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Barometer

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Sun and rain are essential for life — and the weather makes the difference between agricultural success and failure. That's why timely warnings of adverse weather conditions and weather advice for the next month or season are vital to rural communities, explains Keith Groves, Operations Director.

Spring in your step

Growing up in Shropshire, I'm well aware of the importance of weather in the countryside. If there's mild weather early in the year, crops start to grow but are in danger from frost. Many farming tasks need specific conditions — at harvest time, our advice on dry periods enables farmers to plan haymaking. However, I must congratulate farmers and others who live and work in the countryside, as they are often very astute forecasters who are particularly aware of the effects that local factors, such as hills and valleys, have on the weather. In fact, much of our weather folklore stems from the knowledge of rural communities (page 4).

Climate change means the weather is even more variable — and even in a warming global climate there are cold

spells such as in the early part of this year. There is also a big variation in weather in different parts of the country. We offer a range of services to help the agricultural industry minimise loss and maximise profits. We help our customers, including farmers, growers, market gardeners and horticulturists, make important decisions. But it's not just here in the UK where we help people — our expertise has a worldwide impact, such as our support for the Guyanan meteorological service (pages 9–10).

Farmers have long thought that the answer is in the soil, and we are no different, with our research on how soil moisture levels affect the weather (page 15). Constant improvements to our forecasting processes mean we can provide even earlier and more detailed

warnings of severe weather. Our new high resolution 1.5 km model will help highlight heavy convective storms that cause flash flooding, helping us advise when and where floods are likely. Working together with the Environment Agency in the new joint Flood Forecasting Centre will also reduce the threat from sudden flooding, providing earlier, more accurate warnings (page 3).

As the climate alters we can expect to see changes throughout the UK. Familiar landscapes could look quite different as the need to conserve water and to save energy alters the face of the countryside. Farmers will need cereal crops that can grow and be harvested under different and more variable temperatures and rainfall. Crops and livestock may become more vulnerable

to pests and diseases like Bluetongue (pages 7-8). We are working with the Royal Horticultural Society to understand how climate change will affect plants and gardens (page 6).

Our seasonal forecasts benefit many people, especially the farming community. For example, our winter forecast accurately predicted the cold start to winter — in fact the coldest start to December for 30 years. Our spring seasonal forecast will also be indispensable to many people. Rural communities are often exposed to severe weather — and just as weather gives life, it can also take it away. Spring is always a sensitive time for plant growth and new life, with frost posing a serious risk to crops and young animals, so our warnings are again of vital importance.

In this issue

News and updates

- 03 **In brief**
 - New look website
 - United Nations Climate Change Conference
 - New joint Flood Forecasting Centre
- 04 Farmers' folklore
- 17 The Weather book

Features

- 05 **Key weather events**
 - Frozen over
- 06 **In full bloom**
 - Hampton Court Palace Flower Show
- 09 **The tropics**
 - Forecasting in Guyana
- 11 **Countryfile**
 - The BBC rural current affairs programme
- 13 **Down in the woods today**
 - An interactive approach to climate change

People

- 07 **Our people**
 - John Gloster, Met Office research scientist
- 16 **Science profile**
 - Imtiaz Dharssi
- 18 **Celebrity weather**
 - Lord Bath

Science

- 15 **Science focus**
 - The answer is in the soil

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New look website

Our new brand was applied to the website in November. Together with a fresh, more modern look, it now has improved functionality, content and navigation.

Users can customise content on the homepage; for example, a bookmark function enables visitors to create a list of favourite pages so they can quickly find the content they find most interesting.

A new 'Climate Change Centre', brings our climate change content into one place, helping people stay up to date with the latest climate science, impacts and news.

More newsfeeds of weather warnings, news releases and job vacancies, and a wider range of content, including audio and video, gives a much better visitor experience.

Further changes will follow next year after feedback from users. The next phase of improvements will see changes to the presentation of weather information.



Photo: UN Photo/Mark Garten

United Nations Climate Change Conference

A United Nations Climate Change Conference (the 14th Conference of the Parties, or COP 14) took place in Poznań, Poland in December. Government representatives from more than 192 countries gathered to discuss international action on climate change.



In parallel with the policy negotiations, various organisations, including the Met Office, hosted exhibit stands and side events. Met Office scientists stressed the importance of early and rapid reductions in greenhouse gases to prevent dangerous climate change, and a need to link actions on climate change to those to improve air quality and health. In particular, surface ozone and aerosols affect both climate and air quality.

In addition, scientists demonstrated the Met Office's regional climate modelling capacity for developing countries, which enables them to undertake their own climate projections.

Dr Vicky Pope, Head of Climate Change Advice at the Met Office said, "New scientific evidence shows pollution is a bigger problem in terms of human health than previously thought. Air quality is an additional problem that people have not really taken into consideration that now needs to be looked at as part of climate change negotiations."



New joint Flood Forecasting Centre

A new joint Flood Forecasting Centre is being set up by the Met Office and the Environment Agency. The new centre will be based at the Met Office in Clerkenwell Road, London.

One of the key recommendations of Sir Michael Pitt's report on the flooding of 2007 was a joint centre for flood forecasting to bring together Met Office and Environment Agency expertise.

The new joint centre follows the success of a recent pilot of the Extreme Rainfall Alert Service that served emergency responders. The service warned of several flash floods and the response from the resilience community was very encouraging.

In the past, extreme weather prediction by the Met Office has been separate from monitoring its effect on rivers and coasts by the Environment Agency. Neither agency had responsibility for forecasting flooding resulting directly from heavy rain.

Combining Met Office weather forecasting expertise and the Environment Agency's skills in flood forecasting will provide earlier, more accurate warnings enabling emergency responders and the public to take prompt action to protect property and life.

Farmers' folklore

For generations people have looked at nature to predict the weather, but is there any truth in the old sayings?

Farmers' lives are dominated by the weather, giving rise to many weather-based tales, weather folklore and weather sayings. The most famous weather saying of all must surely be, "Red sky at night, shepherd's delight; red sky in the morning, shepherd's warning." With modern technology and the sophistication of modern weather forecasts, many of us now take these weather sayings with a pinch of salt, but there may be more truth to them than you might expect.

Many weather sayings are rhymes that have been handed down from generation to generation. Most are based on observations made by farmers and people who looked to the patterns of nature for clues to what the weather might have in store. While some sayings may have an element of truth to them, much of the weather folklore based on observations of atmospheric phenomena can be a fairly good indicator of short-range weather changes.

The 'red sky' saying is just one example of the sense of the old folklore. A red sky forms at sunrise and sunset when dust and other particles — trapped in the atmosphere by high pressure — scatter blue light, leaving just red light. In the northern hemisphere, most weather systems travel from west to east, so a red sky at sunset can indicate that high pressure is moving in from the west, which in the UK usually means settled weather. Other sayings, which try to predict the weather for the following season from a single event, are unlikely ever to be accurate. Some sayings, such as "Rain before seven, fine by eleven" may be true in certain cases, but are unlikely to be true all of the time.

