

The view from above

This image of inland and coastal fog over the British Isles was taken by the MetOp A satellite on 27 March 2007.

Featured in Barometer issue 5, MetOp A is the first of a new generation of European polar-orbiting weather satellites. Among the various data it collects are readings of wind speed and direction, temperature and humidity and the greenhouse gases responsible for climate change, taken with unprecedented accuracy. These are transmitted into the headquarters of EUMETSAT — a European meteorological network — from where they are shared with weather and climate experts across the continent, including the Met Office.

In this close view of our atmosphere you can see fog that originated in the North Sea along the north-east coast of the British Isles and further inland. Taken in the morning, this image clearly shows that the sun has not yet evaporated the inland fog while less humid air arriving from mainland Europe has given the fog next to the coastline a smooth shape.

barometer

Issue 7 www.metoffice.gov.uk Met Office magazine



SOGGY SUMMER

Damp start to the season

SAFEKEEPING

The weather in theatre

SCOTTISH SEAT

Introducing the Met Office, Aberdeen



02 In brief

News and updates

04 Key environmental events

Very variable weather

06 Up, up and away

Wind beneath your wings

07 Our people

Jim Squires, Mobile Meteorological Unit

09 Britain's most northerly town

Profiling Lerwick

11 At home in Scotland

Met Office, Aberdeen

13 Changing needs

The weather at war

15 Mountains waves

Science focus downdraughts, gusts and lift

17 Fire!

Science focus Protecting open spaces in hot weather

18 Celebrity weather

Monty Don

Barometer is a controlled circulation magazine distributed free of charge to decision-makers in government, science and commerce, for whom weather and climate information has an impact.

Product information is correct at the time of publication but may be subject to change.

For queries about *Barometer* contact Sarah Quick, Met Office, FitzRoy Road, Exeter, Devon, EX1 3PB, UK

For any queries about Met Office products or services, contact our Customer Centre (24hrs):

Email: enquiries@metoffice.gov.uk
T: 0870 900 0100 F: 0870 900 5050
From outside the UK:
T: +44 (0)1392 885680 F: +44 (0)1392 885681
www.metoffice.gov.uk

© Crown copyright 2007 07/0063
Met Office and the Met Office logo are registered trademarks

Printed on Revive Matt Paper which contains 75% post-consumer waste paper.

Counting raindrops



The soggy start to summer, with heavy rain well forecast by the Met Office, washed-out open air events and brought more serious consequences to parts of northern and eastern England, recalls **Steve Noyes**, Operations and Customer Services Director.

Summertime has arrived but for many has felt more like the autumn with wavering temperatures and persistent, heavy rain. While the wet weather failed to dampen the spirits of revellers and spectators at annual events such as the Glastonbury festival and the Wimbledon tennis championships, the sunnier skies we hope for in the UK at this time of year were noticeably absent. They were replaced, as forecast, by torrential downpours which led to tragic consequences and thousands of stranded people as exceptional rainfall totals caused flooding, particularly across northern England. At times, parts of the country received a month's worth of rain in just a few hours.

As the clean-up begins, many may wonder what has happened to the summer that usually entices us to make the most of the great outdoors — and some to take to the skies. Whether you're jetting off for work or leisure this summer, our new Airport, Airline and Air Traffic Control Briefing services (page 3) will help make sure that your flight leaves on time. *Barometer* also reports on the growing number of gliding enthusiasts across the UK (page 6) who get away from it all using nothing more than air currents and aerodynamics to stay aloft. Whatever your choice of outdoor pursuit, whether it's hot and sunny or cloudy and wet outside, the Met Office can help you prepare for the weather with hourly, daily, 5-day or even 10-day forecasts and additional advice on UV radiation and air pollution levels. See www.metoffice.gov.uk

Barometer introduces the Met Office, Aberdeen (pages 11-12) which is a lifeline to all those who take to the sea for a living such as in the fishing, ferries

and marine and offshore industries. On hand 24 hours a day, 7 days a week, 365 days a year our Aberdeen office provides vital weather information for the whole of Scotland and Northern Ireland. Observations and forecasts in Scotland also support the aeronautical rescue teams operating out of RAF Kinloss and nearby RAF Lossiemouth that come to the aid of anyone getting into difficulty while out and about in the surrounding area.

Before a weather forecast can be made it is important to look at the current state of the atmosphere and local weather studies usually require measurements of temperature, humidity, rainfall, wind and pressure as well as observations of levels of sunshine, cloud cover and visibility. These are just some of the important data collected at Met Office observing stations around the UK, including at Lerwick (pages 9-10) which also measures changes in the earth's magnetic field for the British Geological Survey and monitors the level of stratospheric ozone for climate scientists around the world.

Here, at the Met Office, we use sophisticated climate models — largely similar to those used to forecast the weather — to also look at what could happen as a result of climate change. These models include detail on all the major components of the climate system, including processes occurring in the atmosphere, on land and in the ocean, which our climate scientists and expert consultants can interpret for your individual needs. *Barometer* looks at climate change in the headlines (pages 2 and 5) and at what the Met Office is doing to help the military combat the effects on its operating environment (pages 13-14).



Climate change is with us. **Everyone's talking about it.** As the world's leading authority on the weather and climate, the Met Office was behind many of the headline-grabbing climate change events so far this year.

Loud and clear

Few people realise that the Met Office has conducted climate research since the 1970s and opened the **Met Office Hadley Centre** in 1990. Today, it is the lead centre for international research into what could happen as a result of climate change and an independent review published in May 2007 noted, "It is beyond dispute that the Hadley Centre occupies a position at the pinnacle of world climate science and in translating that science in to useful policy advice."

Page 5 provides an update on the substantial contribution made by Met Office scientists to the fourth assessment report from the **Intergovernmental Panel on Climate Change (IPCC)** which will inform action in the UK. This long-awaited report drew together the worldwide consensus on

climate change and was published by the IPCC in three instalments this year.

Models used by our scientists to predict the global climate are essentially similar to those used to forecast the weather. Different climate models can give different projections but they all agree that a certain amount of warming is inevitable — a key finding of the IPCC report in February 2007. The fundamental message is that mitigation and adaptation now will stave off very significant and damaging impacts of climate change on environments, societies and economies later. Any reduction in greenhouse gas emissions that takes place, no matter where it occurs, makes a difference by not adding to the risk.

With much of the world sensitised to this pressing issue, in June 2007 the Met Office co-sponsored the **Guardian Climate Change Summit** which brought together leaders in UK politics, business and the media to explore how they can prepare for and combat our changing climate. Further afield, ways to limit climate change were hotly debated at the **G8 Summit** titled '**Growth and Responsibility**' which took place in Germany the same month and for which the Met Office provided UK policy advice. The Met Office also acted as key scientific adviser to **Live Earth**, which lived up to its promise to be the greatest show for the earth as well as on it. One of the largest global events in history, Live Earth brought together 150 of the world's top musicians for 24 hours of non-stop music across seven continents and drew attention to our climate crisis through a worldwide audience of 2 billion people.

