Met Office

CLOUDY ISSUE
Clouds and climate

SKYWARD AMBITION
Customer focus

CLOUD NINE
Championship success

Barometer

Issue 10 www.metoffice.gov.uk Met Office magazine

Summertime for the Met Office brings high-profile outdoor events, such as Wimbledon and the Hampton Court Palace Flower Show, that rely on our accurate weather forecasts, explains Phil Johnston, Commercial Business Director.

No two gardens are the same

According to its organisers, visitors to the annual flower show at Hampton Court Palace rank the one-off gardens and distinctive floral marquees among their favourite features. Most visitors to the show spend about five hours walking around outdoors so, like its organisers, hope for fine weather. The Met Office helps visitors to plan their day in advance and staff to know if the covered restaurant will be packed with soggy sightseers escaping the rain. This year's Hampton Court Palace Flower Show (8–13 July 2008) additionally saw the Met Office team up with the Royal Horticultural Society to present a climate change dome, where visitors could learn about the impact of our changing climate on the UK's parks and gardens.

Just as gardening author Hugh Johnson observed, "No two gardens are the same", neither are Met Office customers, nor the way we respond to their unique requirements. Barometer describes how Met Office Consulting (page 6) takes the time to understand each customer's business operations now and how these may change in the future, depending on their sensitivity to the weather and longer term effects of climate change. Working closely with each customer from the inception of a project through to delivery, our Business Managers call upon a network of expertise from across the Met Office to offer strategic advice as well as tools and applications while ensuring scientific integrity and that the customer gets the best possible solutions. If you would like to find out how Met Office Consulting can help your organisation, email consulting@metoffice.gov.uk

In the past year, heavy rainfall and severe flooding may have provided a taste of the disastrous weather conditions associated with climate change. Yet while the future impacts may be much greater, they needn't take business or government by surprise. From this autumn, a series of new climate change seminars will be available from the Met Office that will be particularly appropriate for those with responsibility for, or an interest in, planning, projects and policies (pages 9 & 10). Importantly, they're designed to be accessible to everyone, whether or not you come from a scientific background.

In fact, making weather and climate change information accessible to all its customers is one of the most powerful things that the Met Office does. A view shared by Ewen McCallum, Head of Customer Services and Chief Meteorologist at the Met Office (pages 7 & 8). While it's vital to our customers to know what the weather and climate may have in store, to the Met Office first-rate customer service is as much about giving value to our information as accurate forecasting is. Our guiding principle is to work on the quality of the whole service, rather than just the communication of the raw material.

A fine example is the crucial role that Met Office forecasts play at Wimbledon where everyone hopes for sunshine and strawberries to accompany the world-class tennis The Championships offer (pages 11 & 12). For 13 days each summer, talking about the weather and Wimbledon — two very British institutions — are inextricably linked. While the balls are on court, detailed and up to date weather information is sent directly to the Referees' Office so officials know whether to expect sunshine or showers and how to respond.

Hugh Johnson summed it up well when he wrote that, "No two days are the same in one garden". Although Britain's weather may not see such extremes as some parts of the world, it rarely fails to surprise which is why more and more people are choosing to have the Met Office on their side.

In this issue

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.

Cover image: Cloud vortex streets off the Cape Verde Islands
Courtesy of MODIS Rapid Response Project at NASA/GSFC