The accuracy of the sayings often depends on where you are in the world — a familiar saying in the northeast USA is, "A cow with its tail to the west makes weather the best; a cow with its tail to the east makes weather the least". There is some sense to this, as cows usually stand with their faces away from the wind when they feed. In the northeast USA, easterly winds typically bring wet weather and westerly winds often bring fair weather, so cows do often provide a good indication of the weather. One of the most well known supposed natural

indicators of rain is when cows are lying down. This may have an element of truth to it as the cows sense the moisture in the air and make sure they have somewhere dry to lie down.

Some sayings are more descriptive than predictive — with the cold weather after Christmas, the old saying, "When the wind is from the east, 'tis neither fit for man nor beast," was particularly apt when an ice-cold, easterly wind from the Continent blew a bitter winter chill towards the UK.

While the source of many of the old sayings is unknown, it is clear that in the past, when more people lived and worked on the land, weather was very important and they watched for patterns to help them predict the weather. They then made up rhymes to help them remember these patterns. Some of these sayings do have more than a grain of truth in them, and it is testament to the fact that the weather is just as important to us today that many of us remember and use them.

➤ There's more weather folklore and plenty of other information in the new Weather book by the Met Office and publishers Dorling Kindersley (see page 17).

As winter held the UK in its icy grip, some people confused the short-term weather with the end of climate change.



Frozen over

Photo: Getty Images

The average temperature across the UK in December was 3.1 °C — a full degree below the long-term average — making December the coldest in the UK for 12 years. A cold first half of December was followed by a milder interlude which meant it wasn't a white Christmas.

However, temperatures dropped and temperatures in early 2009 were rarely above freezing in some places. Icy weather created some dramatic landscapes, but with temperatures down to -12 °C it also caused difficulties with road closures, increased accidents and delays. Burst water pipes left homes without water and forced some schools to close.

Lakes and rivers froze in some areas including the Lake District, Hertfordshire and Essex. Boats were frozen in their moorings on the Monmouthshire and Brecon Canal in Pontypool. Sustained sub-zero temperatures also caused the sea to freeze, with harbours at Poole in Dorset and Padstow in Cornwall covered with ice. Even the fountain in Trafalgar Square in central London froze over.

By mid-January, the ice had mostly melted and a more familiar British winter had returned, with heavy rains and strong winds. After the cold, dry spell it was more like the type of winter we've become

accustomed to in recent years. As rain fell on ground hardened by frost, we worked closely with the Environment Agency to monitor the threat of floods. After warming up briefly, the second half of January saw unsettled weather with strong winds and heavy rain.

Then, between the 2 and 9 February, periods of heavy snow fell across the UK, leaving a covering of more than 15 cm over large areas of England, Wales and Scotland. The last time such widespread snowfall affected Britain was February 1991. Bingley in Yorkshire had 51 cm of snow on 9 February, while in central London, some places had close to 20 cm, a rare event for the capital.

Heavy snow also caused problems in the west, particularly the west midlands, South Wales and South West England with 200 motorists stranded on the A38 in east Devon during a freak snowstorm. Road, rail and air transport was badly affected throughout the country, while hundreds of schools closed. Some councils in England were concerned that they would run out of road salt.

By mid-February, snow was still falling in some places so we continued to warn people of ice on roads and pavements, advising them not to venture

out unless their journey was essential. In mid-February, melting snow and heavy rain meant that we again teamed up with the Environment Agency to monitor flood risk. It was a challenging time for many people, including the Met Office, but our early forecasts proved to be highly accurate and useful — especially for the emergency services.

As winter held the UK in its icy grip, some people confused the short-term weather with the end of climate change. In reality however, the cold snap in the UK was an example of the usual variability of weather. Despite variations, global temperatures continue to rise, emphasising how relatively cold our winter was, embedded within the warming trend. At the same time as we had snow in the UK, there was an extreme temperature of 47 °C in Australia causing devastating wildfires, emphasising the need to look at climate change with a global perspective. In fact, 2008 was the tenth warmest year on record globally, all of which have occurred since 1995. Indeed, the way in which the UK noticed and reacted to the cold snap shows just how accustomed we have become to recent mild winters — in line with our climate change predictions.

Last summer, the Hampton Court Palace Flower Show marked the start of a budding relationship between the Royal Horticultural Society and the Met Office.

As the UK's number one gardening charity, the Royal Horticultural Society (RHS) has always looked to the Met Office to find out what's going on with the weather. However, last year this relationship blossomed further. At the Hampton Court Palace Flower Show 2008 the RHS and the Met Office teamed up to educate and advise Britain's gardeners on climate change, and the impact this may have on gardens right across the country.

Garden party

Eager to come up with something different from the traditional marquee in which to create a unique showcase, the RHS opted for a striking geodesic dome complete with eye-catching displays. Inside, experts from the Met Office gave public talks about the science of climate change, supported by gardeners from the RHS.

"Visitors responded really well," explains Guy Barter, Head of Advisory Services at the RHS. "Each of the six daily talks attracted over a hundred visitors. With graphics and data from the Met Office we were able to demonstrate how climate change might affect the British gardens of the future, as well as give people practical horticultural advice they could put into action straight away." As a result of appearing at the show, Met Office scientists were also featured on BBC TV's *Gardeners' World*.

Climate change is expected to bring hotter, drier summers and milder, wetter winters over the next 50 to 80 years — and with it plant life, and gardeners, will have to adapt. "The changing climate is likely to have far-reaching effects on the average domestic garden in the long term," explains Guy. "Water logging and drought will both be big issues and some traditional garden plants, such as delphiniums and lupins, simply won't be able to stand up to the challenge, especially in the South East of England."

What's more, warmer temperatures will bring with them higher risk of pests and disease. The changing climate is already creating ideal conditions for the spread of insects such as lily beetle, rosemary beetle and red spider mite — all of which are a threat to gardens. Fungal diseases will also thrive with



Photos courtesy of RHS

In full bloom

increasingly wet winter conditions; recent wet, mild winters appear to have led to more fungal root diseases.

Harvest festival

However, the future of gardening in Britain is not all doom and gloom. In fact, Atlantic Europe is one of the few areas where climate change will actually benefit plants and crops. Gardeners are already experiencing longer and warmer growing seasons despite the wet weather. This means that, not only can a wider range of plants be grown, but plants will also tend to yield more.

Nevertheless, Guy is careful to stress that gardeners should still remain focused on the present when planning their gardens. "There's no point selecting plants for your garden in anticipation of a climate shift, because they simply won't thrive," he says.

"Instead, at the RHS we suggest going for plants that suit their current soil and conditions, so that they are able to resist whatever the climate throws at them in the short term. In the meantime, gardeners should cultivate an awareness of the potential changes that could occur in their garden so that they're prepared for the future, as it happens."