The message is loud and clear. Climate change is happening — now. At the Met Office we will go on studying its causes and consequences and advising governments, businesses and individuals what it means for them through our new consulting service.

➡ For more information visit www.metoffice.gov.uk



All images © MSN Entertainment Design



European friends

In April 2007, during a spell of glorious spring weather, the Met Office hosted the 30th EUMETNET Council meeting in Aberdeen. Recognising that the weather has no borders and that nations depend critically on data and products from others, EUMETNET — a group of 22 European national meteorological and hydrological services — manages a series of programmes aimed at improving the basic meteorological infrastructure of Europe. For instance, it recently launched the Meteolarm system at www.meteolarm.eu providing easy internet access to warnings of severe weather for most European countries.

In addition to discussing its various programmes, the Council meeting considered the changing face of Europe and the role of national meteorological services (NMSs) in dealing with the European Union (EU) and its related institutions. Though not all EUMETNET members belong to the EU, changes to the regulatory framework introduced by the EU or European Commission can have a significant impact across all of Europe's NMSs. In response, EUMETNET now intends to set up an Economic Interest Group to raise its profile and give it a legal basis within the EU.



Global links

Met Office Chief Scientist, John Mitchell, led the UK delegation at the 15th World Meteorological Congress in Geneva on 7-25 May 2007. The Congress is the four-yearly meeting of the World Meteorological Organization (WMO), which is the United Nations body that coordinates the exchange of weather and climate information worldwide.

It was agreed that a World Climate Conference should be held in autumn 2009 to highlight the importance of climate predictions in decision making. Delegates from the United States joined us in the discussion, particularly on promoting the growing usefulness of seasonal forecasts and the longer-term implications of climate change.

In addition, Met Office delegates initiated and supported a number of ideas to improve the running and functioning of the WMO, and took the opportunity of meeting with other NMSs from around the world to strengthen collaboration in improving our weather forecasting and climate prediction models.

John was also re-elected to the WMO Executive Council which governs the WMO between sessions of Congress, underlying the importance with which we view the organisation.

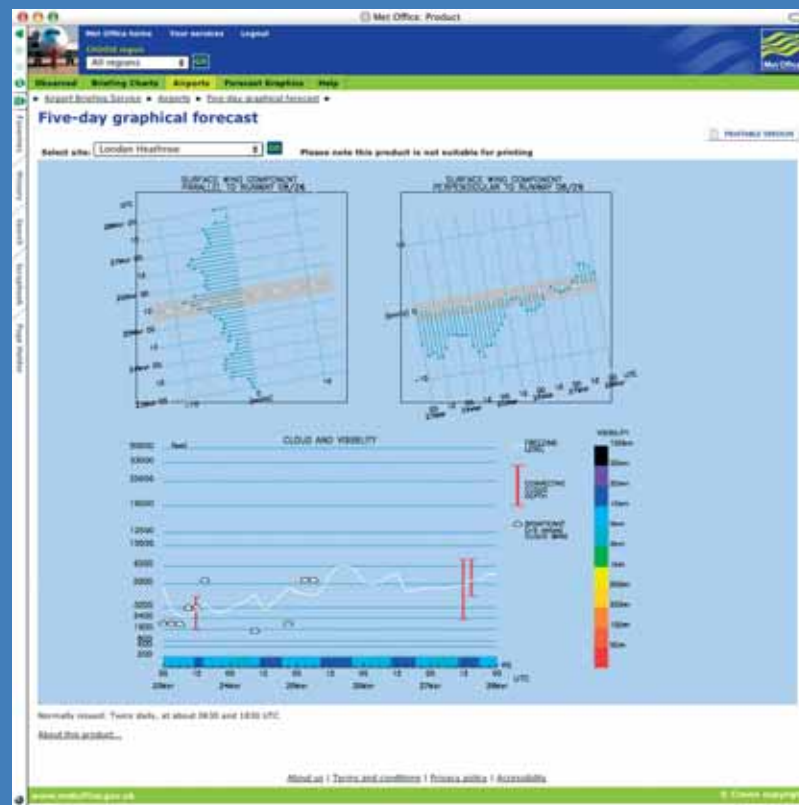
Eye to the sky

Three new weather briefing services have been launched by the Met Office for the aviation industry ahead of this summer's getaway. The Airport, Airline and Air Traffic Control (ATC) Briefing Services use the latest advances in forecasting and graphical displays to bring weather to the heart of flight operations.

It is estimated that more than 25% of flight delays are caused by the weather and when you're travelling on business or seeking sun, sport or culture overseas nothing's more frustrating than a delay at the airport. To reduce hold-ups, the

three new services help operations staff plan ahead with confidence by accurately identifying potential weather hazards up to five days in advance, keeping flights on time and increasing customer satisfaction.

Subscribers to the service have unlimited direct access to high-quality forecasts from the Met Office with interactive charts that allow users to pan, zoom and animate sequences of weather data. If you would like more information or a free trial, please contact the Met Office Aviation Team on aviation@metoffice.gov.uk



Spring and summer swap places

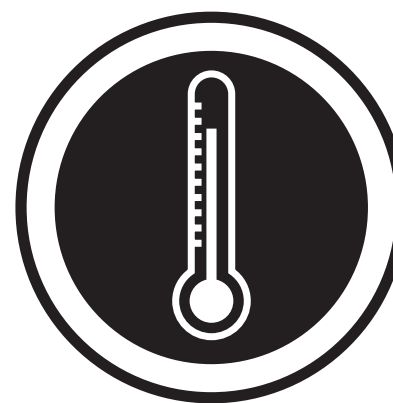
In a 2006 survey funded by Culture Online, part of the Department of Culture, Media and Sport, the weather was officially voted an icon of England. For a weather-obsessed nation, the variable conditions experienced across the UK this spring (March to May 2007) and into summer (June to August 2007) were no doubt a hot topic of conversation. So how did the weather differ from one month to the next?

The spring forecast released by the Met Office at the beginning of March predicted warmer and wetter-than-average conditions for the season ahead. In what proved to be an accurate insight into what the weather had in store for the UK, spring was indeed heralded by above-average temperatures and rainfall in March. However, in marked contrast, Arctic chills then brought significant snowfall to many parts of northern England and the cold conditions persisted until the end of the month.

Just like the dates of Easter which vary from one year to the next, so too does the UK weather in March and April as demonstrated by the changeable conditions this year. Temperatures recovered over Easter 2007 which fell in the second week of April and the fine weather encouraged many of us to spend time outdoors for the first time this year.