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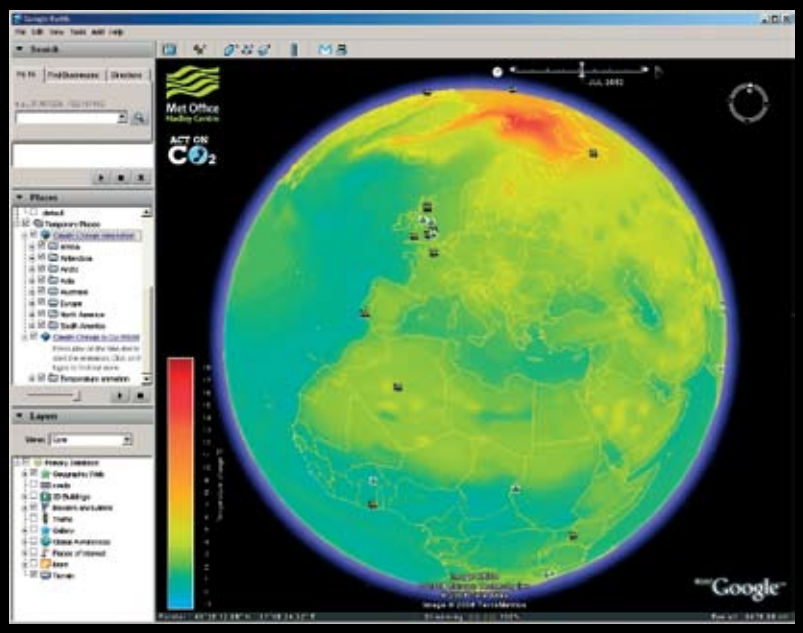
Facing the sun

Built over 33 acres, with each garden taking up to three weeks to create, and attracting more than 160,000 visitors, the Hampton Court Palace Flower Show is gardening on the grandest of scales. It's been held at Hampton Court Palace each year since 1989 with the Royal Horticultural Society (RHS) one of its key supporting charities. Preparations take 11 months and begin as soon as the display plants and products of the previous show have been sold off to visitors.

The RHS is the UK's leading gardening charity and is dedicated to advancing horticulture and promoting good gardening. As well as getting involved in educational events such as the Hampton Court Palace Flower Show, the RHS carries out scientific research into issues affecting gardeners including the way different plant species respond to different growing conditions.

For this year's Hampton Court Palace Flower Show (8–13 July 2008), the RHS teamed up with the Met Office to present a climate change dome (see artist's impression below). Here, visitors were able to learn about the impact of our changing climate on outdoor living, including on the growing seasons of indigenous plants within our parks and gardens.



Photos: ©Google

Redrawing the world

Millions of Google Earth users around the world can now see how climate change could affect the planet and its people over the next century. Thanks to a project involving Google, the UK Government, the British Antarctic Survey and the Met Office Hadley Centre, two new 'layers', or animations, have been added to the widely popular programme, one of which shows the loss of Antarctic ice shelves over the last 50 years. The other, uses world-leading climate science from the Met Office to show world temperatures over the next 100 years under medium projections of greenhouse gas emissions. Users can also read stories of how people in the UK and in some of the world's poorest countries are already being affected by changing weather patterns and access information on the action that can be taken by individuals, communities, businesses and governments to tackle climate change.

The new Google Earth animations were launched in May 2008 when Environment Secretary Hilary Benn said, "Climate change is redrawing the map of the world. Unless we act, its impacts will be felt everywhere, as sea levels rise, crops fail, extreme weather increases and more areas are at risk of drought and flooding."

Rain, rain, go away

Much of the damage in last summer's floods was caused by surface water flooding as a direct result of the extreme rainfall. The Met Office with the Environment Agency in England and Wales and the Scottish Environment Protection Agency has developed a six-month pilot service for emergency responders that forecasts and assesses the impact of extreme rainfall.

From July 2008, those who've taken up the offer will receive extreme rainfall alerts from the Met Office – county-level advisories that use our latest forecasting technology to make them aware of the risk of surface water flooding from extreme rainfall up to 24 hours in advance of an incident. Where possible, an 8-hour warning could help emergency responders test their action plans by taking preventative action, such as clearing drains of leaves and other debris.

From August 2008, to help emergency services, local authorities and utility companies in England and Wales target the areas most likely to be affected by surface water flooding, the Environment Agency will provide data showing areas naturally vulnerable to this type of flooding, where water may collect during extreme rainfall.

Ark of the Arctic

In the event of plant epidemics, nuclear war, natural disasters or climate change, the world's crops at least will be safe, deep-frozen in a vault in the middle of a Norwegian mountain.

The most northerly part of Norway, Svalbard (literally "cold shores") is an archipelago in the Arctic Ocean north of mainland Europe. Comprising the islands of Spitsbergen, Bear Island and Hopen and a handful of unpopulated neighbours, the archipelago is half the size of England yet home to fewer than 2,300 people. With 60 per cent of its landmass covered by glaciers, the islands' polar bear population matches its human one.

