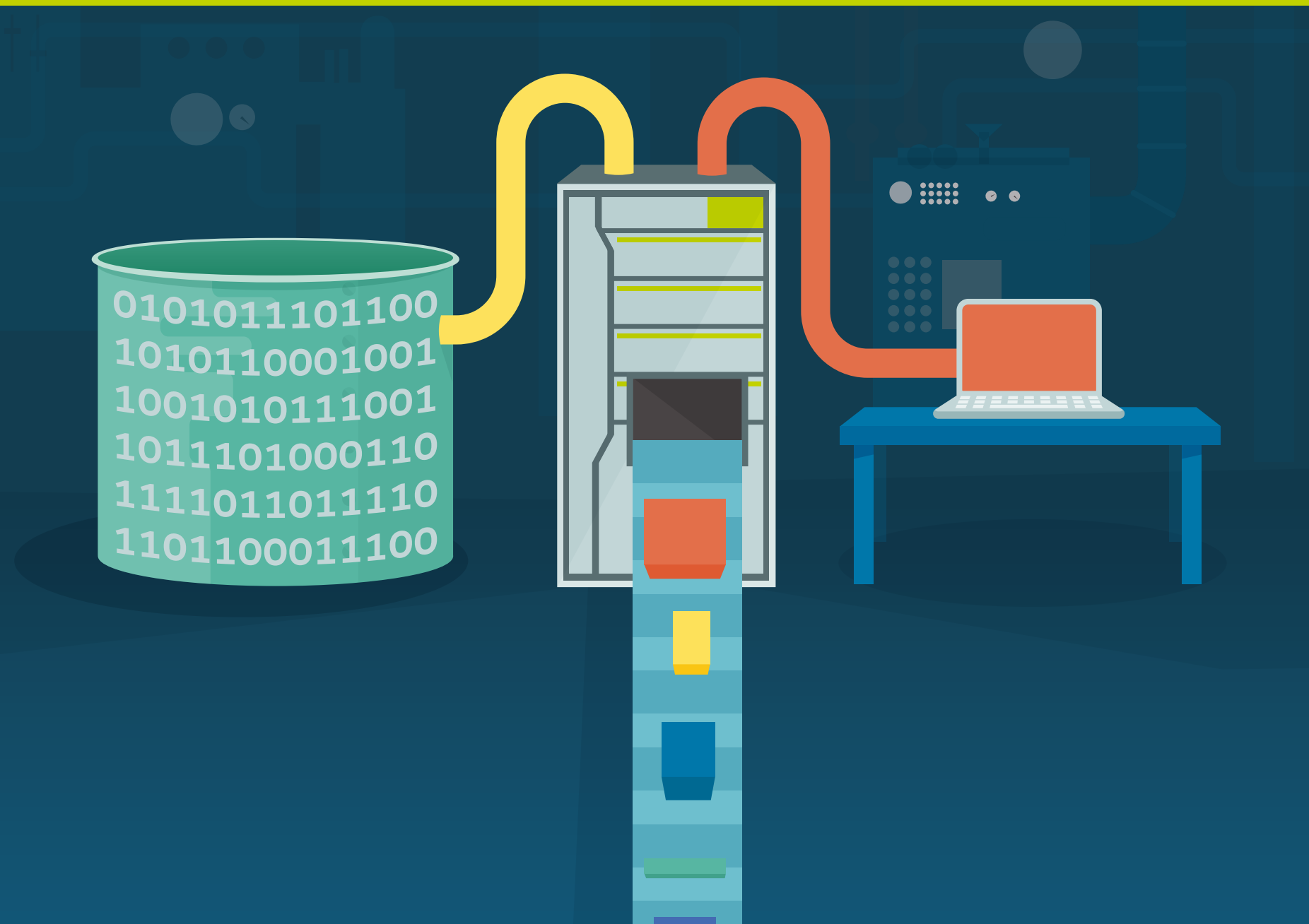

Professor Stephen Belcher, Met Office Chief Scientist, describes his passion for his new role and work addressing the challenges of big data and climate change.

Leading science to services

Being Chief Scientist at the Met Office is a wonderful job because of the broad range of science done in the Met Office, as well as the world-leading scientists who produce it. We are unique as we not only produce fundamental science, but also use science to deliver highly successful weather and climate services to our customers. So, I was delighted to take on the role following the retirement of Dame Professor Julia Slingo at the end of last year.

As Chief Scientist, my responsibility is to nurture our scientific and technical excellence. For the Met Office to maintain its world-leading reputation, it is essential that our scientists are able to meet their full potential. I am proud that the Met Office is working towards achieving this, for instance, through supporting opportunities for women in science (page 9).

Another important part of my role is to champion Met Office science; my ambition is for the Met Office to be recognised as a leader in weather and climate science. This means that we need to work with experts in other fields, and deliver through partnership, building on the legacy of my predecessor.

Before the Met Office I worked mainly in academia at the universities of Cambridge, Reading, and Stanford in California. My research covered several areas spanning foundation, weather and climate sciences, and focused on turbulence in the atmosphere and oceans. While at Reading I ran the school of Mathematical and Physical Sciences, which includes the world-famous Department of Meteorology. After that I became the first Joint Met Office Chair at Reading under the Met Office Academic Partnership.

Five years ago I joined the Met Office as Director of the Met Office Hadley Centre. I am particularly proud of the work that we did on climate dynamics which informed the improvements to the seasonal forecast system and the new UK Climate Projections (UKCP18) which come out next year. I also refocused the climate science programme onto both science and services, and substantially increased our international work, for example through the Climate Science for Service Partnership China (CSSP China).

Capitalising on the new supercomputer

Our new supercomputer was delivered ahead of schedule which has meant that many of the latest science upgrades are now going operational and are helping to improve our forecasts (page 19).

A new supercomputer also means huge volumes of data. Now, data is one thing, but information is another, so we are looking at intelligent ways of creating useful information and extracting value from that data (page 4). That is where the science to service aspect comes in. Improvements to our weather and climate models will enable development of better services, particularly relevant in our support of the Government's emerging Industrial Strategy (page 7) and in supporting our humanitarian work (page 15).

Communicating the value of our science

It is important that we communicate the value of the science that we produce, and the new Met Office science twitter feed is a great way for people to follow our research across foundation, weather, climate and applied science. More generally, the Met Office progressively shares a mixture of content in innovative ways using different channels (page 13).

Another good example of communicating science is our interactive global animations. These involved scientists, programmers, designers and the Met Office Informatics Lab working together to create a new way of visualising one of our global climate datasets (page 11).

Translating meteorology into risks

Increasingly, we are assessing and predicting environmental risks, translating meteorology into actual impacts, like flooding, drought or damaging wind storms. This concept draws together a thread that runs right through foundation, weather, climate and applied science. To assess present-day risk we need to understand the extent to which it is due to natural fluctuations or climate change. This enables us to predict changing risk over timescales from a few days ahead, to seasonal, decadal or even longer.

Who could have imagined the expansion in the range of services we now provide? A great example of this is space weather (see page 17). Ten years ago it was hard to anticipate that we would ever produce these forecasts operationally, yet here we are having done so for over a year. I can't wait to help create the next evolution in our services, all underpinned by a strong fundamental science programme!

July 2017

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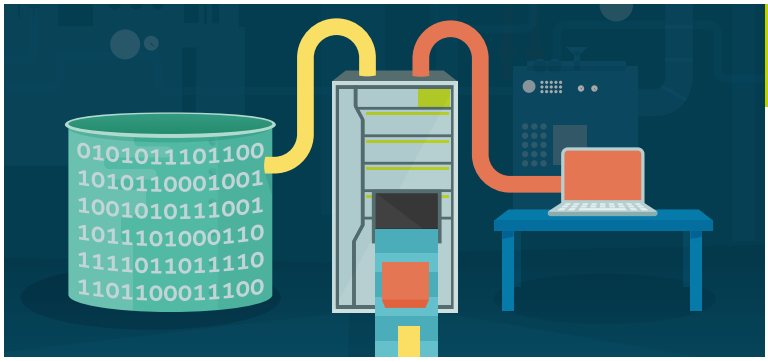


In brief

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

The Weather Maker

Cornwall's Eden Project is highlighting the links between climate and rainforests in a major new exhibition called The Weather Maker.

Complexities of the rainforest and climate cycle are brought to life in the Eden Project's Rainforest Biome as the Weather Maker exhibition explores how rainforests act as air movers, water sweaters, flood defenders, rain makers, sun reflectors and carbon catchers.

The Eden Project worked with climate scientists, including Professor Richard Betts, from the Met Office Hadley Centre and the University of Exeter, to gain access to the latest research.

Professor Richard Betts said:

"Rainforests are well named because they have a two-way relationship with the weather. These extensive blankets of forest actually help create rain, as warm moist air rises above the forests. Winds carry moisture from over the ocean, which falls out as rain and is then recycled back to the atmosphere through evaporation. As water evaporates from leaves this has a cooling effect and this effect is amplified as the moisture rises to form clouds above the forest which help to reflect sunlight. Beyond the forests themselves, rainforests have an influence on the global climate by stimulating the circulation of air around the globe and helping to absorb atmospheric carbon as the vegetation grows."