As the mild spring weather looked set to continue, the Met Office forecast for the London Marathon (which took place on 22 April 2007) anticipated exceptionally warm conditions with

~~SPRING~~ ~~SUMMER~~



highs of 23 °C in the capital. On the day, the hot weather certainly seemed to favour the spectators more than many of the runners but Kenyan athlete Martin Lel out-sprinted his rivals to claim his second London Marathon victory. Zhou Chunxiu also overcame the testing, above-average temperatures to become the first Chinese woman to win the gruelling event. Overall, climate scientists at the Met Office confirmed that April 2007 and the 12-month rolling period from

~~SPRING~~ ~~SUMMER~~



May 2006 to April 2007 were the warmest in the Central England Temperature (CET) series which dates back to 1659. The CET showed a final temperature for April 2007 of 11.2 °C, beating the previous record of 10.6 °C set in 1865.

Unsettled conditions returned to dominate the Bank Holiday weekend in early May bringing rain and showers to many parts of the country, although temperatures remained above average. The following Bank Holiday weekend

at the end of the month was a different story again. It saw a sharp drop in temperatures with heavy rain and strong winds in places affecting people's plans for travel and outdoor activities.

After a reasonably dry start to June, extremely heavy and prolonged rain fell on to an already soggy UK, leading to serious floods which threatened lives and caused substantial damage to property particularly in parts of northern and eastern England. Tragically, some people died and thousands more had to spend nights in temporary accommodation or were left without power. The Met Office issued early warnings of the severe weather several days ahead and worked with emergency planners across the UK including the police and military rescue teams, the Environment Agency (for England and Wales) and the Scottish Environment Protection Agency (for Scotland) to advise the public on the possible impacts. As yet more heavy rain fell on already flood-hit areas, forecasters at the Met Office kept everyone informed of developments as the downpours deposited well over three times the monthly average rainfall for June in some places.

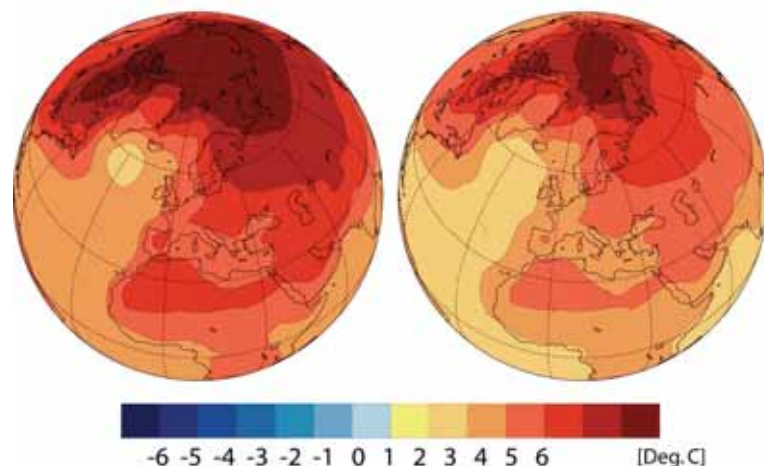
Despite an unsettled start to the summer, the Met Office continues to expect that the mean temperature for the season will be above the 1971-2000 averages over much of Europe, including the UK. While parts of Europe have experienced a heatwave so far this summer, the mean temperature in the UK was surprisingly 1°C above the 1971-2000 average. As far as rainfall is concerned, indications for the remainder of the season favour average or drier-than-average conditions over central and southern Europe and wetter-than-average conditions over parts of northern Europe. For more information see www.metoffice.gov.uk



Climate savvy



Dry river bed in Spain. The IPCC predicts that southern Spain will suffer from high summer temperatures and water shortage making large areas uninhabitable.



IPPC: two possible temperature change scenarios by 2070

Met Office scientists recently made a substantial contribution as authors and reviewers of the fourth assessment report from the Intergovernmental Panel on Climate Change (IPCC).

Convened in 1988, the IPCC is the brainchild of the World Meteorological Organization and United Nations Environment Programme and brings together the best climate research from pre-eminent scientists across the globe, including the Met Office. As reported in Barometer issue 6, the IPCC Working Group I stated in February 2007 that warming of the planet is now unequivocal and indisputable.

The second instalment (Working Group II), released in April 2007, looked at who and what will be vulnerable to the effects of climate change and the capacity to adapt. The findings emphasised the increased frequency and severity of floods and droughts as a key result of climate

change and highlighted that future vulnerability not only depends on how the climate changes but on development in these areas.

The final instalment (Working Group III), published in May 2007, assessed options for mitigating climate change. In line with the Stern Review on the Economics of Climate Change (published in October 2006) it said that action must be taken now to avoid long-term costs. It found that full use of available mitigation options is not being made in either industrialised or developing nations; and that, even with current climate change mitigation policies and related sustainable development practices, global greenhouse gas emissions will continue to grow over the next few

decades. The report recognised that changes in lifestyles, behaviour patterns and management practices could help reduce the impact of climate change across all sectors; while its contributors agreed that growth in greenhouse gas emissions could be reduced at a reasonable cost through renewable energy, reducing deforestation and improving energy efficiency.

To help others work out what a changing climate means for them, the Met Office has developed a model that can be run on a home computer to generate detailed climate change predictions for anywhere in the world. The programme, known as PRECIS which stands for Providing Regional Climates for Impacts Studies, is

available to climate scientists and researchers across the globe involved in impact, vulnerability and adaptation studies. As part of the UK's commitment to the United Nations Framework Convention on Climate Change, it is available free of charge to developing countries.

Based on the Met Office's own regional climate models, PRECIS is supplied on two DVDs and a five-day training course is essential for users to learn how to install and use the software. Experiments can then be set up easily for any region of interest worldwide and a typical area of study would measure 5,000 km by 5,000 km.

➔ For more information visit www.metoffice.gov.uk



During summer, the long days and warm weather entice many of us outdoors — some even take to the skies. With its tailored services for general aviation, the Met Office helps thousands of people get airborne, including gliding enthusiasts across the UK.

Up, up and away

In the hustle and bustle of modern life, there are very few places where you can truly get away from it all. Perhaps that's why there are over 10,000 glider pilots in the UK who, between them, make around 500,000 flights each year.

Although some modern gliders now have engines to get them out of tricky situations, for the most part they rely on no more than their aerodynamic design and natural thermal air currents to fly gracefully through the sky. Reaching heights of up to 40,000 feet and travelling at up to 170 mph, pilots soar in the company of buzzards with nothing but the sound of the wind around them and a bird's eye view of the world below. This sensation may explain the popularity of the sport. There are around 90 gliding clubs in the UK — governed by the British Gliding Association, see www.gliding.co.uk — which offer training to the increasing number of enthusiasts wishing to take up this exhilarating sport.