At its largest settlemet, the town of Longyearbyen, the midnight sun (where the sun remains visible at local midnight) can be seen from April to August, while polar night (the opposite phenomenon, where the night lasts for more than 24 hours) takes place from October to February with November to January spent in unbroken darkness. It's here, high above an icy fjord and deep inside a frozen mountain, that the Svalbard Global Seed Vault — dubbed 'The Doomsday Vault' — has been built to store samples of the world's agricultural seeds. Financed by the Norwegian government and overseen by the Global Crop Diversity Trust, it is hoped the project will safeguard crop diversity in the event of a global catastrophe.

Fenced in and guarded, with steel air-locked doors, motion detectors and polar bears roaming outside, the concrete facility — a 400-foot tunnel blasted into the side of a mountain — is, its backers say, the most secure building of its type in the world. The tunnel's chambers have the capacity to store seeds of the world's 1.5 million distinct agricultural crops, packaged in envelopes originally designed for the military and placed in sealed boxes. Each packet holds about 500 seeds, depending on their size, that represent one crop sample. They remain the property of the country that donated them.

Given Spitsbergen's singular geography, the vault has a natural temperature of -6 °C. Refrigeration units then reduce the temperature down to -18 °C. At this level of cold storage, conservative estimates suggest it will be at least 19,500 years before any deterioration occurs. Even in the event of equipment failure, the mountain's permafrost will ensure temperatures inside the vault never rise above -3.5 °C — perfectly adequate for seed conservation for some years.

But the Svalbard Global Seed Vault is not a stamp-collecting kind of exercise — its collections are destined for use. In future, as the number of donated samples grows, seeds will be taken out, planted and harvested and fresh seeds put back into cold storage. With up to 75 per cent of the world's crop diversity lost over the past century, and agriculture forced to adapt to shifts in climate, ever more virulent diseases and pests and the requirements of a rapidly expanding global population, restoring biodiversity is imperative.

Cross section of Seed Vault Image: Global Crop Diversity Trust

Photo: Mari Tefre/Svalbard Global Seed Vault

Cyclones, earthquakes and snow at Easter

Photos: Getty

Some meteorologists will argue that it's more likely to snow at Easter than Christmas and this rang true in March 2008 when people got to make snowmen while eating their Easter eggs.

But spring 2008 will also be remembered for two terrible natural disasters around the world, one meteorological and one not. On 4 May Tropical Cyclone Nargis ripped through parts of Burma and may have killed as many as 100,000 people; just days later, an earthquake measuring 7.8 on the Richter scale brought devastation to the Sichuan Province of China. Nearly 70,000 people lost their lives and 15 million people lost their homes.

Devastation on this scale can put our weather into perspective, but the elements still cause problems in the UK. This spring, that was particularly true of March. Statistically, the highest chance of snow at Easter will be when the holiday falls early in the year. This year it was particularly early and you would have to be 95 years old to remember the last time Easter Sunday was on 23 March. More surprisingly, it won't be that early again until 2228.

Predictions of Easter snowfall proved correct with nearly 30 cm recorded in the Highlands of Scotland and as much as 9 cm over lower parts of eastern England. Easter wasn't that bad everywhere though, with day trippers and holidaymakers enjoying some sunshine further west.

Another phenomenon steeped in weather history is the gales occurring around the March and September equinoxes. This year, a swathe of damaging winds and heavy rain crossed the country during the second week of March. On some coasts, winds reached 80 mph or more and Jersey recorded its highest wind speed since Boxing Day 1999.

Ten thousand homes lost electricity, trains ran under speed restrictions and the port of Dover was closed. Traffic was diverted from road bridges and Met Office forecasts alerted emergency services to deal with coastal flooding, damaged buildings and fallen trees.