New map on app

A new interactive rainfall map is among the latest improvements to the Met Office Weather app.

Since we launched our app last year we have listened carefully to what people want, regularly conducting research and reviewing analytics to understand how the app is being used.

The new interactive forecast map shows rainfall radar for the next 24 hours, and an observations map for the last six hours. Forecast intervals are hourly for the next six hours and then every three hours after that.

Observations for the past six hours are expressed in five minute intervals. You can swipe through the thumbwheel, pan and zoom at any point on the map, and view rainfall amounts for your chosen location.

Dee Cotgrove, Executive Head of Media and Communications says, "Although our app is already classed as one of the best apps of 2016 in the Google Play list, we intend to enhance it even further. Other improvements include optional notifications on days when pollen in the region is expected to be moderate, high or very high.

So we can continue to develop new features, please let us know what you think of the app by contacting us at enquiries@metoffice.gov.uk."

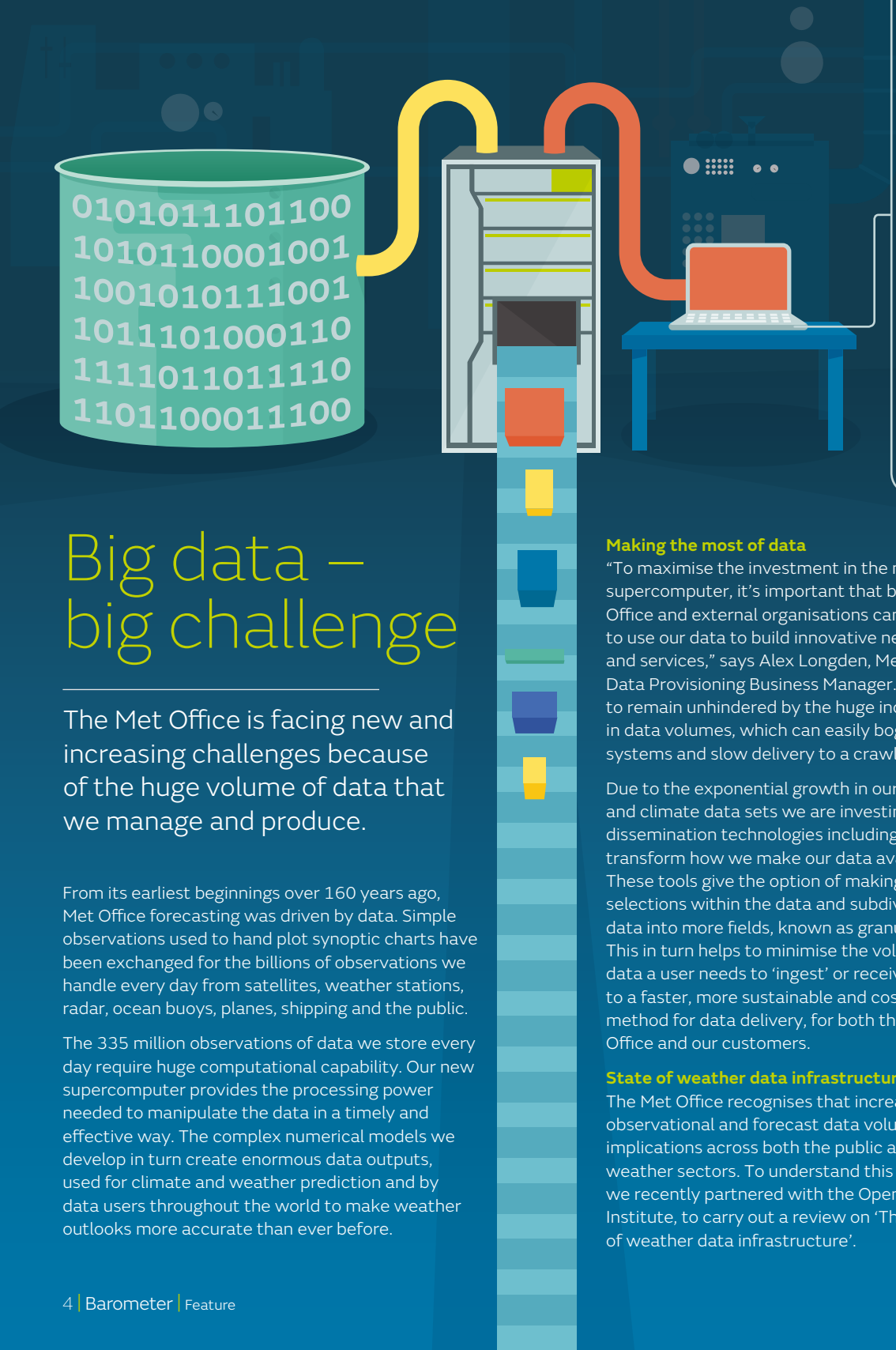
- **For iPhone the app is available from the App store.**
- **For Android the app is available from the Google Play store.**

Top Customer Service Awards

Following on from our success last year at the Top 50 Companies for Customer Service Awards, the IT and Customer Service team has again been recognised for high level customer service.

Winning best provider of service by phone and email demonstrates an outstanding level of customer service provided by the Met Office. This comes at a time when we have received our largest number of enquiries recorded, with over 157,000 customer contacts managed so far this year.

The awards were presented following an extensive mystery shopper programme where we were assessed on the quality, timeliness and personalisation of the service offered by phone, email and social media.



Big Data Drive

- To make Met Office data more useful, we are undertaking a **Big Data Drive** to transform how our data is accessed, disseminated and stored.
- **Several major changes** are being researched, tested and implemented to ensure that we take the steps needed to realise the opportunities that our data provides for society.
- In 2015, every day we produced around **30TB** of public weather data and we expect to produce **200 to 250TB** with the installation of the final phase of the supercomputer.

Big data – big challenge

The Met Office is facing new and increasing challenges because of the huge volume of data that we manage and produce.

From its earliest beginnings over 160 years ago, Met Office forecasting was driven by data. Simple observations used to hand plot synoptic charts have been exchanged for the billions of observations we handle every day from satellites, weather stations, radar, ocean buoys, planes, shipping and the public.

The 335 million observations of data we store every day require huge computational capability. Our new supercomputer provides the processing power needed to manipulate the data in a timely and effective way. The complex numerical models we develop in turn create enormous data outputs, used for climate and weather prediction and by data users throughout the world to make weather outlooks more accurate than ever before.

Making the most of data

"To maximise the investment in the new supercomputer, it's important that both the Met Office and external organisations can continue to use our data to build innovative new products and services," says Alex Longden, Met Office Data Provisioning Business Manager. This needs to remain unhindered by the huge increase in data volumes, which can easily bog down systems and slow delivery to a crawl.

Due to the exponential growth in our weather and climate data sets we are investing in new dissemination technologies including APIs to transform how we make our data available. These tools give the option of making more selections within the data and subdividing data into more fields, known as granularity. This in turn helps to minimise the volume of data a user needs to 'ingest' or receive, leading to a faster, more sustainable and cost effective method for data delivery, for both the Met Office and our customers.

State of weather data infrastructure

The Met Office recognises that increases in observational and forecast data volumes have implications across both the public and private weather sectors. To understand this better, we recently partnered with the Open Data Institute, to carry out a review on 'The state of weather data infrastructure'.

"The review is encouraging discussion on how the global weather data infrastructure can be sustained, and deliver value to society," explains Alex. "As well as looking at the need for continuing investment in technical infrastructure and supercomputing resources, the review looks at the role of global, regional and national meteorological services in collecting observations and generating forecasts."

The review also highlights the technology creating new data and in turn generating new, big data challenges. Supercomputing is enabling new and improved weather models which are harnessing a variety of sources of weather observations from ground, air, sea and space based monitoring and sensors. These trends exist within a wider landscape of innovation and changing consumer expectations where instant and real-time access to data is increasingly essential.

All of this presents huge challenges but, as Alex says, "There are massive opportunities for organisations to unlock even more value from weather data. Creativity and innovation will ensure that new products and services are developed to meet the needs of specific sectors in our society."

Seasons to remember?

Met Office meteorologist and weather presenter **Aidan McGivern** looks back at the seemingly unremarkable winter, asking whether it will be one that sticks in the memory.

Ask any meteorologist what inspired their interest in the weather and they often recall a childhood memory of a hot summer or snowy winter. Often, it is claimed, these memories are formed at a particularly early age; for example, "I was born during the summer of '76 so it was inevitable I'd become a weather forecaster."

When my daughter was born in December 2016, I wondered what kind of winter would be imprinted on her mind. When Molly McGivern follows in her father's footsteps and becomes a meteorologist, will she put it down to being born during the infamous snowy / windy / cold / sunny winter of 2016-17?

I just hoped it wouldn't be another wet winter. Winter 2015-16 was the second wettest on record; 2013-14 was the wettest in a series extending back to 1910. Those seasons were dominated by a powerful jet stream over the Atlantic, spawning deep depressions and hurling them towards the UK throughout winter.

There were signs suggesting this season might be different. Atlantic storms were notable for their absence during Autumn 2016. September was dry and unusually warm, October was dominated by high pressure and November was often cloud-free with sunny days and frosty nights. In fact, some places recorded their coldest temperature for several years on 30 November.