Jill Harmer, Web Production Manager at the Met Office, took her first flight in 1981 and has been hooked ever since. She and her husband, a gliding instructor, have flown everything from vintage wooden gliders to high-performance, high-speed models.

"I remember going round in circles beneath a thermal during my first flight, looking at the countryside below and experiencing the feeling of floating on air," says Jill. "I love gliding

because it's outdoors, it's a sport that you can really get involved in and it's something that links so much with the weather — if you don't understand what the weather's doing, then you won't stay up for very long."

Once a glider has been launched, by winch or a tow plane, the pilot must look for sources of rising air to stay airborne. During a cross-country flight, gliders use two main kinds of weather phenomena — thermals and lee waves.

Glider pilots look out for fluffy cumulus clouds that are formed when air has risen from a heat source on the ground and reached a point of condensation to make a cloud.

Meanwhile, altocumulus lenticularis — or long, thin clouds — usually indicate a lee wave, which is created when the prevailing wind travels over a large hill or a mountain. See page 15 for more on the science behind lee waves.

"You climb up by circling in the bit of air that is rising and then glide over to the next cloud where you think the air will be rising," explains Jill, whose longest flight lasted seven hours and covered 500 km.

As they become more experienced, glider pilots will build up an intricate knowledge of the weather. Before embarking on any flight, pilots are also legally required by the Civil Aviation Authority to study the online briefings provided free by the Met Office. Some may wish to improve their meteorology further and subscribe to the Met Office general aviation service, enrol on a two-day training course or learn remotely with our training CD-ROM.

After all, when gliders are up in the sky, it's just them and the weather. Their unique understanding of the atmosphere is what gives them the freedom to fly.

Did you know?

- > A sailplane is another name for a glider
- > Most gliders are one- or two-seaters. Beginners always learn in a two-seater with an instructor until they are competent enough to fly on their own
- > Gliders are made from many different kinds of materials, including wood, fabric and carbon-fibre
- > Some gliders are designed for specific purposes such as cross-country flying or aerobatics
- > The basic aerobatics tricks are 45 degree lines, a loop, a one-turn spin, a wingover and climbing turn. More experienced pilots can perform flick rolls, outside loops and rolling turns
- > Gliders can be launched by aerotow — when they are pulled by a light aircraft — or on a winch, which is the most common
- > Self-launching gliders have an engine that enables them to get airborne without any assistance
- > To stay airborne, gliders rely on air that is rising, which is called 'lift'
- > Glider pilots often set races, which, for example, could involve completing a 300 km triangular course and getting back to where you started in the fastest time possible

➔ To find out more about the Met Office services for general aviation or to book a training course at the Met Office or your flying club, contact the Customer Centre on 0870 900 0100 or visit www.metoffice.gov.uk





Armed with the weather

From the Battle of Trafalgar to the D-Day landings and contemporary warfare, the weather has as always been a crucial factor in military operations. As Officer Commanding the Met Office's Mobile Meteorological Unit, no-one understands this better than **Jim Squires**.

When Jim was just eight years old, his uncle, who had been an RAF pilot during World War II (WWII), took him to the cinema to see 633 Squadron — a 1964 film about a WWII British squadron engaged in aerial warfare. Within seconds, Jim was utterly captivated by the world of military aviation. In fact, he watched the movie four times in a row, leaving his uncle to retreat to the local pub.

Over 40 years later, Jim is now Wing Commander Jim Squires, Officer Commanding, Mobile Meteorological Unit (MMU). A fully trained member of the Royal Air Force (RAF), with the military skills needed to survive in hostile environments, he oversees meteorological services for RAF deployments in some of the world's most unstable countries.

Consequently, he has spent many months of his career living in a tent, sharing shifts with two or three other forecasters and engineers to deliver critical weather forecasts around the clock for military aviation in Afghanistan, Bosnia and Iraq.

"In the UK, we would have at least five forecasters to provide a 24-hour forecast service for the RAF. Out on deployment, it's quite different. There is half the number of people to do the same job," says Jim. "All we do is work, eat, sleep and exercise."

"Most of the time we are based on an airfield within the guarded wire boundary and are protected from what's going on outside. But, in places like Basra, there were rocket and mortar attacks every night,

and sometimes even during the day. The scariest place I've worked, though, was Bosnia when we were moving around with the Army and there were a number of attempted ambushes — it certainly concentrated the mind!"

Meteorology at war

In 2000, the MMU became the RAF's first Sponsored Reserve Unit. Today, there are around 80 members, of which a core staff of 13 is based at RAF Scampton in Lincolnshire.

Jim spends all year in uniform, two months of which are out on deployment. For the remainder of his time, it is his job to run the MMU, which involves everything from selecting and training new recruits to managing the meteorological services for RAF operations and exercises. But, why is the weather so important to the RAF?

"The obvious reason is flight safety," explains Jim. "Above that you can use the weather to tactical advantage, which is something that has happened throughout history and which is where the MMU service can add real value."



" You can use the weather to tactical advantage, which is something that has happened throughout history and which is where the MMU service can add real value."

"In Afghanistan, for instance, there may be a 10-day run-up to an operation. We would look at the weather and say, 'Well, if you go on Tuesday or Thursday next week, the weather's going to stop you. However, if you go on Wednesday, the weather could give you a tactical advantage.' Our technology puts us in a much stronger position."

Instant Met Office

Born in Nottinghamshire, Jim went to school in Workop and then joined the Met Office in 1974 as an Observer, going on to complete a Higher National Certificate in Maths, Statistics and Computing before finally qualifying as a forecaster.

His early service included three years flying as an Air Meteorological Observer with the Meteorological Research Flight at Farnborough. Then, in 1987 he was appointed as Senior Meteorological Officer at the Royal Aerospace Establishment, Bedford.

Twelve years and a succession of promotions later, he was appointed Officer Commanding, MMU. He now serves at RAF Scampton and lives near Lincoln.

Throughout his career, Jim has maintained his early passions for military aviation and meteorology and is dedicated to the work of the MMU. "Our aim is to provide the same service that Met Office forecasters provide at RAF bases in the UK, some 3,000 miles away, whether that's in the middle of the desert or in the Arctic."

"I can send in a handful of forecasters, plus equipment, and they'll be up and running in just a few hours. It gives me immense satisfaction to know that the MMU can walk into a field, a desert or snowy wasteland and, regardless of the conditions, set up an instant Met Office. That's down to the professionalism of my team."



Britain's most northerly town Lerwick

Watch a national television weather bulletin supplied by the Met Office and you cannot fail to notice Lerwick, 130 miles north of the Scottish mainland and main port of the Shetland Islands.