With the success of the Climate Change Dome at the Hampton Court Palace Flower Show behind them, the RHS hopes to continue to nurture its relationship with the Met Office, with plans afoot for another joint project in 2009. "At the RHS we are dedicated to promoting good gardening and the science of horticulture," concludes Guy. "And, collaborating with the Met Office enables us to do just that."

The summer of 2006 was hot. Too hot. As cities across Europe basked in glorious sunshine, a devastating livestock disease, traditionally found in Africa and the southern Mediterranean, was able to travel north.

A farm in Belgium was hit and the viral landscape of Europe changed forever. Striking cattle and sheep, the virus causes mouth and nose sores, soaring body temperatures, haemorrhaging, inflammation and breathing problems; all symptoms which could lead to lameness, infertility, miscarriage, stillbirth and even death — Bluetongue had arrived.

“Bluetongue is an economically crippling virus that has been able to spread north because of the warming climate,” explains John Gloster. “Passed from animal to animal by biting midges, the replication of the virus in the midge’s gut is temperature dependent, so warmer weather means a higher chance of the disease spreading.”

Watch out for the midges

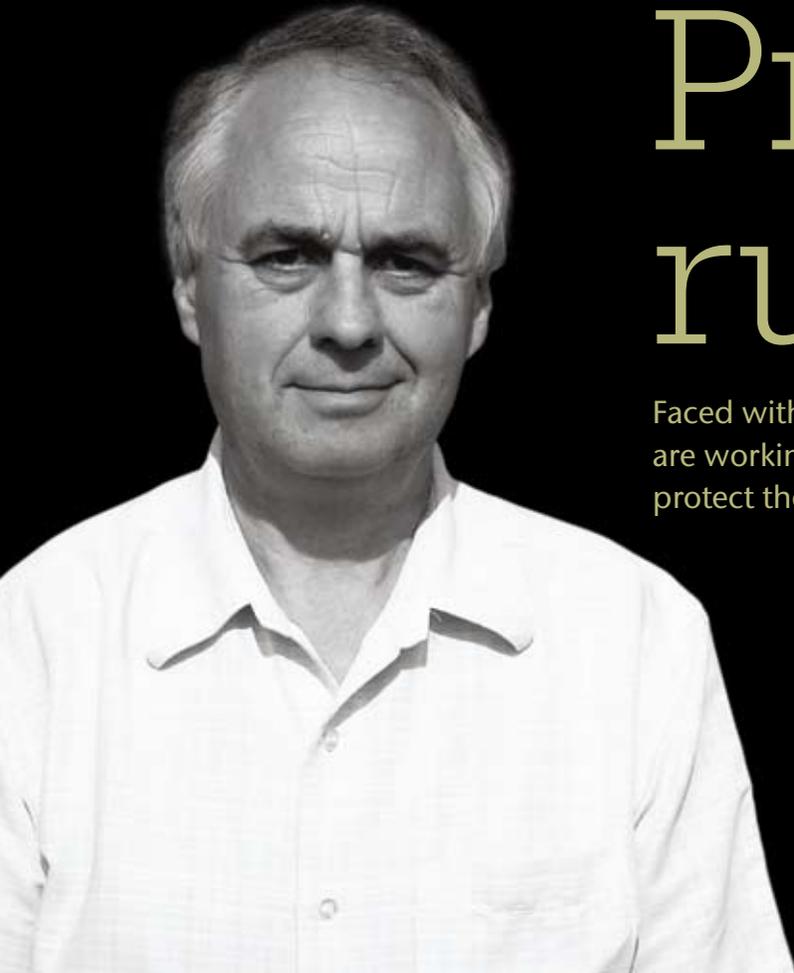
Based at the Institute for Animal Health (IAH) since 2004, John researches the spread of a number of exotic animal diseases that threaten the health of British farms, including Bluetongue. “The virus seeded in summer 2006. This was a time when temperatures were at their warmest, so the conditions were ideal for it to spread, transferring from midge to midge via either cattle or sheep,” says John. “In early 2007 it became apparent that the infection had survived the winter and the virus went on to affect thousands of farms throughout Europe, with almost 20,000 outbreaks recorded.”

With the warming climate, Britain has become increasingly susceptible to diseases like Bluetongue, which thrive in hotter temperatures. In order to address this threat, in June 2006, the Met Office and IAH were commissioned by the Department for Environment, Food and Rural Affairs (Defra) to monitor developments of Bluetongue in response to global warming and to create an operational early warning scheme for the UK.

“Through our research we began to untangle a very complex relationship between the weather and the midge itself,” explains John. “Temperature affects the midges’ ability to transmit the disease and its survival, while the weather, through wind speed and rain, either aids or prevents the midges from becoming airborne.”

Blowing in the wind

By exploring the relationships between these factors, John’s team was able to model how Bluetongue spreads and provide Defra with detailed information of where and when the disease might hit the UK. John works with the Met Office’s Atmospheric Dispersion Group. Laura Burgin, Atmospheric Dispersion Scientist, is responsible for a number of aspects of the work including integrating the results from the laboratory studies into an interface to the Met Office’s operational atmospheric model (the Numerical Atmospheric-dispersion Modelling Environment, or NAME for short). “We set up a web-based daily advisory service and ran the model every night from



Protecting rural Britain

Faced with an ever-warming climate, Met Office scientists like **John Gloster** are working with the Department for Environment, Food and Rural Affairs to protect the nation’s farms from the threat of exotic animal diseases.

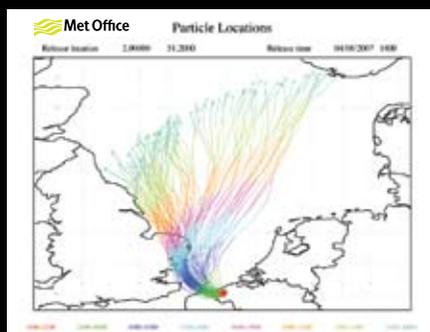


Photo: Erica Olsen/FLPA



Photo: Hugo Philippott/PA Photos

“We were able to deliver in real time. Within 30 minutes of speaking to Defra we identified the most likely date for the infected midges’ arrival — on the night of the 4/5 August — and where it had come from.”



Courtesy of Claire Witham

April through to November,” says John. “This meant that, when we knew where the disease was in Europe, we could tell if the midges would be airborne that night and where the wind would carry them. In this way we were able to successfully predict the arrival of Bluetongue infected midges into the UK before it had even happened.”

On 15 September 2007 there was a suspected case of Bluetongue in Suffolk. “We were able to deliver in real time,” says John. “Within 30 minutes of speaking to Defra we identified the most likely date for the infected midges’ arrival — on the night of the 4/5 August — and where it had come from.” This early warning system has since been upgraded to improve the service for Defra, providing information on the conditions at locations throughout Europe, along with a seasonality function to factor in the prevalence of midges.