Early April began in a similar vein to late March and it proved to be the coldest April for seven years. Another spell of sleet and snow moved southeast across the UK bringing 5-10 cm of lying snow to parts of the Midlands and South East England, closing Heathrow airport for a time and forcing travellers to change their plans. With April lying midway between winter and summer it is often a month of contrasts. A warmer spell replaced the earlier wintry weather and, by the end of the month, temperatures hit 22 °C in Norfolk.

By and large, May was a warm and sunny month. In fact, it was the warmest May across the UK since the Met Office's areal temperature records began in 1914, highlighted by the temperature of 27.5°C recorded at Great Malvern. There was some rain around, notably the heavy thunderstorms that brought nearly 58 mm of rain to Devon mid-month.

So, although Britain's weather may not see such extremes as some parts of the world, it rarely fails to surprise and the contrast between the first and last months of spring this year was a good example. On reflection though, perhaps it's not such a surprise when spring starts like winter and ends like summer.

Every business wants to succeed; which is why Met Office Consulting is on hand to provide weather and climate change information, helping organisations stay one step ahead.

United we stand

Among the hundreds of athletes who will be competing in this year's Olympic Games in Beijing, only a few will claim victory with a gold medal. So what is it that makes them stand head and shoulders above the rest? Of course, natural talent is essential. But, in order to achieve their full potential and really shine, they need a strong team of experts — from coaches to sports medics and dieticians — at their side who can support them through every stage of their training and competition programme.

The same is true for any organisation that wants to lead in its sector. One of the greatest challenges that most businesses face today is reducing and preparing for the effects of present weather and, in the longer term, climate change.

Eye on the ball

Head of Met Office Consulting Cathy Durston and her team works closely with customers to understand what kind of weather and climate information they need to succeed. "We take time to ensure that we have a full understanding of their business operations now and how these may change in the future," she explains.

"We have a number of Business Managers who are responsible for specific sectors and, as a result, they know their markets intimately and understand how they are responding to the weather and climate change."

The Business Managers in Met Office Consulting, who are all knowledgeable in aspects of either meteorology or climate change, have access to experts right across the Met Office and work with clients from the inception of a project, through to delivery.

Elemental gains

One of the first people that Cathy's team goes to is Dr. Sarah Jackson, Head of Customer Applications, located in the Meteorology Research and Development (Met. R&D) area of the Met Office. Among other things, Sarah is responsible for providing advice on the impacts of the past and current climate as well as day-to-day weather on policy, business and the environment, and developing tools and applications to help customers manage the implications for their businesses.

"I have a broad understanding of all of the research within Met. R&D and therefore know what we can do and who should advise on the most suitable approach to a project," says Sarah. "By using people who are actively working in the field of research to guide our consultancy we can ensure scientific integrity, and that the customer gets the best possible solutions."

Team players

With businesses becoming increasingly concerned about the impacts of climate change, Cathy's team and Sarah's team, often together, regularly collaborate with Dr. Mo Mylne, Manager of Climate Consultancy.

Mo's team is involved in a wide range of projects considering how climate change will alter the threats and opportunities that businesses will face. She is able to call on the pool of expertise within her own department, as well as the scientists who work at the Met Office Hadley Centre — a world-leader in climate change research. While some customers have very specific questions they want answering, others may come with a much broader brief. It is therefore Mo's challenge to help them define and achieve their goals.

"We have developed a methodology of scoping a business's sensitivity to climate change through interactive workshops," says Mo. "We then work with their strategic managers to identify and prioritise research that will enable them to begin to adapt in priority areas."

The combined forces of Cathy, Sarah and Mo's teams add great strength to Met Office Consulting. Nevertheless, within this web of knowledge and expertise, it never loses its focus. Just like the gold-medal athlete, the customer is always placed on the central podium.

If you would like to find out how Met Office Consulting can help your business, email consulting@metoffice.gov.uk. See also, 'Swapping notes' on pages 9–10 about the Met Office's new Climate Change Seminar for professionals.

Photo: PA Photos

Head in the clouds

There's meteorology and there's communication. When the two come together, that's when you get first-class forecasting. Throughout his career, **Ewen McCallum**, Head of Customer Services and Chief Meteorologist at the Met Office, has always had one eye to the sky and the other on his customers.