Lerwick's relatively small size (population 7,000) and seemingly remote location belies the fact that it is a thriving fishing and ferry port, with a busy harbour that hosts many large vessels of the offshore oil industry. It is a vibrant year-round tourist hot spot too, and gateway to northern Europe, offering a range of outdoor pursuits including sailing, scuba-diving and walking. In addition, it's an area rich in natural heritage as the varied Shetland coastline boasts high cliffs to sheltered inlets and sandy bays to salt marshes providing a wide range of habitats for animals, plants and insects. It is also home to an important Met Office observing station where key meteorological and climatological readings have been taken for over 80 years.

The Met Office observatory is part of the Global Climate Observing System (GCOS) that was set up in 1992 and is co-sponsored by the World



Meteorological Organization. It takes hourly measurements of temperature, humidity, rainfall, wind and pressure as well as observations of levels of sunshine, cloud cover and visibility. These data are used in daily weather forecasts from the Met Office and, over the station's history, have contributed to key climatological studies which are shared via the GCOS with all potential users around the world. As part of the GCOS Upper Air Network, the observing station at Lerwick launches radiosonde-carrying weather balloons twice a day. These provide continuous readings of temperature, wind speed and direction, pressure and water content from the surface to heights of up to 40 kms where the balloons burst.

In addition, measurements of stratospheric ozone are made at Lerwick with regular ozonesonde flights that help scientists around the world to monitor ozone levels. Measurements of ozone are also made by a Dobson spectrophotometer — a ground-based instrument designed in the 1920s that is still used today to measure the total column ozone (or the concentration of ozone in the atmosphere.)

The decrease in stratospheric ozone was first reported in 1974 using data from a 'Dobson' and quickly linked to the increasing presence of man-made Chlorofluorocarbons (CFCs). Less ozone allows more of the sun's ultraviolet (UV) radiation to strike the earth which can cause sunburn, eye

damage and more serious long-term health problems such as skin cancer and cataracts. Many countries have since moved to reduce the use of CFCs but, because of the slow rate of air mixing between the lower and upper atmosphere, scientists believe stratospheric CFCs will stay at a significant level well into the next century making Lerwick a particularly valuable observing station.

Lerwick town lies just north of 60° latitude, roughly on the same parallel as the southern tip of Greenland and the northern tips of Labrador in Canada and Anchorage in the US state of Alaska. It is more or less equidistant from Aberdeen on the Scottish mainland and Bergen in Norway and its position makes the observatory an ideal location for taking measurements of changes in the earth's magnetic field. Met Office staff at Lerwick undertake this task on behalf of the British Geological Survey that houses several of its instruments on the premises.

At the crossroads of the North Sea and North Atlantic, Lerwick is also in close proximity to major oil and gas fields including the Sullom Voe terminal — one of the largest facilities of its kind in Europe. At its peak, the terminal handled 1.42 million barrels of oil per day. As explored on pages 11-12 the Met Office, Aberdeen, provides critical weather information to all sorts of businesses in Scotland, including the marine and offshore industries, informed by observations and measurements from its local weather stations, including Lerwick.

So next time you watch the weather on national television, look out for Lerwick in the farthest northern reaches of the weather map — a bustling, cosmopolitan seaport that is a key commercial and industrial hub of the British Isles.



Lerwick at a glance

- > On most maps, the Shetland Islands appear as a tiny archipelago, remote and distant, with nothing to the north, east or west
- > On a global scale Shetland is, in fact, at the hub of the North Sea, a stepping stone to Scandinavia, an alternative route to Europe, or heading north to the Faroe Islands, Iceland and Greenland
- > Lerwick Harbour is a modern port which handles around 5,500 vessels each year. It operates around the clock and is open to shipping in all weather
- > Ferries from Lerwick sail to Kirkwall in the Orkney Islands, Aberdeen, Fair Isle, Bergen in Norway, Seyoisfjorour in Iceland and Tórshavn in the Faroe Islands, as well as to the Out Skerries and Bessay
- > Lerwick is a name with roots in Old Norse and its local descendant Norn that was spoken in Shetland until the mid-19th century
- > The words Ler Wick mean Bay of Mud as does the corresponding Norwegian name Leirvik - leir means mud and vik means bay or inlet
- > Leirvik is also the name given to harbours on the islands of Stord in Norway and Eysturoy in the Faroe Islands
- > The Met Office has run an important observing station on Lerwick for over 80 years. Before then, weather observations for Shetland were made entirely by coastguards, lighthouse keepers and a few keen local amateurs
- > Today, observations from Lerwick are used by climatologists around the world and in the weather forecasts from the Met Office that support local industries, especially those that rely on the sea



At home in Scotland



As well as providing a vital Public Weather Service for Scotland and Northern Ireland and supporting mountain rescue teams, the Met Office in Aberdeen is at the heart of the marine and offshore business community.

For over 150 years, the Met Office has been serving all kinds of different people and organisations around the world. As a National Meteorological Service (NMS), its key task is to provide meteorological information to the UK government, public and industry. At the hub of these activities are the Met Office's two civilian forecasting centres in Exeter, South West England, and Aberdeen, Scotland.

As part of its continuing commitment in Aberdeen, the Met Office is refurbishing its premises and work here should complete in time for the prestigious Offshore Europe Oil and Gas Conference and Exhibition, which takes place in the city on 4-7 September 2007. At Aberdeen, a team of highly-skilled forecasters is on hand 24 hours a day, 7 days a week, 365 days a year, to ensure that Scotland and Northern Ireland have all the weather information they need, when they need it.

A major part of this means working with the Scottish Executive and such organisations as the Scottish Environment Protection Agency, Transport Scotland and local authorities to alert them to instances of high-impact weather. Heavy rainfall, flooding, storms, gales and snowfall can all lead to treacherous conditions

in cities, towns and in the country's remote villages and communities.

This information produced at Aberdeen with the expertise of its operational forecasters, is available to the Met Office's Edinburgh site. Here, it is the job of Public Weather Service Advisers Pat Boyle and Martyn Sunter to liaise with the different organisations, as well as the police, fire and ambulance — or 'blue light' — services, to help them plan for severe weather and to be on hand to advise them during emergencies.

"I spend most of my time out and about, on my feet, visiting Scotland's eight regions, helping to ensure that they are well-prepared for any weather situation," says Pat. "My advice is specifically tailored to the Scottish Executive and I must be ready to address the different concerns of each region."

Saving lives

Met Office observations and forecasts in Scotland are also central to mountain safety advice and mountain rescue operations. For instance, meteorologists based at RAF Kinloss support its Mountain Rescue Team and mission planning and control at the Aeronautical Rescue Co-ordination Centre (ARCC), while those at nearby RAF Lossiemouth provide forecasts directly to helicopter crews.