"UK winters are strongly influenced by large-scale weather patterns over the north Atlantic that affect the track of winter storms."

The large anticyclones that dominated the UK's weather during autumn remained throughout much of winter. Areas of high pressure continued to block Atlantic wind and rain, often re-directing the main storm track north of Scotland. Overall, the UK had just 76% of its average rainfall. Northern Ireland saw the fifth driest winter since 1910. Finally, following a run of wet winters, this one was mostly, although not entirely, dry.

It's only the second winter in which the Met Office and Met Éireann, the Irish national meteorological service, have named particularly disruptive depressions to highlight impacts of severe weather – the storm-naming convention has evolved slightly between the two years, but named storms can already provide a useful indicative comparison of the contrasting character of the two years. By the early February 2016, we'd been visited by Storm Imogen. Storms are named in alphabetical order, and this was the ninth of the season. By late February 2017, Storm Ewan was only the fifth named storm.

These storms were exceptions in a winter otherwise dominated by long periods of settled weather, particularly in South East England. Kent saw its joint driest December on record. Many dry winters go hand-in-hand with colder temperatures and more frequent occurrences of frost, ice and snow. When anticyclones stop moist and mild westerlies, freezing northerlies or easterlies can dominate instead.

This year, however, cold snaps were particularly snappy creating a mild winter overall. Whilst January temperatures were below average in South East England, for the rest of the country, and the rest of the time, it was mild. Temperatures throughout the UK were 1.3 °C warmer than average this winter and for Scotland it was the fourth mildest winter on record and was ninth mildest for the UK overall.

High pressure and its position this winter was crucial. Anticyclones were generally over the near continent, bringing humid winds from the southwest and occasional incidents of dense fog, mist and low cloud.

The same anticyclone that brought benign weather to northwest Europe dragged freezing easterly winds into the Mediterranean on its southern flank. The unusual sight of snow on Spanish beaches and Greek Islands was bad news for holidaymakers seeking winter sunshine. It was also unfortunate for vegetable lovers, as unseasonable weather contributed to a shortage of courgettes and lettuces in supermarkets.

Back in the UK, this year's relatively benign season was a relief following recent more severe winters and unlikely to be remembered for storms or snow. Although this dry winter was an interesting contrast with the last few wet winters, overall it was unremarkable, and unlikely to form a lasting impression on budding meteorologists.

Or maybe it will. According to Met Office Climate Scientist Mark McCarthy, in the UK a winter that is both dry and mild is rare:

"UK winters are strongly influenced by large-scale weather patterns over the north Atlantic that affect the track of winter storms. This generally results in our winters being either mild and stormy or cold and dry. Notably mild and dry winters are less common, with 2017 joining winters of 1921, 1932, 1976 and 1992 in this regard. To understand our variable UK climate in a global context, and how our weather might be affected by climate change, it is important to understand processes resulting in the exceptions as well as the rules."

Compared to mild and stormy or cold and snowy winters, the fact that this year was relatively unremarkable is actually of particular interest to Climate Scientists like Mark. Apparently, in this changeable climate of ours, one day of dry and mild weather may be normal but a winter full of dry and mild days is less common.

So perhaps, in years to come, my daughter will boast of being inspired to be a meteorologist because she was born during the great anticyclonic winter of 2016-17, one of only five notably dry and mild winters on record at the time. Or perhaps she will become a neuroscientist like her mother.

From the very young to the very old

Winter may have been interesting enough for meteorologically-minded newborns but the warm spring that followed was exceptional for the oldest temperature records on the planet.

Overall, it was a dry spring with above average sunshine. It was also another warmer than average season. In fact, Northern Ireland and Wales both had their warmest springs on record and for the UK it was one of the top five warmest springs in a temperature series that extends back to 1910.

The standout spring statistic, however, is found within the Central England Temperature (CET) series. A record of temperatures covering a roughly triangular section of England from Lancashire in the north to London in the east and Bristol in the west, the CET series has monitored monthly temperatures since 1659. It's the longest available temperature series in the world and, in more than 350 years of observations, Spring 2017 was the warmest on record.

Bringing a brighter outlook for Britain

As long ago as 1854, the Board of Trade created the foundations for an organisation – which was later to become the Met Office – spanning the vital links between weather and trade. 163 years on, the bonds between weather forecasting, climate, and economic development are just as relevant today as we work with the Government on the development of its Industrial Strategy.

This ambitious strategy is described by the Business Secretary Greg Clark as a critical part of the plan for Britain after it leaves the EU. Currently a White Paper, the Industrial Strategy aims to bring together a range of policies and initiatives across Government departments to improve living standards, increase productivity and drive growth.

The Industrial Strategy is being developed by the Department for Business, Energy and Industrial Strategy (BEIS), our lead department within Government, and currently it spans ten pillars including investing in science, developing skills, upgrading infrastructure, delivering affordable energy and clean growth, and encouraging trade and inward investment.

Rob Varley, Met Office's Chief Executive says: "When you scan the ten pillars, it's clear that the Met Office will be able to play an important role in contributing to this strategy in many areas to give the UK a brighter long-term outlook. The Met Office itself is transforming to meet the needs of future challenges, and we will be incorporating the priorities of the strategy into this to build on our strengths, and to work with others to deliver even greater value for the UK."

The strategy themes highlight several areas of vital importance for the Met Office including science, research, innovation, skills and infrastructure. Rob adds: "The strategy recognises the crucial role of science for productivity, growth and resilience: features that have been part of our history and will be a vital part of our future."

Met Office science and related services support all parts of the UK and a wide range of sectors across the economy – informing decisions, operations and policy development. The Met Office can help industry become more resilient, competitive, productive and sustainable.

Rob continues: “From scientific research and our first-hand operational experience, we know it is essential that infrastructure is planned, built and operated with resilience in mind. Weather and climate science are core to these considerations. For example new energy-generation infrastructure needs to be sited in the most favourable locations and be designed to withstand future extremes; major transport networks need to be operated safely in times of extreme weather; and it’s vital that digital and telecommunications leaders are updated about the potential risks from space weather.”

Indeed, with so many critical sectors relying on our services, the Met Office’s own assets such as the observation network, the high-performance computer, and our modelling and science capabilities represent nationally-important infrastructure in their own right.

The strategy also emphasises the importance of recognising and building on clusters of expertise throughout the UK. We work across all the regions including Wales, Northern Ireland and Scotland. For instance, the Met Office Marine Centre of Excellence in Aberdeen provides a range of marine weather forecasts, warnings and observations which support the marine industry from offshore oil and gas, renewable energy, to shipping and ports.

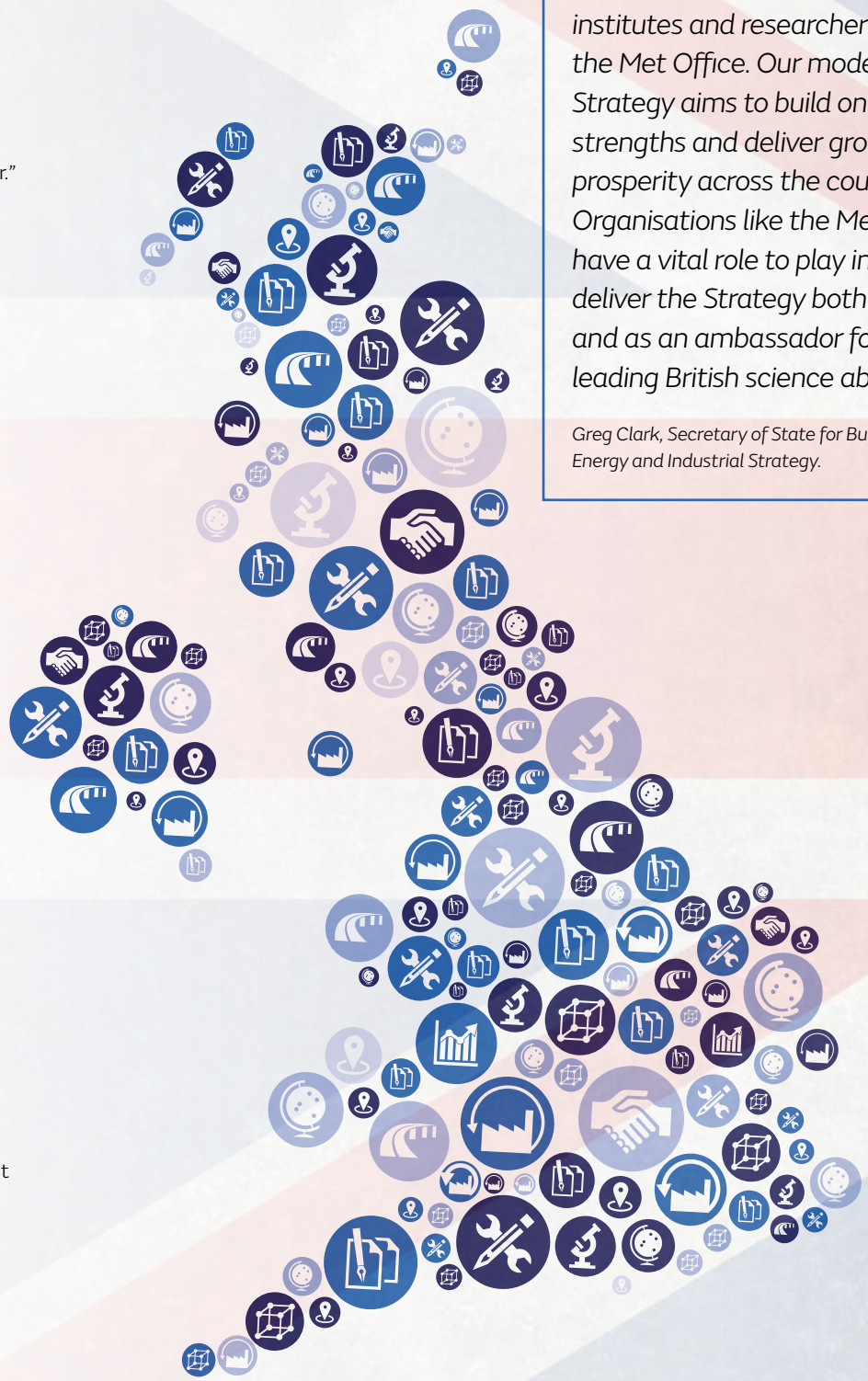
Similarly, the South West, where the Met Office has its head office, is home to an internationally-important cluster of excellence for environmental science, including the world’s greatest concentration of UN Intergovernmental Panel on Climate Change (IPCC) contributing authors.