Preventative steps

Thanks to this level of information, Defra is able to take preventative steps against the spread of Bluetongue in the UK. “Aside from educating and increasing awareness of the disease, we have been able to influence the National Farmers’ Union to explain the need for vaccination to their members,” continues John. “This meant that, at the end of the Summer 2007 season, to stop the disease spreading the following year, Defra could roll out a vaccination programme and, as a result in summer 2008, while Europe had over 20,000 outbreaks of the disease, Britain had none.”

Although a resounding success, there is no happy ending to the Bluetongue tale. Vaccinations only last for one year, so farmers need to undertake annual vaccination programmes. What’s more, IAH have identified two new strains of the disease which have arrived in northern Europe. “Type 1 and Type 6 reached the Netherlands and France in 2008, and both pose serious threats for Britain’s agricultural industry in 2009. For this reason, we can’t just sit back and relax. We need to run the early warning scheme every summer season, farmers need to remain ever vigilant and the Met Office, with the IAH, has to put all of its resources into understanding these new strains to prevent the spread of this crippling livestock disease.”

➡ Turn to page 11 to find out how our research helps the BBC make its Countryfile programme.

Bluetongue: the facts

- > Bluetongue is a non-contagious insect-borne virus which affects sheep and cattle.
- > There are 24 different strains of the virus each requiring a different vaccination. As the climate warms, Britain is becoming increasingly susceptible to all of them.
- > Bluetongue is spread from animal to animal by a biting midge which takes a blood meal as part of its lifecycle.
- > The warmer the weather the quicker the virus can replicate in the midge’s gut — which is why it is traditionally found in Africa and the southern Mediterranean.
- > Symptoms of Bluetongue include: mouth, nose and udder sores, soaring body temperatures, haemorrhaging under the skin, inflammation of the limbs and respiratory problems — all of which could lead to lameness, infertility, miscarriage, stillbirth and even death.
- > Infected animals do not need to be culled and can recover; but recovery is slow, dramatically affecting a farm’s economic productivity.
- > The midges which spread Bluetongue can also carry African Horse Sickness, a disease that has a high mortality rate and could cripple Britain’s equestrian industry if it arrived in the country.



Courtesy of the Institute for Animal Health

The tropics – forecasting and farming



For Guyana, situated on the north-east coast of South America, the climate is generally hot and humid — perfect conditions for growing staples such as rice and sugar. However, it's also prone to sudden intense rains that can be devastating for crops and livestock — and on the country's Gross Domestic Product (GDP). For Bhaleka Seulall, acting Chief Hydrometeorological Officer (Director) of the Guyana Hydrometeorological Service, there are plenty of opportunities to help protect the country from these extreme conditions.

Agriculture in Guyana accounts for 35 to 40 percent of GDP. While rice and sugar are the main crops grown along the fertile coastline, the Ministry of Agriculture is investigating the feasibility of diversifying and growing spice, peppers and citrus in other parts of the country where higher altitudes enjoy cooler temperatures.

The Guyana Hydrometeorological Service, part of the Guyana Ministry of Agriculture, is responsible for monitoring and evaluating the country's weather and water resources, along with providing essential

weather, water and climate information. It also actively supports the government in disaster risk-management and works closely with aviation, agriculture, engineering and other agencies to promote Guyana's socio-economic development. Yet, despite playing a major part in everyday life, the Hydrometeorological Service is still relatively small, with just two main bases and around 50 employees.

A fresh perspective

Bhaleka Seulall joined the Hydrometeorological Service in October 2002 after completing a degree in physics. At the time, it was a career path she knew little about.

"I fell into meteorology by accident, but I quickly realised it is the perfect profession for me. One of the most attractive aspects of my career was that I get to travel around Guyana. It's an incredibly dynamic job. I deal with some very diverse and fascinating technical and administrative issues," she explains.

After two years working for the meteorological service, Bhaleka travelled to the UK to study for an MSc in Meteorology at the University of Reading. "I chose Reading because its meteorological department is world renowned. Although it only takes a year to complete, the course is very comprehensive and covers weather, climate and modelling. Fortunately, I was able to get funding and support from the Met Office and the World Meteorological Organization (WMO)."

It was Bhaleka's first time in the UK, which she describes as a bit of a culture shock. "With its diverse atmospheric conditions, it's certainly the best place to study the weather. I saw hail, rain, frost... In fact, the only thing I didn't get to enjoy as much was snow."

Eighteen months after returning to Guyana, she took up the roles of acting Head of the Guyana Hydrometeorological Service and Guyana's Permanent Representative to World Meteorological Organization and became involved in developing meteorology, hydrology, and climatology policies,

as well as contributing to the country's sustainable development. It has proved to be quite a challenge. Forecasting in the tropics is not easy and, over the past decade, the weather has become increasingly erratic.

Devastating extremes

In January 2005, 224.5 mm (10 inches) of rain fell in 24 hours, devastating agricultural land, and killing livestock — both of which had a major impact on GDP. More recently, two weeks of heavy rain destroyed large fields of food crops, alongside numerous residential homes. The Hydrometeorological Service is keen to better understand and predict such phenomena so it can help protect the local farming communities and the wider economy.

"Fishermen and farmers make up a large proportion of our customers, and they want far more detailed information," says Bhaleka. "Ideally, they need to know exactly how much rain will fall in their area at a specific time. If we predict 20 mm of rain, what this will mean in practical terms for them — should they irrigate the crops or apply fertilizers? This is one way the Guyana Hydrometeorological Service could be more proactive."

By strengthening the agricultural meteorology section of the service and providing forecasting models and products that can be easily used and understood by farmers and fishermen, the industry would be equipped to deal with the rise in high intensity, short frequency rainfall, which Bhaleka believes can be attributed to climate change.

Predicting the unpredictable

Climate change is already having an impact on developing countries where economies are heavily dependent on agriculture and natural resources. Rising sea levels, excessive rains and subsequent droughts have detrimental effects on land, crops, local residents, fresh water supplies and much more.



Photo: Heiner Heine/Imagebroker/FLPA

Photo: Duncan Simpson/Panos Pictures

To deal with such dramatic changes, the Hydrometeorological Service has a number of carefully devised plans to enable local communities to be more involved in managing the impacts of climate change. The plans include providing valuable training for TV and radio broadcasters, as well as training for managers across different industries, in the hope that clearer forecasting will better protect a country at risk from tropical weather extremes.

Meanwhile, in order to strengthen Guyana's early warning system, the Hydrometeorological Service will be installing a Doppler weather radar to detect objects in the air like raindrops, snow crystals, hailstones or even insects and dust. The radar will help show the location and intensity of approaching weather systems, including thunderstorms and hurricanes.

The future forecast for Guyana may be hotter but, with Bhaleka and her staff at the helm and with the continued support from the Ministry of Agriculture, it also looks brighter.

Did you know?