"We produce forecasts twice a day for the ARCC, which act as a quick-reference guides for the weather in the area," says Met Office forecaster Iain O'Grady-Scott at RAF Kinloss. "We also release planning forecasts for the next three days and are available on the phone 24 hours a day to answer queries."

"For instance, if there is an accident in the Western Isles, then we can help medics decide whether it is safest to transport the injured person to hospital in Glasgow by road or helicopter."

In 2006, the ARCC launched aircraft on 2,391 occasions and rescued 1,700 people. Recently, it was involved in the search for a light aircraft that crashed near Oban. Accurate forecasts from the Met Office helped helicopter crews to locate the wreckage and then to guide teams in to rescue the two survivors.

Safety at sea

In addition to serving the public and government in Scotland, the Met Office, Aberdeen, is a lifeline for the marine and offshore industries. Aberdeen is the energy capital of Europe and, here, hundreds of companies rely on our expert consultants to communicate detailed meteorological forecasts in a way that is meaningful to them. As reported on pages 9-10, this includes long-term as

well as detailed daily forecasts that will determine whether or not gas and oil operations — such as anchoring support vessels working with offshore rigs, loading ships side by side or working on large constructions at sea — can be carried out safely.

"This is a dynamic industry, which requires immediate response and constant innovation," says John Mitchell, General Manager Marine in Aberdeen. "The Met Office is not just about the weather, it's about customers."

Recent developments include 15-day probability forecasts that highlight weather thresholds for offshore operations, metocean forecasts that illustrate sea currents, and vessel-specific forecasts that can be used to show how big waves and other conditions will impact a particular ship or rig. Such innovations are increasingly important as the offshore companies move into deeper water and more hostile environments to prospect for oil and gas.

Yet, the work of marine forecasters in Scotland doesn't stop there. Weather affects all kinds of activities on Scotland's coast from harbour construction and ferry routes to sanitation — which is why the Met Office Operations Centre at Aberdeen is always in high demand.



email sent to library



email sent to library

The Public Weather Service explained

- > The Public Weather Service (PWS) provides weather information and weather-related warnings to the UK public
- > In addition, as the Met Office is a National Meteorological Service, the PWS has international commitments that it fulfils on behalf of the UK government
- > The PWS also conducts research and provides forecast and observational data that are essential for the wide range of services offered by the Met Office
- > UK high-impact weather forecasts issued by the PWS enable the public and emergency services to reduce the effects of adverse weather conditions
- > When high-impact weather events are expected to affect large numbers of UK citizens abroad or those involved in relief operations overseas, the PWS will issue a global high-impact weather forecast
- > PWS site-specific forecasts provide accurate weather information to towns, cities and regions across the UK
- > The PWS is also responsible for UK seasonal forecasts, global seasonal forecasts, global pollution forecasts, UK climatological records and maintaining the National Meteorological Library and Archive
- > The PWS is primarily funded by the Ministry of Defence on behalf of the government
- > Funding from the Civil Aviation Authority also underpins the PWS services for the UK and global aviation industries
- > Additional funding is provided by other sources such as the European Union for research and development projects
- > The current total PWS funding amounts to some £83 million per year

As the effects of climate change are felt across the world, political leaders at home and abroad are recognising the potential threat these may present to global security. That is why the Met Office is helping the Ministry of Defence plan and prepare for the future.

Changing needs

• HR ordered from Impact Photos

“An unstable climate risks some of the drivers of conflict — such as migratory pressures and competition for resources — getting worse.”

Then UK Foreign Secretary, Margaret Beckett

The international scientific consensus is that climate change is happening, and it's happening now. Regional changes have been observed in rainfall, wind patterns and extreme weather. Flooding, droughts and tropical storms are becoming more frequent. Natural systems such as the hydrological cycle are also being affected. And, indeed, in many parts of the world climate change is already having an impact on water availability, agriculture and ecosystems.

Climate change obviously has an effect on the environment. However, business and political leaders around the world are realising that it may have much wider consequences in terms of global economics and security.

Addressing the UN Security Council in a recent debate on energy, climate and security, then UK Foreign Secretary, Margaret Beckett said, “An unstable climate risks some of the drivers of conflict — such as migratory pressures and competition for resources — getting worse.

“The Stern Report speaks of a potential economic disruption on the scale of the two World Wars and the great depression. That alone will inevitably have an impact on all of our security — developed and developing countries alike.”

While experts at the Met Office are working hard to produce increasingly reliable and accurate predictions for climate change, they are also in a unique position to offer meaningful advice and support for adaptation and mitigation plans — not least the Ministry of Defence (MoD).

“We are working with the MoD to better understand how climate change will impact their activities at both global and regional levels, as there may be an increased number of deployments around the world, especially in developing countries,” explains Derrick Ryall, Head of Government Research at the Met Office.

As well as anticipating where in the world conflict may take place and the types of conflict that may occur, the military also needs to ensure that their personnel and equipment are fit for the environment. It is crucial that they know what climates they may be operating in and how these may be further affected by climate change.

The heat and dust in Iraq and Afghanistan, for instance, have proved challenging for troops. So, when the MoD looks into designing and upgrading equipment in the future, it must ensure that it can withstand more extreme conditions. The recruitment process may also have to change — with more operations in hotter countries, they may need to screen for those people who are better able to cope with heat stress than others.

“The past is no longer a guide to the future. Anything that has weather sensitivity and has used past climatology to assess risks is no longer applicable,” says Derrick.

“A better understanding of the climate and weather will mean that the MoD can better utilise its operations, design equipment that will withstand the changing conditions, recruit suitable personnel and use the weather to its operational and tactical advantage.”

Climate change and global security

- > Water is one of the most important natural resources that is likely to change significantly in our future climate in terms of its volume, spatial distribution and the timing of supply, contributing to environmental stresses in some regions
- > As competition for resources of every kind intensifies and economies around the world seek political and economic partnerships to secure supplies, some regions may face moral compromises
- > A combination of climate change, uneven distribution of wealth, pressures on resources and weak government may mean that vulnerable regions are at increased risk of humanitarian crises
- > Increased migration and urbanisation will put pressure on infrastructure and governance, destabilising communities
- > The energy market will become more unstable, perhaps tempting some countries to dominate or control the global market. Political and military interventions may be required to safeguard supply
- > Poor harvests may cause major price spikes in food staples such as wheat or rice, resulting in economic and political unrest and humanitarian crises
- > The growing risk of natural disasters may increase the need for military forces to assist in humanitarian and relief operations