Professor Stephen Belcher, the Met Office’s Chief Scientist, highlights the importance of partnerships in building expertise: “Scientific research is best when it’s done in collaboration and the Met Office values working with partners, including our partnerships around the UK such as the Met Office Academic Partnership with the universities of Exeter, Leeds and Reading.” The Met Office’s new supercomputer – the largest dedicated to weather and climate in the world – helps build on this strength and extend this excellence into the future.”

Rob Varley adds: “This is an ambitious Industrial Strategy with an approach that looks across Government departments, across the economy and across every part of the UK. The Met Office plays a key part in supporting businesses to make good decisions and so create a stronger outlook.”

“The UK is home to some of the world’s best science and technology institutes and researchers – including the Met Office. Our modern Industrial Strategy aims to build on these strengths and deliver growth and prosperity across the country. Organisations like the Met Office will have a vital role to play in helping deliver the Strategy both at home and as an ambassador for world leading British science abroad.”

Greg Clark, Secretary of State for Business, Energy and Industrial Strategy.



Women in science

At the heart of the Met Office are people. By valuing the individual differences that people bring, the Met Office is developing a diverse workforce that is representative of society so that our work is relevant to the community and customers we serve. Part of this diversity includes gender balance and, although women are often underrepresented in science, at the Met Office women are making vital contributions to the global understanding of weather and climate. Here are just a few examples.

Laura Paterson

Chief Meteorologist

When Laura recently became one of our Chief Meteorologists it was a great milestone as it was the first time a woman has taken on this role. The position of Chief Meteorologist is pivotal to the success of the Met Office and is seen by many in the global meteorological community as the pinnacle of the career as a meteorologist. Apart from the key role they play in the protection, prosperity and well-being of the UK and our citizens abroad, by leading a team of highly skilled service delivery teams they act as a conduit for pulling through science capability into excellent customer service. The Chiefs also have an important role to play in the Senior Leadership team, as well as ensuring the best of the Met Office is channelled into customer experience.

The team of Chief Meteorologists holds ultimate responsibility for the National Severe Weather Warning Service and leads the Met Office management of high impact weather. Before taking up her current role, Laura was Deputy Chief Meteorologist. Before that she worked for three years supporting the Met Office's Chief Executive and wider Executive team as Private Secretary to the Chief Executive. Before that she worked as a meteorologist in the Met Office's Operations Centre, and onsite, at a several RAF bases around the UK and the world. Laura also completed a five month detachment as a meteorologist to the British Antarctic Survey's Rothera Research Base in 2011. She is a Chartered Meteorologist and sits on the Working Group for the Cooperation of European Forecasters.

Felicity Liggins

STEM Manager and Applied Scientist

Felicity graduated with a Masters in Geology from the University of Southampton. After this, she joined the Environment Agency, working in hydrometry and telemetry and flood risk management. Felicity joined the Met Office's Climate Consultancy team in 2008, helping organisations identify the challenges and opportunities of extreme weather and climate change. Today she works part-time in Climate Services helping organisations around

the world make decisions relating to climate variability and climate change impacts.

Felicity is currently working on European research projects and a DfID funded project in Ethiopia. Felicity also leads the Met Office's outreach programme to young people. On joining the Met Office, Felicity became a STEM Ambassador to promote science, technology, engineering and maths (STEM) to young people. To help this, she undertook a Masters in Science Communication at the University of the West of England. Having enhanced the Met Office's outreach, Felicity now leads an award-winning programme of STEM activities, coordinating a network of over 270 Ambassadors who deliver varied events across the UK and beyond reaching thousands of young people each year. This includes visiting schools, giving talks, running workshops, providing careers advice, attending community events, and holding Met Office Science Camps at our HQ in Exeter. Felicity's two roles are different but essentially both involve finding creative ways to engage people with Met Office science and make it useful.

Annette Sercombe

Business Group Security Architect

Annette has been at the Met Office for 10 years. She works as a Security Architect with responsibility for transitioning the Met Office commercial estate using an innovative delivery mechanism and a new cloud-based architecture. She is solely responsible for managing the security requirements in the change programme, providing advice and guidance to the Senior Leadership team and ensuring that they are informed about the risk of delivery from a security perspective.

In her previous role, Annette designed and implemented new and innovative approaches to cyber security and represented the Met Office at Big Data Analytics (White Hall Media 2015) on the use of analysing large data sets to deliver actionable security intelligence for the business. She is on the external advisory panel for Computing at Plymouth University and was a keynote speaker at the Women in STEM Symposium last year.

Joelle Buxmann

Senior Scientist, Remote Sensing Systems R&D - Lightning, Clouds and Aerosols

Joelle's main interest is remote sensing of aerosols, water vapour and trace gases including nitrogen dioxide and ozone. During her PhD in environmental physics, Joelle designed and built novel instruments to detect trace gases in the field as well as during laboratory studies. Soon after starting to work for the Met Office in Observations R&D in 2013 she went on an expedition to Antarctica on the research vessel Polarstern in collaboration with the University of Heidelberg. Her work focused on detecting halogens (e.g. Bromine and Iodine) from sea salt aerosols, which can cause ozone depletion and transfer toxic mercury compounds into the food chain.

She currently leads the implementation of sun photometers (an electronic device that measures direct and indirect sunlight) and product development within a novel network for aerosol detection across the UK. The network of collocated sun photometers and lidars monitors volcanic ash in case of an eruption and supports the recommendations given by the Met Office Volcanic Ash Advisory Centre (VAAC) to the Civil Aviation Authority. Joelle works in close collaboration with the national and international scientific communities, setting-up the structures to submit sun photometer data to the AErosolROboticNETwork, a global network providing information including total aerosol amounts and size distribution. She has also worked with the Met Office Observation-based Research and Satellite team to implement a sun photometer temporarily on the Cape Verde Islands.