- > Guyana is in the north-east of mainland South America.
- > The country is bordered by Suriname, Venezuela and Brazil.
- > Around 90 percent of the population live off ten percent of the land, largely condensed along the fertile coastland.
- > Agriculture in Guyana accounts for 35 to 40 percent of GDP, with rice and sugar forming the main crops.
- > The Guyana Hydrometeorological Service is part of the Ministry of Agriculture. It is responsible for monitoring and evaluating the country's weather and water resources, as well as providing essential weather, water and climate information.
- > The meteorological service has two main bases — Head Office in the capital Georgetown and the Aeronautical Meteorology Section and Weather Forecasting Office at the airport. It currently employs 53 members of staff.
- > The climate in Guyana is typical of a tropical region. It is hot and humid, with two rainy seasons from May to mid-August and mid-November to mid-January.
- > In the past 10 years, Guyana has experienced extreme precipitation patterns, particularly in December and January. For the past three years, there have been rains of higher intensity and shorter duration.
- > On 10 December 2008, 89.4 mm rain fell within two and half hours.
- > Climate change is a very real issue in the country — records show the hottest days are becoming hotter and nights are becoming warmer in Georgetown.

When reporting on, from and for the British countryside, knowing about the weather and climate is essential – in more ways than one.



John Craven Photo: BBC

Country life

As presenter of the BBC rural current affairs programme *Countryfile*, John Craven has been experiencing the delights and difficulties of the countryside for almost 20 years. From the driving snow of the Highlands and the unpredictable waters of Cornwall's coast to the low-lying mists of the Welsh valleys, the production crew has seen it all, rarely filming indoors. "*Countryfile* revels in the British countryside," says John. "We're out in the elements 48 weeks a year, so knowing what the weather is set to do and how to prepare for it is vital."

Yet, it's not just the crew behind the scenes that needs to know what's going on with the weather, it's an important element of the programme itself. The *Countryfile* forecast, broadcast live during each programme, is an essential tool for rural communities and outdoor enthusiasts.

"It's been part of the show from the beginning," says John. "During our 20th anniversary episode I spoke to our original Met Office weatherman Bill Giles, who explained that, right from the early days, it was regarded as one of the most important forecasts for the BBC."

A week in the country

Longer and more detailed than the daily forecasts, viewers watch *Countryfile*'s extended forecast to help plan their outdoor activities for the week ahead, whether it's ploughing the fields, or walking the fells. "The Met Office forecasters take into account our viewers' needs and tailor the coverage accordingly. They know to pitch it for those that depend on the most accurate weather information possible," says John.

Although the *Countryfile* forecast is a significant part of the programme's makeup, it's not the only aspect of the show that relies on the expertise of the Met Office. Pulled together by a team of experienced researchers, *Countryfile* covers stories from all over rural Britain – from big social and environmental issues to popular outdoor leisure activities. While researching these stories, the team often consults the Met Office, seeking out the most accurate information to feed into their content.

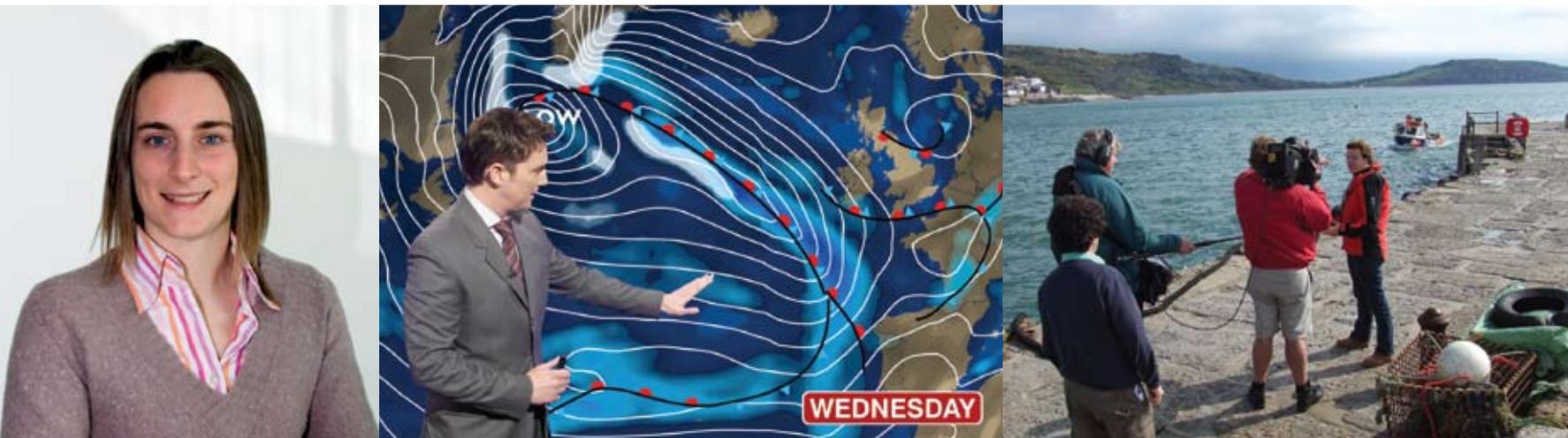
"We've marked the 20th anniversary of the Great Storm with a visit to the Met Office in Exeter; former BBC Head Forecaster Helen Young has featured in

two climate change specials; and forecaster Peter Gibbs gave us an interview about how the east coast is being affected by rising sea levels," explains *Countryfile* Series Producer, Teresa Bogan. "Those shows could not have been put together without the Met Office."

Serving the community

It's not just the meteorological features on *Countryfile* that the Met Office contributes to either. Over the last 20 years a wide range of animal diseases have featured heavily in *Countryfile* because of the potentially devastating effect they have on rural communities. From Bovine Spongiform Encephalopathy (BSE) in the 1980s to Bluetongue and Foot and Mouth in the 2000s, the programme has been responsible for ensuring that farmers have up to date information, facts and comment at their fingertips.

"We have a loyal following among rural communities since we directly reflect their interests and concerns," says John. "During the Foot and Mouth outbreak farmers relied on us to tell them what was happening." At the height of the 2001 crisis *Countryfile* was live every week with the latest



Claire Witham, Met Office Scientist

Photo: BBC and Met Service, New Zealand

“At the height of the 2001 crisis Countryfile was live every week with the latest information and the Met Office played a key part in this through its close work with Defra, forecasting the airborne spread of the disease.”

information and the Met Office played a key part in this through its close work with Defra, forecasting the airborne spread of the disease.

Mutual benefits

What people might not realise, however, is that the relationship between the Met Office and Countryfile isn't all one way — Met Office experts have gained a lot from working with the programme too. Atmospheric Dispersion Scientist, Claire Witham, joined the production team as part of a media fellowship scheme, which aims to provide scientists with well-honed communication skills.