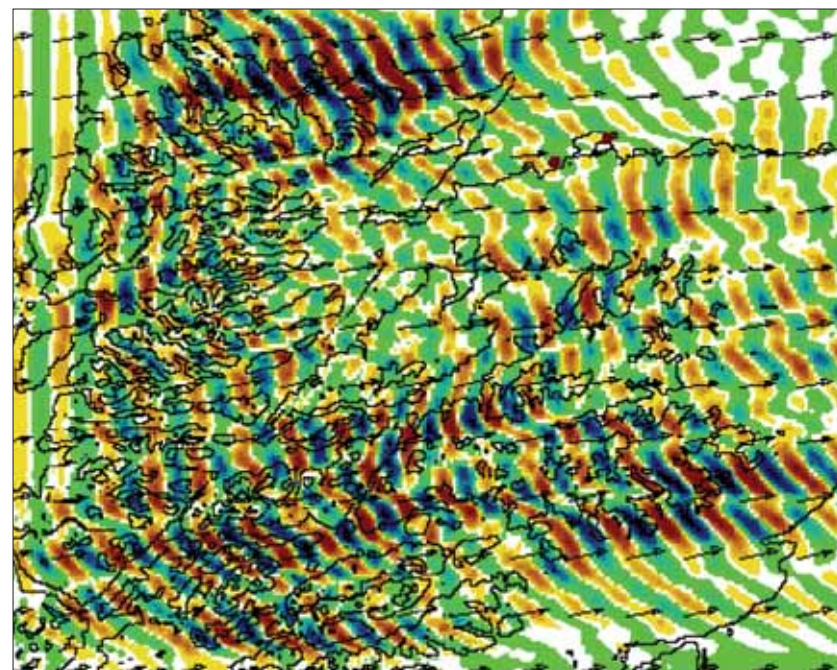


Figure 1: An example forecast of lee-wave motion over the Grampians in Scotland. The colours represent the air vertical velocity, 2 km above sea level, blue being downward and red representing updraughts. The predicted vertical wind speeds in this case exceeded 4 ms⁻¹.

Mountains present a significant obstacle to the atmospheric flow and, as a result, dramatic and potentially dangerous changes in local mountain weather can occur in a matter of minutes. In addition, the airflow above and downwind of mountains can pose a serious threat to aircraft and can give rise to dangerous gusty conditions on the ground.

One particular effect is that of lee waves. These are standing waves that can occur when the wind blows across a mountain and the air is forced upwards. Once elevated, it finds itself denser than the surrounding air and so has a tendency to sink. This sets up an oscillatory or wave motion downwind which can extend for several hundreds of kilometres. These vertical winds associated with lee waves pose a serious aviation hazard because the downward velocities can exceed the maximum climb rate of a light aircraft and so force it to the ground.

The waves are also sometimes accompanied by near-surface turbulent rotors which form as intense horizontal vortices beneath the crests of the waves. Such rotors are highly dangerous and there have been cases where the turbulence was so severe that even large aircraft have broken up or lost engines.

At ground level, lee waves are often associated with strong damaging gusts downwind of the mountains. Indeed, almost every year high-sided vehicles get blown over on the A1 in

Yorkshire when westerly gales blow across the Pennines and generate large amplitude lee waves.

Lee waves also generate spectacular cloud patterns. Smooth lens shaped clouds, often stacked on top of one another and stationary above the ground, frequently form in the crests of lee waves and are regularly observed near mountainous terrain. When safely above the dangerous low-level turbulence, glider pilots can enjoy the benefits of the rising motion in the waves. Some of longest ever distances travelled in a glider have been achieved through skilful use of lee-wave motion to maintain height. For more on gliding please turn to page 6.

Over the last few years the Met Office has collaborated with the School of Earth and Environment at the University of Leeds on a programme of research aimed at improving our understanding of the conditions under which lee waves and rotors form. This work has involved detailed measurements of wave motion over several mountain ranges, most recently the Pennines in northern England and the Sierra Nevada mountains of California. The latter study was part of a major international effort to measure the really big rotors which form over the Owens Valley to the east of the Sierras. The Met Office / Leeds contribution included flying the UK FAAM (Facility for Airborne Atmospheric Measurements) research aircraft in coordinated missions alongside two American research aircraft.



Science profile

→ Simon Vosper, Orography Group Manager

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

Picture a mountain and you will probably think of its physical features — its looming height, rocky crags or snow-capped peaks. But Simon Vosper, Orography Group Manager at the Met Office, sees them in a much different light.

For over a decade, Simon has been studying lee waves and rotors, created when the prevailing wind travels over a mountain or hill. (See the article opposite). While not immediately visible to the eye, these phenomena can affect winds, pressures and temperatures on a global scale and cause turbulence and gusty winds at a local level.

“We have to understand where these waves occur, how they may create regions of turbulence and drag and then try to produce rules and models for forecasters so that they can predict the effect over a specific mountain range,” explains Simon. “We are interested in every size of mountain from the Himalayas to small hills, right across the world.”

Bright spark

Simon first started studying lee waves and rotors while doing his PhD at the University of Leeds in the early 1990s. Professor Stephen Mobbs sparked his enthusiasm for fieldwork, which allowed Simon to witness the complicated theory behind the science unfolding in real life.

“Taking field measurements enables you to really understand the reality for a given mountain range,” enthuses Simon. “It’s only by going out

there and watching it happen that you can answer crucial questions such as: What does the flow of air look like over a particular mountain? How big are the waves? And where do they break?”

Simon’s involvement with fieldwork includes experiments in Cumbria and the Isle of Arran in Scotland and, since joining the Met Office in 2001, the Pennines. One of the highlights of his fieldwork, however, was a recent trip to the United States.

In March 2006, Simon spent a month flying over the Sierra Nevada mountain range in California with a team of scientists aboard the UK FAAM research aircraft — a specially adapted BAE 146, jointly operated by the Met Office and the Natural Environment Research Council.



A view of rotor cloud in the Owens Valley, California, taken from the UK FAAM research aircraft. A lenticular wave cloud is present at higher altitudes. Image provided by Dr Barbara Brooks, University of Leeds.

“I had never sat in the cockpit of a plane before and, while it was certainly very exciting, it was also an incredibly challenging experience,” says Simon. “Alongside the pilots and other scientists I had to plan, not just when to fly — usually in the potentially hazardous conditions that create lee waves and rotors — but also coordinate measurements with two other US aircraft flying directly below and above our own.”

Team effort

Back at base in Exeter, Simon is responsible for overseeing a team of seven expert scientists and ever-improving the quality of the models used by Met Office forecasters to predict the effects of mountains.

“It’s an ongoing and exciting challenge,” says Simon. “We are continually improving our forecast models and, as a result, producing more accurate predictions for customers, all of the time.”

Mountain waves

Mountainous areas are major leisure attractions all year round as they offer both dramatic scenery and a wide variety of outdoor pursuits. **Simon Vosper** in the Flow Over Orography Team at the Met Office explains how mountains can also have a strong affect on the weather.