Dr Helene Hewitt

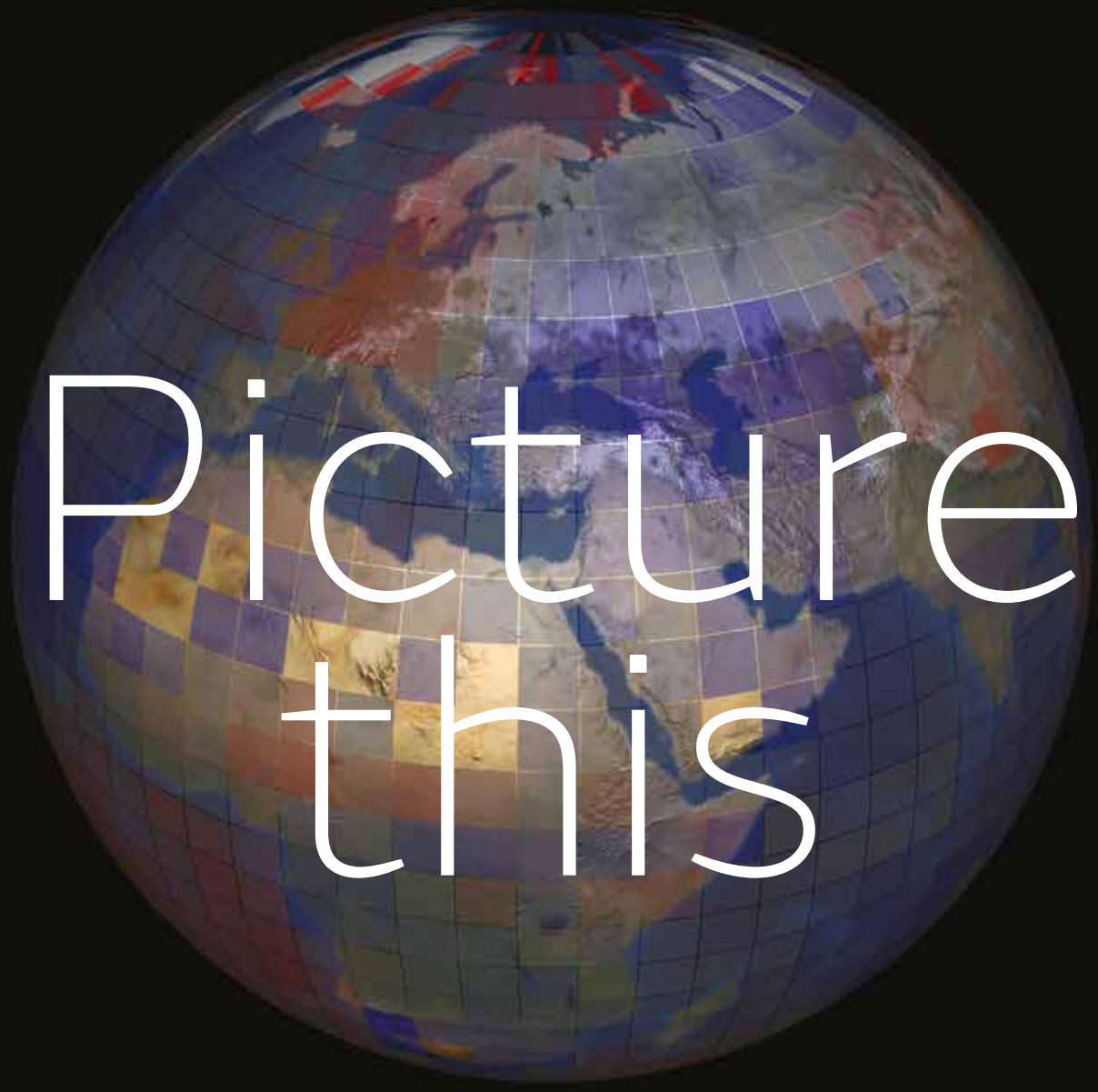
Science Fellow and Manager of Ocean Modelling group

As a Met Office Science Fellow and the manager of the Ocean Modelling group, Helene leads the development of configurations of both the global ocean and the UK shelf seas in support of weather and climate prediction. In particular, she plays a key role in leading the development of high resolution ocean models that enable the representation of important mesoscale processes in the ocean and represents the Met Office on international committees on ocean modelling. Helene began her scientific career studying maths at the University of Cambridge before completing a PhD on mixing in the Western Equatorial Pacific at the National Oceanography Centre in Southampton. She joined the Met Office in 1996 and has worked for the last twenty years in the area of ocean and climate modelling. Helene has two children and juggles family and career by working part-time.

Dr Helen Wells

Group Leader for Science and Meteorology

In her role as Group Leader for Science and Meteorology, Helen leads a team of around 70 operational weather forecasters and scientists who are involved in the development and delivery of Met Office services to industry. She works closely with her team to transform the way we integrate our science and operational meteorology into our industry services ensuring that our services use the world-leading capability and skills of the Met Office in weather and climate. Helen began her career at the Met Office in 2002 as a graduate scientist working on modelling flow over mountains. The Met Office sponsored her to work on a PhD with the University of Leeds which she completed in 2007. In 2010 she began working part-time and subsequently moved to the Aviation Applications Science team as Science Manager developing new science in support of air traffic control, airlines and airports. After maternity leave, she returned to work as Head of Applied Weather Science, leading a team of 45 scientists to develop services for various sectors including defence, aviation and energy. She moved into her current role in 2016.



Picture this

It's a challenge shared by many scientists: how do you communicate complex research data in an accessible and engaging way, without compromising integrity or 'dumbing down'? The Met Office recently came up with a powerful solution.

HadCRUT4 is one of the Met Office's world-leading climate datasets, combining land surface temperatures from the Climatic Research Unit at the University of East Anglia with sea surface temperatures from the Met Office Hadley Centre. Together, this gives global surface temperatures dating all the way back to 1850. Updated every month, HadCRUT4 is a rich resource. Now, it's available in a whole new way.

In a cross-office collaboration between the Met Office Informatics Lab and the Met Office Hadley Centre, scientists, programmers and designers have visualised this dataset in an interactive global animation that's the first of its kind.

A visual treat

In the animation, a world globe is overlayed with a grid displaying whether the temperature within that grid area was higher or lower than a set regional average. If it's warmer in a particular year, the grid box turns a shade of red. If it's cooler, the box turns a shade of blue. The viewer can spin the globe around and move back and forth along the timeline – or they can simply watch as the data plays out from 1850 to the present day. The animation also annotates natural events that affected the global temperature: for example, the volcanic eruption of Mount Krakatoa in 1883 caused several years of cooling, while the periodic emergence of El Niño in the Pacific triggers a flash of red grid boxes as temperatures spike.

Perhaps most significant is a bar demonstrating the change in carbon dioxide (CO_2) in the atmosphere. The rising bar is a reminder that – short-term variations aside – the long-term rise in global temperature is largely driven by the steady increase in CO_2.

An important message

The animation was launched in time for the United Nations Framework Convention for Climate Change (UNFCCC) COP 22 meeting in Marrakech last November, where it was well received by politicians and scientists alike. It adds to work going on all over the world to find new, innovative ways to convey the science of climate change.

As Catherine Cole, Climate Science Communicator for the Met Office's Knowledge Integration team explains, "In 2015, global temperatures were the warmest on record and one degree above the pre-industrial average for the first time, with 2016 also beating records. It felt important to have engaging visuals that demonstrate this."

Equally important is demonstrating the level of certainty behind the data and how this has changed over time. In 1850, many of the grid boxes are greyed out because there simply weren't any monitoring stations in those areas at the time. By the early 20th century, this changes significantly and continually improves. It is an important illustration of the depth, breadth and rigour of the Met Office's climate research.

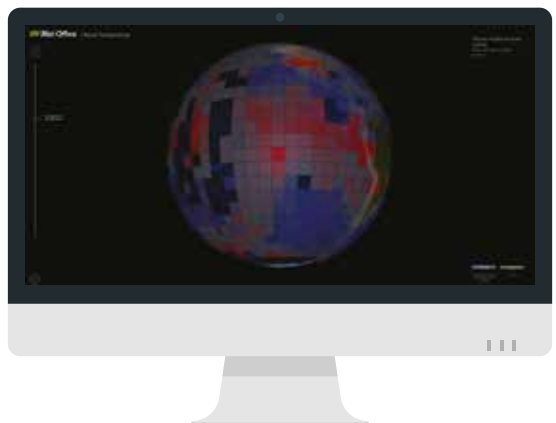
Making an impact

The animation's launch was not limited to the UNFCCC meeting. With the aim of triggering a wider conversation about climate change, it also features in the Met Office climate web pages, where it has received over 3,300 page views to date, and was posted on Twitter. Given that the @MetOffice_Sci Twitter account itself was only a month old at the time, the 36,0000 impressions and 800 engagements it received was a huge success.

"In 2015, global temperatures were the warmest on record and one degree above the preindustrial average for the first time, with 2016 also beating records. It felt important to have engaging visuals that demonstrate this."

So, what next? Just as the HadCRUT4 dataset is updated every month, so is the animation – but keeping it current is just the beginning. Future plans include adding more datasets to the same animation, enabling the viewer to click through several layers of information to gain more detail. For example, the viewer could choose to explore how sea ice extent and volume have changed globally over time, how temperature or rainfall extremes have changed, or how rising levels of moisture in the atmosphere are linked to warming. Multiple global indicators like these show clearly how our planet has responded to the warming caused by rising greenhouse gases in the atmosphere. Visualising all these changes together is important, as Catherine describes:

"A global temperature increase of one degree might not sound much, but it is just one example of many global indicators of change. On top of that, it's important to remember that warming isn't evenly distributed across the Earth's surface and some areas will experience much higher temperatures."



Telling the weather story

The nation's appetite for weather is ideally suited to our modern world where information flows constantly. With an increasing number of outlets for weather and climate information, these are exciting and challenging times for the Met Office Content team which ensures the daily weather story is told clearly, in different ways to different people.

Traditionally, newspapers and TV gave us our daily news and weather fix. Now the sources are numerous; from social media apps and websites on our smartphones, desktops and even watches, to rolling news channels and huge digital information boards that flash up weather warnings and city forecasts. These deliver information; sometimes headline grabbing, relevant, occasionally detailed, and often simply eye-catching.

Producing this takes some planning, as Head of Content, Sarah Fysh, points out: "We have a talented, experienced and dedicated team that includes designers, editors, presenters and technical studio crew, all who understand the necessity for clear yet engaging content."

The daily outlook

After the daily 9 am Chief Forecaster's briefing, the editorial meeting is held. Attended by a range of staff including meteorologists, graphic designers, communications and social media experts, it's a creative, lively affair.

The weather story is broken down into themes, key messages and longer term trends. Everyone chews over the most effective way to communicate and tailor the story for each channel. Similar attention is given to global weather, seasonal trends and upcoming weather-dependent events.