“Claire was a tremendous asset to the team,” enthuses Teresa. “After getting to grips with the making of a TV programme, she started working on the stories alongside our own researchers. Claire was also able to bring her own expertise to the programme. When Bluetongue disease gripped sheep farming in Northern Europe, the weather was crucial in determining whether the disease would reach the UK. Because of her background, Claire was just the right person to help ensure that we delivered the best possible coverage of the story.”

Hard news, entertaining features

Whether it's the threat of Bluetongue, the beauty of ancient woodland walks or the impact climate change will have on our countryside, what Countryfile is most proud of is its ability to strike a balance. “It's incredibly challenging. We have to combine hard news stories focused on the issues closest to those who live in rural Britain with magazine features celebrating the joys of the countryside,” concludes John. “That's the thrill of it, though — engaging people with every aspect of country life when they switch on the programme.”

With a move to BBC1's Sunday teatime slot scheduled for April 2009, Countryfile hopes to bring the countryside alive for an even wider audience. The Met Office will be there from the forecast to the features, helping the production crew to reveal the role of the weather in the daily life of rural Britain.

➤ To find out more about how the Met Office was involved in the handling of the Bluetongue crisis, turn to page 7.

Did you know?

- > Countryfile is a big hit with viewers, with 2,000,000 people tuning in each week — impressive figures for a Sunday morning show.
- > As a result of its success, from April 2009 Countryfile will be moving to a Sunday teatime slot to reach a wider audience.
- > Countryfile is on our TV screens 48 weeks a year and the crew is out filming every week, whatever the weather.
- > The first episode of Countryfile was broadcast in 1988.
- > John Craven joined the team from children's current affairs programme, Newsround, in 1989 and has been presenting Countryfile ever since.
- > It was Met Office forecaster Helen Young that duped John Craven for his This Is Your Life moment. They were 'filming' a feature about Helen for Countryfile at the BBC weather studios, when Michael Aspel appeared with his big red book.
- > 20% of the UK's population lives in rural Britain. However, a recent survey revealed that many more have romantic ideas of pursuing the good life, with 83% of those living in urban areas saying they would like to live in the countryside.

Down in the woods today

When it comes to the impacts of climate change, being prepared hinges on one thing — interaction.

“We take the data produced by Climate Research and use it to clearly explain to customers what it will mean in real terms.”

Whether it’s the spread of the northern forests in Russia, the thawing of the peat bogs in Scotland, or agricultural expansion in the tropical rainforests, for the Met Office Hadley Centre’s Climate Impacts Team, understanding how climate change will affect life on earth means understanding how everything upon it interacts.

Focused on the impact climate change will have on the land surface — and what impact the land surface will have on climate change — the team’s work builds on traditional climate modelling. “Most of the time, the projections from climate change models only look at changes in things like temperature, rainfall or sea-level rise,” explains Impact Model Development Manager, Pete Falloon.

“Impact modelling goes beyond these fundamental observations to explore what the changing climate will mean for all natural ecosystems — including forests, river flows and crop production — and how these will feedback into a change in climate itself.”

Joining forces

Historically, the communities of impact modelling and climate change modelling have remained separate but, in October 2007, the Met Office created an Impacts Model Development Group within Climate Impacts, thereby committing to a more joined-up approach.



“Until recently, the Met Office Hadley Centre was focused on providing climate change scenarios and data,” explains Jemma Gornall, Climate Impacts Scientist. “However, there was a realisation that policymakers and commercial customers needed more than that; they needed a way of taking this data and implementing it into policy and planning, which is where our team comes in. We take the data produced by Climate Research and use it to clearly explain to customers what it will mean in real terms.”

The team does this through a number of commissioned research and application projects, which range from analysis of the changing carbon cycles in northern Russia, to the potential conflicts between agricultural expansion and climate change mitigation in the future. “Owing to the interactive nature of climate change, politicians are faced with very difficult choices,” says Jemma. “It is crucial, therefore, that they understand the impact of their decisions, so that they can make the most informed choices possible.”

Robust science

Informed choice is exactly what lies behind the Eliasch Review, an independent report commissioned by Gordon Brown to look at the cost of reducing forest loss and, consequently, enhancing natural mitigation of climate change. The Climate Impacts Team not only provided a scientific report on the role of forests in regulating the climate and the likely impacts of deforestation to feed into the review, they were also involved in the reviewing process to ensure that all science included in the report was robust.

Model behaviour

To undertake such complex work, the Impact Model Development Group uses a complex tool built around the principle of interaction. The Joint UK Land Environment Simulator (JULES) describes the processes happening at the land surface, including plant growth, evaporation and heat exchange. By using numerical models, the team can assess the likely impacts of climate change on factors such as vegetation productivity and water resources, as well as how these feed back into the climate change cycle.

The key to the success of JULES, however, is that it’s not solely operated by the Met Office. Administrated by the Centre for Ecology and Hydrology (CEH), JULES is a community model, which means that any scientist can access and contribute to the model’s development.

“It’s a really constructive approach to model development since it encourages everyone to interact,” explains Pete. “It enables scientists to bring their best new developments to the fore, and to place them in a context where they can be shared and improved jointly, without taking away from the individual work that people do.”

For Pete, Jemma and the rest of the team, the significance of the work they do within climate change research is obvious. “Without studying the interaction of the land surface with the atmosphere, we wouldn’t be able to achieve an accurate representation of climate change,” says Pete. “Everything we do is about striving to understand the real situation of our climate, so that we can best predict what will happen in the future.”

It’s all linked

Predicting just how climate change will affect the rural landscape is a complex task...

- > In Northern countries, warmer temperatures will allow the expansion of forests into areas currently dominated by shrub vegetation. This may increase carbon storage and exert a cooling effect on the climate.
- > However, in Amazonia, global warming is predicted to dry the area which may lead to the ‘dieback’ of forests, emitting large amounts of carbon into the atmosphere and accelerating climate warming.
- > In snowy landscapes the spread of forests could further warm the local climate because trees are darker than the snow covered surface so they absorb more radiation.
- > This increased warming could consequently lead to the thawing of peat bogs that contain huge stores of carbon. This exposure could in turn increase global warming.

➤ Turn to page 15 to find out how soil is represented in our forecasting models.



It may sound strange, but the soil affects our weather. Imtiaz Dharssi, Data Assimilation Scientist, explains how soil is represented in weather forecasting models — ultimately vital research that will create more accurate forecasts.

The answer is in the soil



Photo: David Burton/FLPA

Most people rarely stop to think about soil. However, soil — the layer of weathered rock particles and decaying organic matter on Earth's surface — is incredibly important since it supports life. Understanding soil is essential for meteorological, climatological, agronomic and hydrological applications. Properties of soil have a significant impact on near-surface temperature and humidity, low clouds and precipitation by influencing the

exchange of heat and water between the land surface and the atmosphere. During summer, soil moisture is thought to be one of the most important variables influencing the weather over land regions, far from the sea. It has been suggested that the continental European summer climate depends on winter and spring soil moisture accumulation; the years with low soil moisture corresponding to hotter and drier summers.