It was always obvious to Ewen what he was going to do with his life. "My earliest memories are of staring at the spectacular cloud formations in the Clyde Valley, south-west Scotland, where I grew up," he explains. "I wanted to know why the clouds were there, what it all meant and what might happen next — so I set about finding out."

Ewen learnt the science to underpin his passion and joined the Met Office in 1974 as a forecaster, so that he could continue to study the weather and communicate it clearly to others.

"Making weather information accessible is one of the most powerful parts of what the Met Office does, and is a key responsibility of a forecaster," Ewen continues. "It's a constant balancing act — it's one thing to use your skills to forecast the weather and another to help the public understand it. If you can't do that, then you're not doing your job properly."

Clear spell

Ewen honed his skills in communicating the weather during a spell at the Met Office College, where he instructed new recruits in the "dual language of forecasting". In 1987, he progressed to the role of Chief Forecaster and so became a media spokesperson for Met Office. As well as being involved in numerous communications

"Making weather information accessible is one of the most powerful parts of what the Met Office does."

projects, Ewen also appeared on television and radio, and commented on weather events for newspapers. Throughout this time, Ewen's goal remained constant — to ensure that the Met Office was not only producing accurate meteorological information, but that it was combined with the art of communication to create first-class forecasting.

Back to the drawing board

During the early 1990s, Ewen drew on this art of communication even more heavily when he took on the new role of Head of Forecasting. This hailed a period of dramatic change for the Met Office, as the forecasting process was put under scrutiny to see how it could be made more effective. This involved rationalising the forecast network — deciding how much should be centralised at the Operations Centre at the Met Office's former site at Bracknell — as well as introducing new technologies to improve accuracy.

"We had to ensure that these changes were smooth and straightforward for both staff and customers and didn't interfere with the Met Office's forecasting capabilities," Ewen explains. "Whatever the methods we use to gather information, the key to successful forecasting lies in how well we interpret and present the weather, and I wanted to make sure that we continued to get that right."

Go between

In recent years, Ewen's emphasis on balancing science and communication has been put into practice outside the forecasting arena — looking at how the Met Office can communicate with its customers more effectively. Now Head of Customer Service Management, Ewen has set up a team to act as a link between the business areas of the Met Office that talk directly to customers and the functional areas that produce the information.

"We've always had excellent meteorology and good science at the Met Office, but a few years ago we realised that our customer service needed attention," says Ewen. "My team was set up to improve the underlying processes that ensure service improvement."

Working with government departments, the utilities and transport industries, the Customer Service Management team identifies and addresses underlying problems in the Met Office's relationship with its customers — taking a proactive approach to customer service. "For me, customer service is as much about giving value to Met Office information as forecasting is," says Ewen. "Here, I'm working on the quality of the whole service, rather than just the communication of the raw material."

On cloud nine

Although he is now focused on customer service, Ewen remains ardent about the weather and continues to represent the Met Office in the media as its Chief Meteorologist. Recently, he had the opportunity to consider his lifelong enthusiasm for the weather — and clouds in particular — by penning the foreword to The Cloud Book by Richard Hamblyn, published by David and Charles in association with the Met Office, that aims to make sense of the ever-changing shapes in the skies.

Making sense of, and giving value to, meteorological information has underpinned every stage of Ewen's Met Office career. However, it also remains a fundamental fascination that links him to his childhood, and keeps him looking skyward.

Turn to page 17 to find out how clouds may affect climate change.

For a chance to win a copy of The Cloud Book, simply complete and return the survey at the back of this issue of Barometer.

Photo: Science Photo Library

Climate change: swapping notes

In the past year, heavy rainfall and severe flooding may have provided a taste of the disastrous weather conditions associated with climate change. Yet while the future impacts may be much greater, they needn't take us by surprise. With the Met Office's Climate Change Seminars government and business can learn about why and how the climate is changing and how to adapt and survive.

Pile driver working on sea defences

The effects of climate change are becoming increasingly tangible and include everything from uncharacteristic seasonal weather to severe flooding. In order to protect communities and commerce, the Met Office helps government and business to understand and plan for such events before they happen.