Sarah explains that this meeting helps crystallise the weather and climate stories of the day: "If there's anything significant affecting the UK that will be the focus, but global weather also plays a key role in our output. We not only create content for our own channels but for syndication partners such as the Mirror Online and the Telegraph."

The many layers to a story

Cyclone Enawo, which hit Madagascar in early March, highlights how a weather story structures and drives clear and informative content. Output included a detailed presenter-led video forecast, which was used on YouTube and sent to syndication partners. The Media Services Team (MST) produced a short animation zooming from the Indian Ocean into Madagascar, adding model winds, rain and cloud – all created on the Visual Cortex weather graphics systems and shared on Facebook. In addition an image-based weather explainer highlighting the difference between hurricanes, typhoons and cyclone was posted on the Met Office Twitter account.

To plan future content, the team has a grid of seasonal weather topics and upcoming public events. For example, explanatory videos including pollen, UV and summer heat will go live through spring.

Joining the conversation

Different formats fit different platforms, so the team uses different outlets; YouTube, Twitter, Facebook, Instagram, Snapchat. Twitter lends itself to simpler, eye-catching graphics or brief animations. These also work well on YouTube along with more detailed forecasts and presentations. A variety of videos and infographics are also produced for Met Office partners, who have branded content on their own channels.

"Sharing content across platforms means we reach many different audiences," explains Sarah. "We know that not everyone uses every platform, but conversations happen on all of them – and we're part of that. It's important to remain the authoritative voice in these conversations so people know they can trust our information."

Unsurprisingly, audience numbers spike when there's severe weather on the way. However people also respond well to explainers that give a more in-depth look at weather. As Sarah points out, "We don't just tell people what's happening, but why."

Going live

The Met Office hosted a first live broadcast on Facebook this January before a potentially disruptive snowfall in the UK. More than 2,000 people tuned in and during the following days the total views peaked at well over 400,000. This relatively new platform holds exciting possibilities for the Met Office, as it focuses on delivering the latest weather information, warnings and advice.

"We're at the heart of the story and Facebook Live enables us to leverage this in a way that really engages with our audience. It gives people behind-the-scenes access to our operations centre with real-time updates on how the story's developing," says Sarah.

Launching new services

The Met Office was one of the chosen launch partners for Twitter Moments – a feature bringing together threads of tweets to form a story. Since then, the Content team has provided Moments at least twice a week highlighting the weekly outlook and weekend forecast. James Glynn from the Twitter Moments team tweeted "a special shout out to @metoffice who make awesome, graphics-rich and informative Moments week in, week out."

The Met Office also launched a Snapchat channel on World Met Day on 23 March encouraging subscribers to snap and share pictures of clouds.

Lights, camera, action

On top of online content, the Met Office works with all UK broadcasters, through storm naming or providing weather data and information. For example, Welsh language channel S4C uses Met Office weather data and graphics to produce its own forecasts. Sky is now taking our flagship Public Weather Media Service (PWMS) which includes Met Office data, warnings, guidance and expertise to bring weather forecasting to their audiences across multiple platforms.

Other broadcasters, such as Channel 5 and British Forces Broadcasting Service (BFBS), air forecasts produced and presented entirely by the Met Office. A full production studio has been set up at the Met Office with a dedicated team of experienced presenters.

Before joining the Content team, Clare Nasir presented for ITN, GMTV, BBC and 5 News, Aidan McGivern for ITV and Alex Deakin for the BBC. These well-known presenters write, produce and front daily weather forecasts, explainers and Facebook Live. You can read more about Alex's work on page 21.

The MST team also plays an important part in broadcasting for the Met Office website and BFBS, as well as producing social media posts. A great success story for the Met Office's mission to develop in-house talent has been the presenting debuts of Chris Page and Ellie Creed on Channel 5.

The Content team has evolved significantly over the past two years. Output continues to increase, with a firm vision – its benchmark remains quality and creatively driven. Supported by a wealth of Met Office expertise the team is proving themselves to be heads above an increasingly crowded world of weather information.

Reaching new heights

The annual **Television Radio Industry Club** (TRIC) awards ceremony in March honoured achievement in television and radio.

This year, as the UK's national weather service, we sponsored the weather presenter category. Shortlisted were ITV's Laura Tobin and Sky's Nazaneen Ghaffar, and our huge congratulations go to BBC's Carol Kirkwood who won the award for best TV weather presenter.

Dee Cotgrove, Met Office Executive Head of Media and Communications, said, "We recognise what a challenging role being a presenter can be and the Met Office operates at the heart of the television industry supporting talented presenters who are vital to delivering our forecasts and warnings."

WFP
World Food Programme
wfp.org

Save the Children

Responding to crisis. Building resilience.

From earthquakes to a refugee crisis that rocked the world – disaster and devastation has dominated recent news. But behind the scenes, there have also been stories of hope. Organisations from around the world have come together to pool knowledge, translate complex science into clear guidance, and build resilience – for whatever tomorrow may bring.

In a natural disaster or humanitarian crisis, the speed at which the world reacts can make a life-or-death difference. The Met Office will often join relief efforts within a matter of hours – sharing expertise with government agencies, organisations such as the UN and on-the-ground teams. It's down to Met Office's Head of International Crisis Management and Resilience, Gavin Iley, to coordinate that response.

> *"Effective crisis response isn't something that any one organisation can do on its own. It needs global partnership."*

"If an earthquake happened right now, it would be my job to ensure that those agencies that approach the Met Office for support get relevant information they need," Gavin explains. "But in the longer term, the Met Office works hard with partners to build resilience – helping global agencies and governments prepare for, manage and reduce future disaster-based risks."

Turning complex science into lifesaving support

Whether it's communicating with a member of the public who is planning a bank holiday beach trip or a disaster response team preparing aid drops, relating complex weather data to real-life scenarios is what the Met Office does best.

During the refugee crisis in south-eastern Europe, it wasn't enough to supply scientific information. "We couldn't simply say 'it will snow'," says Gavin. "We strived to develop a three way conversation – meteorological service to meteorological service and then onto the response teams – to move our weather information from forecasts into the all important impact space. This involved understanding what problems any snowfall may cause, whether it was blocked roads, poor conditions underfoot or an impact on temporary structures. By doing so, we could focus our analysis to provide more relevant and therefore usable advice."

Off the coast of Libya, Save the Children needed to know exactly how the weather would impact on their search and rescue efforts off the coast, so the Aberdeen-based Met Office Marine team delivered tailored data – from daily route-specific reports and five-day forecasts, to wind speed and surface swell. In this instance, it was just as important to forecast bad weather as clear skies. "We learnt that refugees were less likely to set sail in poor weather, which gave rescue crews a window in which to return to Sicily to refuel and restock," Gavin explains.

From weather centres to warzones

Painting a clear picture with weather data was intrinsic to the World Food Programme's (WFP) work in Syria, too. By 2016, communities in Deir Azzor had become completely cut off from the outside world. Aid drops were desperately needed. However, that relied on detailed local meteorological information, which was virtually non-existent.

Using detailed atmospheric data, including wind pattern, speed and direction, the Met Office was able to provide the WFP with vital information to inform its aid drop programme, enabling the WFP to map the drops precisely. Sherif Georges, WFP Aviation Service Deputy Chief, believes this was "One of the main factors contributing to the success of this operation, delivering urgent supplies to over 20,000 families that have been besieged for over two years."

Paying it forward in Tanzania

The Met Office's internationally recognised expertise in disaster risk reduction and resilience has led it to work with Tanzania Meteorological Agency and the Department for International Development. Drawing on its disaster risk reduction experience, the Met Office was able to support the Tanzania Meteorological Agency to enhance its early warning services and better communicate with both government officials and the general public – so weather warnings are listened to and acted upon.

The ARISTOTLE Project

The Met Office is one of 16 organisations from 15 countries that form the groundbreaking ARISTOTLE Project. Established by the European Commission, it was operational in February 2017 and by early March had already been activated on six occasions.

The aims of ARISTOTLE are simple; translate complex scientific information into impact-based advice for decision makers in the European Commission in the event of a natural disaster. As well as providing timely information in the event of a disaster, ARISTOTLE also looks to provide advice on developing hazards such as flooding and severe weather, so it can mitigate associated risks. To do that, its global members pool a huge range of environmental data from various sources – translating it into practical, actionable information.

But Gavin is quick to stress that this wouldn't have been possible without collaboration. Not only did many different Met Office divisions have input – including aviation specialists, scientists and operational meteorologists – but the project involved everyone from Canadian airdrop specialists to global airlines.

"Effective crisis response isn't something that any one organisation can do on its own. It needs global partnership."

The power of partnership

Whether it's reacting to a sudden disaster or building resilience to deal with future crises, sharing intelligence and expertise is crucial. Gavin cites the 2016 refugee crisis as a prime example. Within days, the Met Office was working with the Serbian, Turkish, Greek and Croatian met services to provide reports to the UN's 'winter cell' operations hub in Geneva. The hub then used those reports to inform and better manage operations on the ground.

Coordinating the Met Office's involvement, Gavin has a challenging role to play – but it wasn't without rewards. "In the heat of the battle, we don't have time to stop and think. But when you reflect, often a year or so later, you find yourself realising 'you know what, we actually made a real difference'."