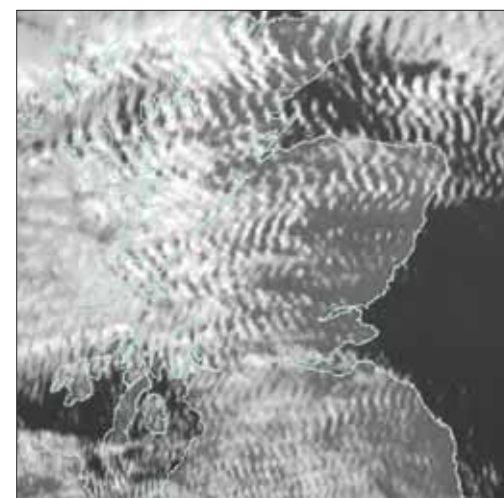


Figure 2: A high-resolution satellite image showing the cloud patterns due to lee-wave motion across Scotland. Long trains of lee-wave clouds are commonly seen in satellite imagery over mountainous terrain. The image shown corresponds to the exact time of the forecast shown in figure 1.



Fire!

Summertime for many of us involves cooking alfresco on camping stoves and barbecues. Outdoor enthusiasts particularly recall the long and glorious summer of 1976 and, more recently, the record-breaking temperatures of 2003 and 2006. Fewer remember the huge number of wildfires that spread across the countryside in the hot and brittle conditions.

Carelessly discarded disposable barbecues are the most common cause of accidental fires in the UK. Arson is another major contributor — unfortunately there is a strong correlation between the number of wildfires and school holidays. The weather also directly affects the likelihood of fires and determines their severity. While fires started by lightning are extremely rare in the UK, a very hot dry spell lasting a few weeks or months, such as the summer of 1976, can cause surface conditions to become extremely arid which increases fire risk.

In order to assess the risk of wildfires across the country, the Met Office has developed a sophisticated Fire Severity Index to provide information on the moisture state of the land surface which, coupled with wind speed, indicates the likelihood of a fire and its rate of spread. Areas suffering from long-term drought, for example, will experience fires that behave in an almost uncontrollable manner, because the fuel is much drier. Where brittle vegetation lies on a peat soil, the peat itself is likely to ignite, significantly exacerbating the problem.

Once peat smoulders the flames can travel very slowly, without detection, deep underground for many kilometres before resurfacing weeks later and sparking further fires far from the original blaze. En route, the fire can destabilise trees and cause permanent damage to the peat itself, making it unsuitable for future growing and leaving a barren landscape in its wake.

Following an intense fire, precious landscapes may be lost for ever and local wildlife may never return. The UK holds 75% of the world's open heather moorland, 2% of which was destroyed

in the fires that resulted from the unseasonably warm spring of 2003. Even controlled burns can sometimes go awry as many landowners burn their land to clear old vegetation, providing a pathway for new shoots. Occasionally, these burns escape and become uncontrollable, leading to intense fires which require a lot of manpower to control. Numerous fires over an extended hot summer or a large, uncontrolled burn can put a considerable strain on fire fighting resources.

The Met Office has been working with Natural England and the Countryside Council for Wales for some years to tackle this problem, and more recently has been advising the Scottish Executive. On receipt of an 'exceptional' Fire Severity Index from the Met Office, authorities have the power to restrict access to certain land, including National Parks, for public safety reasons. With summers in the UK forecast to be even hotter and drier with climate change, it is possible that fire risk conditions in our open spaces could increase significantly.

The Index has other uses, for instance, in helping the fire services to predict the number of fires which may occur over the coming days so they can prioritise resources. Land managers also see benefit in further developing the system so they know when it's safe to burn off old vegetation or when they should put up fire warning signs for visitors.

You too can help — by taking extra care when lighting your barbecue and disposing it responsibly. It takes very little effort and will go a long way to protect our unique landscape and open spaces, particularly in hot weather.



For celebrity gardener, author and broadcaster Monty Don, life has not always been a bed of roses. The collapse of his business in the late 1980s led to a near-breakdown, which saw him and his family move to the country to rebuild their lives. But his love of gardening helped him carve out a new life, and opened up new and inspiring opportunities.

Monty Don The healing power of nature



Montagu Don is a familiar face on television, presenting Gardeners' World and other primetime horticultural favourites. While he's renowned as a green-fingered guru, behind his on-screen persona is a man who continues to suffer from Seasonal Affective Disorder - a type of winter depression caused by a lack of sunlight. How does he cope? He turns to nature.

"I know that earth keeps me sane. It cannot be cheated. It is my base reality. Getting back to the earth is an absolute starting point, from which everything can grow, everything can be possible."

This belief comes as no surprise; Monty forged an entirely new and successful career living off the land. In the past decade, he's written a weekly gardening column for the Observer, penned several successful books and grown in celebrity status — all thanks to his love of the outdoors.

In fact, his 'faith' in the healing power of nature has led him to undertake several ambitious projects to help people in less fortunate situations.

Earth figure

At least one day a week, or whenever his busy schedule permits, Monty can be found on the 'Rock', a smallholding in Worcestershire. But this is unlike any other smallholding because the people that grow the produce, tend the animals and take responsibility for its day-to-day maintenance are young people that struggle with drug addiction and crime. This is all part of the Monty Project, a charity set up in collaboration with the probation service in 2004 to help people 'reintegrate and conquer their addiction by working with the natural world'.

Initially, the project got off to a rocky start, not least because local residents felt uncomfortable by the presence of the young addicts. After months of set backs, things finally began to progress with the arrival of spring. "This is the

time to really get on the land," Monty says "You become completely dependent and responsive to the weather and soil. Growing conditions can change within a day, from wet in the morning to warm soil in the afternoon, so the timetable becomes very important.

"On the Rock, we got the group to respond to what's actually happening, to feel that connection with the weather, land, plants, animals and so on. It was like a reality check, to realise that something depends on them for survival."

It's clear the project has had a profound impact on Monty's life. "It dominated everything I did for 18 months and setting up the charity took a lot of work — more than I ever imagined." However, his efforts have paid off and there are plans to set up new sites.

Climate change and apricots

With the experience of someone so closely linked to the weather, what are his views on climate change?

"In terms of growing produce, our increasingly warmer climate enables us to raise a greater variety of plants, fruits and vegetables. In fact, fruits are getting better every year. We now have a fantastic harvest of peaches, apricots, tomatoes and so on.

"That said, climate change is having an incredibly serious — and potentially utterly disastrous — impact on the world, which is why it's crucial to continue to try and do everything within our power to deal with it."

Keeping the faith

Monty has had his fair share of set backs and difficulties, but one thing's for certain: it's impossible not to feel inspired and invigorated by his belief in the outdoor life and the healing power of nature.