Indeed, Prime Minister Gordon Brown, speaking at the May Day Business Summit about the importance of creating an economy that can reduce and prepare for climate change, said: "We know that we will only succeed if individuals and communities, as well as government and business, are part of the solution."

For the past decade, the Met Office has been working with its customers to help them make sense of how climate change will affect their organisations (see United We Stand on page 6). Its Climate Change Seminars provide a solid foundation for professionals in the public and private sectors who want to understand the fundamentals of climate change and what they can do about it.

"It has become increasingly clear that there's a need for a seminar, aimed at professionals, that provides an overview of climate change," explains Jane Wardle, Business Manager for Government Business Development (GBD) at the Met Office. "As well as helping them to make better decisions, benefiting their organisation, it will act as an excellent basis for further training that focuses on the specific needs of their sector."

Ask the experts

As well as delivering the UK's national weather forecasts, the Met Office is a world-leader in climate change science, research and modelling. "We are in an ideal position to steer organisations through the challenges posed by climate change," says Kirstine Dale, Head of GBD. "The Met Office can guide its customers impartially, not only on climate change science but also on its interpretation, use and application."

The Climate Change Seminars are delivered by specialist Met Office presenters supported by scientists from the Met Office Hadley Centre. While it is relevant to all professionals who want to know more about climate change, it's particularly appropriate for those with responsibility for, or an interest in, planning, projects and policies. What's more, it is designed to be accessible to everyone, whether or not you come from a scientific background.

Many different organisations will benefit from the training including sustainable development planners, local authorities and emergency responders, as well as water, electricity and other utility companies and insurers, to name a few.

In the know

The Climate Change Seminar covers four key areas. In 'The Earth's Climate: An Introduction to Climatology,' participants will hear from the experts the latest evidence that the world's climate is changing, the reasons for these changes and the truth behind many climate change myths. Moving on, 'What Does the Future Hold?' will describe the global and UK predictions for climate change and its potential impacts.

'Planning for the Future' will look at ways organisations can reduce their contribution to climate change and, through case studies, focus on strategies to help them adapt. This is done alongside explaining the international and national policies that have been created in response to a changing climate. Finally, 'Sources of Help' will point course delegates in the direction of additional sources of information, advice and support.

"By the end of the seminar all participants will be able to recognise the steps they need to take to help their organisations best deal with the changing climate in their sector. They'll also have the tools they need to dispel scepticism about climate change

New stone groyne for coastal protection

Coastal defence under construction on the North East coast, England, UK

Photos: Construction Photography

"By the end of the seminar all participants will be able to recognise the steps they need to take to help their organisations best deal with the changing climate in their sector."

in their organisation and ensure their colleagues' engagement," says Jane.

The list of situations in which this kind of understanding may prove invaluable is endless. Just a handful of examples includes: design improvements to the Thames Barrier that are able to withstand rising sea levels and increasingly powerful storm surges; an assessment of the risks posed to the Department for Work and Pensions, for instance, relating to changing tourism and levels of unemployment benefit; and the construction of utility companies' infrastructure such as reservoirs, sewers and power stations that are able to withstand more extreme and intense weather.

Steps ahead

The Climate Change Seminar complements the Met Office's current range of courses, which have been developed to suit a wide range of learning styles and sector needs. This autumn, the Met Office will be taking things one step further with the introduction of an additional series of climate change workshops.

"These interactive sessions will help professionals in specific roles and sectors to see in detail how climate change may affect their organisations, and what they can do now to plan for it so they can lead them to a better future," concludes Jane. "Climate change is happening — now. With the help of the Met Office, everyone can be better prepared."

If you're a professional working in the public or private sectors and would like to find out more about how the Met Office can help your organisation plan for climate change, then email climate.courses@metoffice.gov.uk or visit www.metoffice.gov.uk

Climate Change Seminar at a glance

Delivered by experts from the Met Office and scientists from the Met Office Hadley Centre this one-day Climate Change Seminar covers:

- A myth-busting introduction to the Earth's climate and climatology
- The reasons behind why our climate is changing
- Global and UK climate predictions for the future
- The impacts of climate change
- The importance of planning for the future
- Strategies for reducing and adapting to climate change
- International and national policies
- Sources of further information, advice and support

Photo: Rex Features

Everyone hopes for sunshine and strawberries at Wimbledon. So, when the balls are on the court, Met Office weather forecasts have a crucial role to play in every game, set and match.