Beyond the sky

From awe-inspiring auroras to disrupted power grids, space weather can have a huge impact on Earth. With experienced forecasters on the lookout 24/7, the Met Office's Space Weather Centre makes sure the UK is ready to act, whatever happens.

Space weather refers to the impact on Earth of solar flares, solar radiation storms and coronal mass ejections (CMEs): huge outbursts of energy and charged particles. CMEs can pierce Earth's magnetic shield and cause geomagnetic storms and disturbances in the upper atmosphere. These, in turn, can stop radio and satellite communications from being reflected back down to Earth and can also induce currents in the ground that have the potential to damage the national grid.

As our society is increasingly reliant on technology in almost every aspect of life, knowing when these phenomena might affect us is vital to safeguarding key infrastructure. And that's where the Met Office Space Weather Centre, which marked its second anniversary in October 2016, comes into its own. Mark Gibbs, Head of Space Weather, explains how the centre has developed over the last three years:

"Space weather forecasting is very immature compared with terrestrial weather forecasting. But new knowledge is being generated all the time – which means we're constantly bringing more capabilities into our service."

Underpinning UK resilience

Just as the Met Office supports the aviation industry and transport network with customised terrestrial weather services, the Met Office Space Weather Centre is also working to tailor forecasts to specific industries. For example, we help operators of geostationary satellites, which are commonly used for observing the weather and transmitting communications yet can experience upsets caused by strong solar winds.

"We're getting particularly strong solar wind at the moment," says Mark. "So although there haven't been any headline grabbing CMEs this solar cycle, it's actually been quite a challenging period for geostationary satellite operators. We're trying to better understand their needs and we are getting to the point of offering tailored forecasts and telephone briefings for them ahead of their key manoeuvres."

Looking for the Northern Lights

There is also a sunnier side to space weather. CMEs and strong solar winds are what cause the Aurora Borealis. This spectacular natural phenomenon is sometimes visible as far south as the UK – although it is usually associated more with Scandinavia and the Arctic. The Met Office will be launching an Aurora Borealis forecast model this summer, ready for the autumn season when their occurrence becomes more likely.

Mark explains that the model will provide forecasts 30 minutes ahead of visible aurora and will feature on the Met Office's public web pages.

"We always get spikes in interest in our website when there's visible aurora around. Out of all space weather, it's what really interests people – it's just something everyone wants to see, me included."

Shared expertise

As the UK's forecasting capability develops and diversifies, the Met Office Space Weather Centre continues to work closely with its US counterpart, the National Oceanic and Atmospheric Administration (NOAA) Space Weather Prediction Centre.

In the early days of the Met Office Space Weather Centre, NOAA was something of a mentor, providing training to get the Met Office's space weather forecasting off the ground. Now the two partners have equal skill and capability when it comes to creating forecasts – and they maintain a constant dialogue to interpret shared data.

Leaders in the field

The Met Office Space Weather Centre is the only centre outside the USA that's in operation 24/7 manned by expert forecasters. As one of the global pioneers in this area, it also provides forecasts to countries with varying levels of space weather forecasting capability. For example, the Met Office works with the Swedish meteorological service to provide the government and key infrastructure with warnings about upcoming solar activity.

Other countries work with the Met Office to fill in gaps in their own services. One of these is South Africa, which does have a solar activity forecasting service, but it's only manned during normal working hours. So, every morning, the Met Office briefs them on what's happened overnight and any developing themes for the week ahead.

Mark points out that this approach is much the same as the Met Office's terrestrial weather services. "It's about sharing knowledge. It never stands still – and we've still got so much to learn."

Image reproduced courtesy of Airbus

Reaching new heights

As the organisation responsible for managing the UK's space weather risk, the Met Office is playing a key role in the development of a new solar observation spacecraft.

Currently, space weather forecast models use data provided by a spacecraft that just gives a head-on view of the sun. While this is essential for observing whether a CME is on a collision course with Earth, we can't tell the speed accurately from it. As potential power-grid disrupting CMEs can take anywhere from 15 hours to 5 days to arrive, having an accurate picture of how fast they're travelling is vital for infrastructure operators to put risk mitigation measures in place.

A fresh perspective

This observational gap could soon be filled. The Met Office has been instrumental in leading the development of a concept for a satellite mission to L5 – a point in space that will give a profile view of CMEs as they travel towards Earth. This will enable space weather forecasters to determine how fast a CME is moving – and will feed into more accurate forecasts about when and how Earth could be affected.

"We hope that the L5 Mission will enable us to see a CME travelling all the way from the sun to the earth", explains Mark Gibbs. "So if our initial estimates of when it will arrive are inaccurate we can make corrections as it gets closer. It's like terrestrial weather forecasting in that way – we update our longer range forecasts so they become more accurate with time."

The L5 Mission concept has now been taken on by the European Space Agency, after significant investment from the UK and other EU member states. As the mission develops, the Met Office will take a leading role in planning what observational equipment needs to be on board.

Life in the ocean wave team

Originally established in 1854 as a service to mariners the Met Office has been helping to protect people at sea ever since. Today, the Wave Modelling team is an essential part of the Met Office's commitment to Safety of Life At Sea (SOLAS), coastal flood forecasting, and improved weather forecasts.

Output from the Met Office Wave Modelling team is used in a variety of contexts. Many people are familiar with the shipping forecast, but the team's work also ultimately helps efficient and safe marine operations to be carried out by operators in industries such as offshore oil and gas and renewables. Many of these services are delivered through the Met Office Marine Centre of Excellence in Aberdeen.

The Wave Modelling team develops global and regional models to forecast sea-state conditions up to seven days ahead. As Andy Saulter, Surge Waves and Met Ocean Projects Manager explains, "Models describe the evolution of ocean surface wave energy spectra, from which descriptive characteristic parameters are derived such as wave height, period, direction and whether waves are 'wind-sea' or 'swell' like. Mariners need detailed information on these parameters to make important decisions."

As well as supplying off-shore intelligence, increasingly the team provides forecasts close to the coastline. "We have been helping the UK Coastal Flood Forecasting agencies assess coastal flood risks in tandem with tide and surge model information," says Andy. The team has also collaborated with the Royal National Lifeboat Institution (RNLI) and Plymouth University to develop a new Beach Safety Weather Manager tool for lifeguards (see page 21).

The team has various collaborations with UK academic institutions and other national meteorological services. One key relationship is being part of the WAVEWATCH III community model developers group. "Model configurations are based on the National Centre for Environmental Prediction (NCEP) community model WAVEWATCH III, which enables us to contribute to and benefit from the efforts of a worldwide group of research and development scientists," explains Andy.

There are two ways in which the Wave Modelling team improves accuracy of wave forecasts. "The first, more generic, activity is to pull through ongoing developments in the science community in the way that wave growth, dissipation and propagation processes are parameterised in our models," says Andy.

"The second method focuses specifically on coastal waters," Andy continues. "This is where we apply techniques such as grid refinement to improve how the model describes the coastline and shallow water bathymetry – improving this means we can increase the range of coastal locations for which we can forecast with confidence."

Recent changes involved both types of improvement, along with ongoing updates to the numerical weather prediction model used to force the wave model. For example, significant upgrades to wave growth-dissipation 'source terms' and grid scheme were introduced to the global wave model, taking full advantage of extra computing capacity provided by our new supercomputer in order to provide forecasts out to five days ahead. The same grid scheme and physics configuration have been applied to a North Atlantic-UK ensemble wave model which provides probabilistic forecasts out to seven days ahead. All upgrades to our models are tested in parallel with operational versions in parallel suites. The latest upgrades, which were tested in parallel suite 38 (PS38), are now fully operational.

Together these updates deliver a solid improvement in the accuracy of the model. Now, forecasts of significant wave height 72 hours in advance are statistically as accurate as the 24 hours ahead forecast before PS38. Improving prediction of high energy sea-states is particularly important for maritime safety and coastal forecasts, since these events often carry the largest risks to public safety.

Latest improvements are a reason to celebrate, but the Wave Modelling team is already working on more developments. Of particular focus is further improving wave forecasts for the complex shallow and highly tidal UK waters. Simultaneously the team is testing the benefits of more direct two-way coupling between atmosphere and ocean modelling systems. Long term, representing coupled interactions could improve wave models and lead to an enhanced ability to forecast weather and climate as well.

See the opposite page for a profile on Andy Saulter, Surge Waves and Met Ocean Projects Manager.

Science profile

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

Andy Saulter

Surge Waves and Met Ocean Projects Manager

A growing number of shipwrecks first prompted the Board of Trade to establish the Met Office. Over 160 years later, we meet one scientist whose work still centres around protecting the livelihoods – and lives – of mariners and coastal communities.

Growing up in Cornwall, Dr Andy Saulter has a longstanding connection to the sea. He remembers his love of surfing beginning at 14. But he'll also never forget how the Penlee Lifeboat disaster rocked his local community.

Following his first degree at the inland University of Bath, he was drawn back to the ocean, studying oceanography in Southampton ahead of a spell working in the offshore oil industry as a hydrographic surveyor. After that came a PhD and research into the effects of sediment transport processes on coastal erosion at Plymouth University, before embarking on his Met Office career. And he's been wrapped up with waves (almost) ever since.