Representing soil in forecast models is essential for producing accurate forecasts. Soil moisture can vary significantly over short distances so measurements made at one location are not especially informative about conditions at neighbouring locations. Variability in soil moisture is partly due to the spatial distribution of rainfall but also the spatial variation of the soil's physical properties, vegetation and topography. Consequently, there are few observations of soil moisture. Instead, observations of screen temperature and humidity are used to specify the soil moisture at the start of a forecast in the Met Office global weather forecasting model. As errors in the model's initial soil moisture cause errors in forecasts of screen temperature and humidity, knowledge of errors in forecasts of screen temperature and humidity can be used to slowly correct, or 'nudge' the model's initial soil moisture.

Working with experts at the University of Reading, attention has focused on improving the model soil hydraulic and thermal properties. The soil hydraulic properties affect the ability of soil to hold water and the rate at which water moves through the soil. Soil moisture, together with the soil hydraulic properties, controls transpiration from plants and direct evaporation from bare soil. The soil hydraulic properties are derived from information about soil texture; fractions of sand, silt and clay particles and organic matter. Also, the soil thermal conductivity and heat capacity depend on soil moisture and soil texture, so they also influence the land surface-temperature.

Improvements to the calculation of soil thermal conductivity result in a significant reduction of both the model's northern hemisphere (NH) summer warm-bias and the model's NH winter cold-bias. Average errors in screen temperature for the NH winter are reduced by about 10%. During summer, the new soil thermal conductivity gives a greater flow of heat from the surface into the ground

resulting in atmospheric cooling. In winter, there is a greater flow of heat from the ground towards the surface resulting in a warming of the atmosphere. The direction of the flow of heat depends on the vertical temperature gradient. Improvements to the model soil hydraulic parameters are found to significantly increase the model soil moisture, by reducing surface evaporation and run-off. The new soil hydraulic properties significantly reduce errors in screen temperature and humidity. All these improvements have been incorporated, in parallel, into the Met Office climate prediction model.

Future improvements include a more accurate calculation of the flow of water through unsaturated soils and use of more accurate regional and global maps of soil texture. Long term, significant improvements to the initialisation of soil moisture in weather forecasting models are planned. Most notably, microwave remote sensing by satellite offers global data coverage with a horizontal resolution similar to the grid-length used by weather forecasting models. Unfortunately, satellites only sense the top few centimetres of soil. Therefore, assimilation methods are being developed to combine information from indirect observations such as screen temperature and humidity, precipitation and surface radiation with satellite measurements. Assimilation methods are also being developed to correctly propagate information from the satellite measurements into deeper soil levels.

Representation of soil and soil moisture are becoming increasingly important areas of research at the Met Office — both for weather forecasting and climate prediction. So, the answer is in the soil, and you can be certain that we are looking for it.

➔ See the opposite page for a profile on Imtiaz Dharssi, Data Assimilation Scientist.

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...

Imtiaz Dharssi loves problems. Corrupt data, inaccurate programmes, incorrect code — these are all opportunities for him to do what he does best. As a Data Assimilation Scientist in the Met Office Meteorological Research and Development Team, Imtiaz uses his problem solving expertise to improve the performance of the Met Office models.

Yet, it wasn't a passion for the weather that led Imtiaz to the Met Office, more a passion for how it was predicted. "The Met Office uses sophisticated numerical models to predict the weather and climate," he explains. "To develop these models you need strong physics, maths and computing skills. I've been fascinated by these things from an early age, so I have all the skills that the Met Office requires."

Fault finder

Imtiaz first joined the Met Office in 1990 as part of the Data Assimilation Team, which focuses on using observations to specify the initial conditions in a model at the start of the weather forecasting process. "When I describe what I do people often think it sounds quite easy," Imtiaz continues. "However, all observations contain errors, so one key task is to find ways to filter these errors out. Also, satellites usually measure indirect quantities such as the radiation emitted by the land surface or atmosphere and it is very challenging to use these indirect observations."

During his PhD, Imtiaz developed mathematical models and computer programmes. His first role at the Met Office required him to put these skills into practice. "The first project I worked on was for the European Space Agency," says Imtiaz. "The organisation was working on a satellite that could measure wind speed, but about 50% of the observations the satellite gathered were corrupt. I had to design a quality control scheme to detect and remove the corrupt observations. I wrote a mathematical description of the problem and then developed a novel algorithm to solve the problem."

Imtiaz implemented this algorithm as a computer programme, followed by testing and full documentation of results — which led to the publication of his work in a peer-reviewed journal.

Globetrotter

In 1997, Imtiaz left the Met Office to travel in India, Thailand and Indonesia, where he took up a post lecturing in computer programming, a role that helped to develop his communication skills. Following his return to the UK in 2005, Imtiaz rejoined the Met Office and the Data Assimilation Team, where he now works on improving the specification of the land surface in weather forecasting models, this time focusing on soil.

"Soil moisture is thought to be one of the most important variables influencing the weather over land regions, far from the sea, during the summer," says Imtiaz. "But, there are very few observations of soil moisture content available. This means that we have to use indirect observations such as near-surface temperature and humidity to deduce the soil moisture content."

Providing solutions

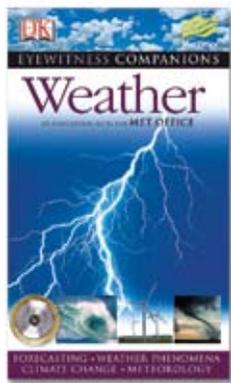
Collaborating with scientists from the Climate Research and Surface Processes teams at the Met Office, as well as experts from the University of Reading, Imtiaz combines various expertise to find the best solutions to such problems. "To get the best results we combine my skills in numerical modelling with the scientific input of land surface experts. It's about joining up different knowledge and backgrounds to find a solution — the final product."

The key to Imtiaz's continued motivation is simple. "The most rewarding part of my work is the fact that it has helped to improve such a wide range of Met Office resources, from the high resolution regional weather forecasting models to the global weather forecasting model and the climate prediction models," he concludes. "I am able to turn my research into practical solutions, which improve the Met Office's ability to forecast the weather, and that is very satisfying."



Imtiaz Dharssi,
Data Assimilation

"Soil moisture is thought to be one of the most important variables influencing the weather over land regions, far from the sea, during the summer."



The Met Office has teamed up with Dorling Kindersley to produce a book about the weather and climate as part of the publisher's Eyewitness Companion series. The book shows just how important the weather is and the profound effect it has had on humanity.

The Weather book

The new book, simply entitled, 'Weather' describes the complex science of meteorology. Whatever your age or knowledge, the book covers everything you need to know about weather and climate.

Drawing from expertise across the Met Office, the book covers a wide range of areas, looking at how weather works, weather phenomena, world climates and forecasting. The book also covers climate change in detail, using facts, figures and world-class science from the Met Office Hadley Centre.