State of play

For millions of people around the world, the end of June means one thing: Wimbledon. The world-famous tennis tournament is as much a British institution as talking about the weather, and for 13 days in early summer the two are inextricably linked. The possibility of rain can affect Wimbledon almost every year, so it is imperative that the team behind The Championships know when it's going to strike, and whether it's going to spot or pour.

Court control

Championships Coordinator and Head of Security Richard Oxborrow and his colleagues have worked closely with the Met Office for many years to ensure that play runs as smoothly as possible, before and after the showers. Using a private system, the Referees' Office can access detailed, up to date weather information directly from the Met Office. This is then fed into an electronic communication network so that officials on the ground know when to expect rain, and how to respond.

"Play becomes dangerous when the grass courts are wet so it's important that the covers are pulled on at the first sign of rain, if not before," explains Richard. "The system we use is very simple — a series of electronic boxes, stationed around the grounds, display coded numbers that inform court coverers and umpires when to cover and uncover."

The forecasting service helps Richard and colleagues deal with other potential problems during The Championships, too. For instance, they need to know when to bring out the sun cream, as well as monitoring things like wind speed that may affect temporary structures.

Sowing seeds

However, it's not just about each individual Wimbledon fortnight — preparations for the following Championships begin as soon as the last point is won. From the Head Groundsman's treatment of Wimbledon's 40 grass courts to the construction cranes working on site as part of the Club's long-term development plan, accurate forecasting is an essential element of the year-round preparations.

Since 1994, two major developments have been completed — the new No.1 Court and Broadcast Centre finished in 1997, and the Millennium Building with new facilities for players, press and Club members, which opened in 2000. In addition, new offices and a state-of-the-art Wimbledon Lawn Tennis Museum were completed in 2006. But, it's the latest project that's set to revolutionise the way tennis is played at Wimbledon. In 2009 the Centre Court will have a brand new closing roof. Rain will no longer stop play. Instead, when rain is forecast, the translucent roof will shelter the court from above, while floodlights that mimic daylight conditions will illuminate the action down below.

"With a roof on Centre Court we are almost certain to finish the main events of The Championships on time," explains Richard. "It's psychologically distracting for players to constantly have to stop and start because of rain. Importantly, the roof will also allow us to offer our spectators, both in the stands of Centre Court and at home around the world, continuous world-class tennis — after all, that's why they're watching."

Weather gains

Ensuring that Wimbledon offers great tennis, day in – day out, has always been a guiding principle for The All England Lawn Tennis and Croquet Club, and coping with the problems that the weather can create remains an intrinsic part of that — whether it's lashing down a strawberry tent in high winds or activating an impressive retractable roof.

"It's our attention to detail that makes Wimbledon what it is," concludes Richard. "Responding effectively to weather conditions is just one piece of the jigsaw but, by doing so, we are able to make sure that Wimbledon remains the best tournament in the world on every level."

Did you know?

- The first Championship at the All England Lawn Tennis and Croquet Club was held in 1877 to raise money to buy a new court roller
- Championship tennis at Wimbledon was first televised in 1937 for an hour and a half a day; these days, Wimbledon fortnight is broadcast to 185 countries around the world
- There are 18 Championship courts including the famous Centre Court and No.1 Court, and 22 practice courts — all are grass and need year-round maintenance
- Around 470,000 spectators visit the grounds during the 13 days of play
- 2007 was the wettest Wimbledon in 25 years. One third-round match between Nadal and Soderling took five days to finish because of delays
- The Club's long-term plan has involved numerous developments, including the new No.1 Court and Broadcast Centre as well as the Millennium Building; improvements to the main Clubhouse and new Club offices; the Wimbledon Lawn Tennis Museum; and the retractable roof over Centre Court which will be in place ready for 2009

"With a roof on Centre Court we are almost certain to finish the main events of The Championships on time."