"Surge forecasting is incredibly important for coastal communities – from protecting homes to preventing loss of life."

Mapping the ocean

Now manager of the Surge and Wave Modelling team in the Ocean Forecasting R&D (OFRD) group, Andy's team develops ocean surface wave models that predict sea states – put simply, the characteristics of waves. That information then flows into services such as the Shipping Forecast produced by the Met Office on behalf of the Maritime and Coastguard Agency. His team's surge model, on the other hand, maps the effects that strong meteorological forces can have on tide predictions. "If a major storm pushes into the North Sea during a period of spring tides, the resulting storm surge can cause unusually high water levels – which could lead to coastal flooding," Andy explains.

Safety in numbers

The models feed into Met Office Safety of Life at Sea services, used by everyone from fishermen deciding whether it's safe to work, to a family organising a weekend boat trip. And the data within the models can make a life-saving difference.

"If a severe storm is on the horizon, the potential for a rapid deterioration in conditions at sea or for coastal flooding can bring with it very real dangers," Andy says. "We need to make the public aware as far ahead in time as possible, so they can plan for the event and maybe even be evacuated if needed."

His hydrographic surveyor background means Andy knows not only what it feels like to face severe storms at sea (with sea-sickness) but also how marine industries rely on MetOcean data. Once started, their high-value and large-scale operations often can't be stopped. So they need to know the exact two- to three-day 'weather window' in which they can operate efficiently, economically and safely. That requires robust forecast models underpinned by accurate, authoritative science.

A sea change

Recently, Andy and his team have refined how the models forecast conditions close to the UK coastline – with its challenging jagged shores and complex underwater bathymetry. A major change to the grid system the model uses – which Andy describes as "basically recreating the world from LEGO blocks" – is making a massive difference.

"By improving how the model describes the coastline and shallow water, we've increased the range of locations we can forecast clearly and confidently," he explains. In turn, that will aid UK coastal flood forecasting agencies and support the RNLI to predict surf heights and rip currents with their new beach forecast service.

Andy's team has shared this new grid scheme with the wider marine modelling community, via the wave model WAVEWATCH III. Global scientists, including Andy, feed into this 'community model' – allowing it to continually develop.

The rest is history

Despite operating at the cutting-edge of wave science, Andy often draws on the pioneering discoveries of the most influential oceanographer of '40s America, Walter Munk.

"He saw that South Atlantic storms could push wave energy right up to African beaches. But he also found you could calculate the timing of that swell using analytical solutions."

First used to precisely predict conditions for WWII beach landings, Munk's historical methods still form many of the underlying principles upon which contemporary wave models are based. And Andy is mindful that his modern-day work remains rooted in the heritage of the Met Office: "Keeping industries operating and keeping people safe, despite what the sea throws at them, has always underpinned everything we do."

It’s great outdoors

Nothing beats that feeling of being outside, and our forecasts can help you make the most of being out in the open air.

At sea

As the weather gets warmer many of us start to head to the coast. We are working closely with the Royal National Lifeboat Institution (RNLI) and Plymouth University to create a rip current product that will help lifeguards throughout the busy summer. The Beach Safety Weather Manager product will provide key information for lifeguard resource managers as to the risks of rip currents to aid resource decision making.

On court

If you’re lucky enough to have tickets to Wimbledon, or watching it on the TV, you will benefit from the Met Office keeping an eye on whether rain will stop play. As part of our service to the All England Lawn Tennis Association, we will have two meteorologists on site for the duration of the next three Wimbledon Tennis Championships. We’re also providing forecasts for the qualifying tournaments.

UV forecasts

Lots of people enjoy getting outside when it’s sunny but did you know that you can still be exposed to UV rays on cool or cloudy days? Find out if you could get sunburnt by checking the UV forecasts on the new Met Office Weather app. That way you can make sure you’re prepared and cover up or put on protective sunscreen if needed.

Under canvas

Many of us are bound to recall a camp where weather has played a leading role. As Cool Camping Editor, James Warner Smith says, “Whether it’s planning the day’s activities or deciding how many layers to pack, an accurate idea of the weather and temperatures in store can make all the difference on a camping holiday. We always try to include information on nearby wet-weather attractions in our guidebooks because experience shows that, come rain or shine, if you’re prepared it needn’t stop the fun of your holiday.” See the tear off reply card opposite for a chance to win a Cool Camping book.

In the saddle

The key to an enjoyable ride is keeping a close eye on the forecast and the Met Office offers cyclists a range of weather information and warnings to help them travel safely. Sam Jones at Cycling UK says, “If you cycle frequently in the UK, there’s one thing you nearly always do before leaving the house – check the weather. It’s all very well saying, ‘There’s no such thing as bad weather – just inappropriate clothing,’ but an accurate forecast can help you make the right decisions that will allow you to enjoy your ride.”

Up mountains

We’ve worked with mountaineering organisations, local authorities and mountain rescue teams to improve our mountain forecast service. Enhancements will include user-friendly titles to sections of the forecast and video content to emphasise what weather hazards mean. Two large Scottish regions (East and West Highlands) have been split into smaller regions providing more local information. Mark Jones from the Brecon Beacons Mountain Rescue Team says, “We choose Met Office forecasts because they are the most accurate. More site-specific, altitude-specific information is of particular interest, along with visibility and precipitation, as these are the main factors affecting lost walkers or casualties on the hills and how we conduct searches.”

Bringing weather to life

From appearing on Celebrity Mastermind and The Great Sport Relief Bake Off to presenting the weather on Channel 5 and Facebook Live – life for **Alex Deakin**, who's now back at the Met Office, is as varied as ever.

It was while studying astrophysics at Birmingham University that Alex's interest in the weather and climate was sparked. After graduating in 1997, he joined the Met Office's meteorology training scheme. "It fitted me perfectly," he recalls, "a case of moving on from studying the atmospheres of other planets, to going back to Earth."

One of his earliest jobs was at ITV, preparing graphics and briefing the presenter, Sian Lloyd. The broadcasting side of things took off following a chance encounter in 1999 at a film premiere for The Perfect Storm. It was there that he met the head of BBC Weather, Helen Young, who invited him to a nerve-racking – but successful – screen test. For the next sixteen years, Alex went on to become one of the BBC's most popular weather reporters.

Painting weather pictures with words

"We never read off a script," says Alex. "The graphics are your prompt. When I'm training presenters today, I emphasise how crucial the first ten seconds of your delivery are in capturing someone's attention."

Alex admits that being surrounded by scientists at the Met Office can sometimes make it tricky to switch into 'presenting mode' to communicate complex information to viewers without using technical terms.

"I imagine that I'm talking to a friend – so phrases like 'occluded fronts' become 'it's a grotty, old day'. And I'll throw in some dramatic-sounding adjectives to peak people's interest and keep them watching. You could say that's my 'trademark' style."

On leaving the BBC in 2016, Alex joined the Communications team at the Met Office to work in its new broadcasting suite. It's here that, surrounded by high-tech wizardry, he creates weather forecasts for the Met Office national weather forecast, the British Forces Broadcast Service and Facebook Live.

As the Met Office's latest social media channel, Facebook Live's fun, ad hoc format is proving very popular – especially with the younger viewers who prefer their information snack-sized.

Alex might present the weather in the studio or film outside during a frosty morning. He even put 14 love songs into a Valentine's themed forecast. But whether he's describing a weather bomb on his Twitter feed, or interviewing the Chief Forecaster in the Operations Centre, it's clear that social media is gaining ground as a forecasting platform.

"When I'm training presenters today, I emphasise how crucial the first ten seconds of your delivery are in capturing someone's attention."

"It's great for people to access all the in-depth information available," Alex explains. "We're hoping Facebook Live branches out into a Q&A format, perhaps on topics such as pollen and UV levels."

Visual Cortex capability

Along with his presenting role, he is also creating forecasts using Visual Cortex – the Met Office's new graphics system.

"It's mind-boggling having so much computer power at my fingertips. In the old days, one weather symbol might represent 300 square miles. Now I can display the atmosphere, 30,000 feet up, before swooping down through the clouds onto details like towns and rivers."

Despite all the technology at his disposal, Alex – in his own words – tries not to be like a 'kid in a sweetshop' and avoids adding too many confusing visual layers. It's always a matter of considering the range of devices people might be using to view forecasts – and adapting accordingly. So while a jet stream graphic might look brilliant on a 64" plasma screen, it's not going to work well on a smartphone.

With so many current leaps in science and technology, Alex feels he's returned to the Met Office at a very exciting time.

"This is the start of something big. We must stay open-minded about where technology is taking us. Like the weather, you need to keep a close eye on what's coming up next."

Small but perfectly formed

The Coastguard Rescue Service has been promoting coastal safety all year round on Twitter with the adventures of the 'wee guys' in the world's smallest Coastguard Rescue Team.

Using Lego, the Coastguard team tweets a variety of informative and amusing scenarios highlighting safety advice. They even tweeted about the Met Office Operations Centre and our Met Office Weather app in preparation for the arrival of Storm Doris. They mentioned the Met Office again on World Met day in March.

Follow the adventures at @CoastguardTeam