It also has a fascinating section on the history of weather:

"From the earliest migrations to the rise of the great empires, the course of human history has hinged on the weather. The climate has always determined where and when humans have thrived — indeed, climate change poses the greatest threat to human society over the coming decades.

"Over the course of its history, the Earth's climate has undergone dramatic changes. Volcanic activity over millennia changed the mix of gases in the atmosphere, allowing complex life-forms to evolve, which in turn affected the climate by emitting or absorbing greenhouse gases such as methane and nitrous oxide, and in the case of humans, producing vast amounts of carbon dioxide through industrial processes.

"In addition, fluctuations in the source of our energy, the Sun, have tipped the planet in and out of ice ages. Only a few thousand years ago, the world was in deep "freeze", with extensive ice sheets extending from the poles and much lower sea levels. In fact, much of today's natural landscape was fashioned during the last glacial period and the millennia that followed.

"Weather extremes have shaped the course of human history in dramatic ways. When the last ice age began and sea levels fell, the first humans began their exodus from Africa. In more recent times, large migrations, such as the mass migration that followed the Irish Potato Famine in the 1840s, have been partly forced by weather conditions. Battles have been won and lost — and history determined — in many instances because of the weather.

"As scientific understanding of weather developed in 16th and 17th centuries, and instruments such as the barometer were invented, farmers and seafarers began using the weather to their advantage.

"Today, we are faced with the effects of man-made climate change, and devastating consequences if industrial society does not change the polluting ways in which it produces energy.



The tragic conflict in Darfur, East Africa, for example has arisen over dwindling areas of arable land, caused by reduced rainfall.

"Climate is inextricably linked to our past and our future. Whatever we do to shape the world we live in, the weather will always play a vital role in deciding our fate — and that of our planet."

For your chance to win a copy of the Weather book simply complete and return the pre-paid card at the back of this issue of Barometer.

➔ You can order the Weather book for £12.99 from www.dorlingkindersley-uk.co.uk or by calling Dorling Kindersley's general enquiries number 020 7010 3000.

Images courtesy of Dorling Kindersley

A life less ordinary

Lord Bath

From TV celebrity to writer, artist and proprietor of one of the UK's best-loved tourist attractions, it is hard to pigeonhole Lord Bath and his extraordinary life. The question is, with so many considerations — and indeed, responsibilities — what makes him tick?

Lord Bath is regarded as one of the UK's more eccentric aristocrats and the media will often focus on his unique sense of style or alternative way of living. But delve deeper into his life and it quickly becomes clear he puts a great deal of care and thought into all his work.

His artwork for example, plays a key role in the daily tours of Longleat house. The murals stretch around all four walls and ceilings of many rooms and each have different themes.

In one of Lord Bath's favourite sitting rooms, he has painstakingly depicted the ages of man, starting in the first panel with conception and working its way through innocence, adolescence, maturity and finally eternity on the ceiling.

"I start by thinking about the wall space I have to work with and then about the subject. Sometimes, there's a chapter of my life that needs pictures."

While much of his work draws from the psychology of dreams and shows a fascination with the typical challenges that face mankind, his work is also very personal. This is perhaps best highlighted in his poetry and the memoirs he's been painstakingly writing for decades — much of which can be viewed on his website.

His memories are highly candid and while the published versions stop with the end of his academic studies in Oxford, he has continued to add to them over the decades. Out of respect for others, he is waiting for the right time to publish.

Wild side

The idea to turn part of Longleat into a safari park initially came from Jimmy Chipperfield of the famous British Chipperfield's Circus, and was very quickly taken up by Lord Bath's father.

"At the time, my father was desperately looking for something he could do with the house — and a way to make money."

Longleat was the world's first safari to open outside of Africa and was an instant success. It covers 128 acres of the 9000-acre estate. While Lord Bath delegates the running of the park, he is constantly mindful of the challenges the attraction faces.

"The weather affects us enormously. A good year means we are in the height of business. The state of the economy also has an affect, but the weather makes a considerable difference."

The best days for Longleat are bright, but not too hot — when the temperature soars, people tend to



Photo: PA Photos

flock to the coast. The animals, however, seem less concerned by the vagaries of the British weather than the tourists and adapt very easily to the temperate climate. As Lord Bath points out, "You find lions on the snowy fringes of Kilimanjaro, so big cats can take the cold."

Longleat is home to an impressive array of animals including giraffes, rhinos, wolves and even tigers. It has a successful breeding programme, which this year has seen the arrival of infant meerkats, sea lions, rhesus monkeys and wallabies to name just a few.

Heritage home

While the animals at Longleat are unaffected by the British weather, the house itself doesn't always fare so well. It was built on the site of an original priory, which burned down in 1567, took 12 years to complete and is widely regarded as one of the finest examples of Elizabethan architecture in the country. The upkeep of such an impressive building is incredibly costly and recent repairs to the roof came to £1.2 million.

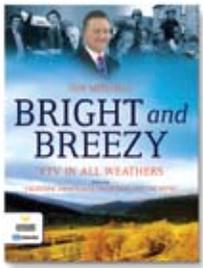
"It's a substantial investment", says Lord Bath. "But vital if the integrity of the house is to be safeguarded for future generations. It was last done 80 years ago and should have lasted

far longer but the length of the lead sheets used and the fact they expanded and contracted according to the weather caused problems.

Lord Bath moved into the house in 1952, following the death of his grandfather. Today, the house serves as both a home and tourist attraction and much of it remains in its traditional style. During the guided tours, visitors will often encounter Lord Bath sitting at his desk in one of the rooms displaying his artwork.

"I like it when people come in here as I have a pretext to talk about my murals. I enjoy that."

There may be many challenges to running Longleat but one thing is for sure — it's a great day out. There are few places where you could experience such imaginative artwork, set within fine Elizabethan architecture, and then spend time watching an array of animals from around the world. In fact, Longleat stands as a great and appropriate testament to Lord Bath, in both its wonderful eccentricity and its incredible diversity.



Bright and breezy

2008 was a great year for Met Office publishing. Jon Mitchell, Met Office forecaster and TV weather presenter for ITV Yorkshire compiled a book celebrating the 40th anniversary of Yorkshire Television (YTV). Proceeds from sales of the book, *Bright and Breezy: YTV in all weathers*, are being donated to the Yorkshire and the Lincolnshire & Nottingham Air Ambulances.

At the heart of the book is a collection of images sent in by viewers, capturing the region's weather with informative captions, for example see bottom image:

"This surreal image shows an approaching snow shower on the North York Moors, and a heavy one at that. This is reminiscent of the classic photographs showing approaching dust storms in the desert, but something different is going on here. The air is blowing in from the Arctic and vigorous cumulonimbus clouds are generating snow showers on a squall line. The snowflakes reflect light efficiently resulting in the appearance of a white wall."

Images courtesy of Great Northern Books