Photos: Seat Sport UK



Cutting to the chase

When it comes to all-conditions motor racing, SEAT Sport UK has a winning formula — to use the weather to its advantage.

Piers Phillips, Chief Engineer for SEAT Sport UK, gazes at the clouds above Donington Park. It's the third race weekend of the Motor Sport Association's British Touring Car Championship (BTCC) 2008 season, sponsored by HiQ. The team has had good results so far and are hoping to build on them this weekend; but, as always, what's going on in the skies above the circuit will have a massive bearing on what happens on the track.

In fact, the weather is a significant factor in the all-conditions BTCC and developing a winning or losing strategy has a lot to do with accurate forecasting.

Forewarned and forearmed

For 2008, SEAT Sport UK has brought Met Office forecasting into the fold and is benefiting from a bespoke service that has been designed specifically to help them plan their race tactics.

On the Thursday before every race weekend, Piers speaks to Met Office forecasters about how the weather is set to behave over the next three days. Over the weekend he might contact the Met Office another four or five times to ensure that his team are on top of the game. "The information the Met Office provides us with is invaluable," says Piers. "If it's going to rain at any point during the weekend, we need to know when, to ensure that we get the best out of every session."

Slick tactics

The race track responds very differently in different weather conditions — from cold and wet, to hot and dry — and affects the drivers' handling of the cars. To turn this to their advantage, teams change their tyres according to the conditions. For instance, when it's dry the mechanics fit the cars with 'slick' tyres that give maximum rubber contact with the road. This

"We're lucky to have the best team with the best information available to it, so we can ensure that we have the best-equipped car possible."

increases grip and allows the driver to go faster. Conversely, on a wet track there's much less grip. In this case, thick treads are used because they remove the water beneath the tyre and give the driver more control on the slippery surface.

Since one of the main restrictions of the BTCC is on the number of tyres a team can use, such decisions can be very important. "At Rockingham in April we had a very changeable weekend and drivers had to contend with all sorts of weather conditions. However, because of the Met Office forecasts, we were able to use that to our advantage," says Piers. "We knew it was going to rain on Sunday. This affected our choice of tyres on Saturday, as we didn't need the slicks. And because we were able to plan tactically, we had some good results."

En-genius

Such thorough planning is good news for SEAT Sport UK driver Darren Turner, as it gives him a head start before he's even pulled up to the starting grid. "Winning a race is definitely a team effort," he explains. "Although I can mentally and physically prepare for every race, a driver is only as good as his car. We're lucky to have the best team with the best information available to it, so we can ensure that we have the best-equipped car possible."

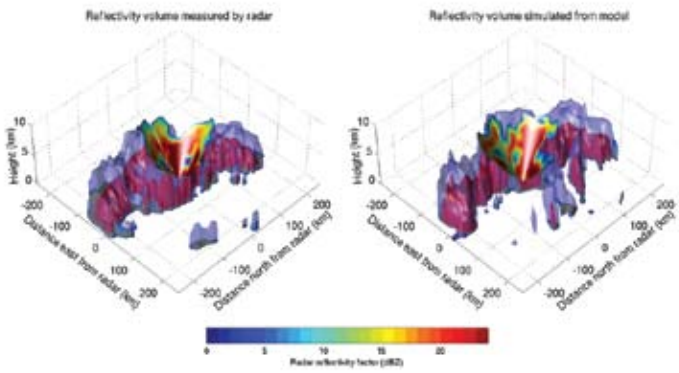
This season, that car is the Leon TDI — the first ever front-running diesel touring race car. A completely different concept to petrol, it is challenging SEAT Sport UK's world-class team of engineers and drivers to rewrite the racing rule book.

"With the petrol we ran last year we were very competitive in the corners and braking. However, we lacked a bit of raw straight-line speed," says Darren. "The diesel offers that but it behaves in a very different way, so it's a learning curve for everyone involved."

Luckily, they seem to be learning fast. At Donington Park the SEAT Sport UK team made history as the first diesel to win a round of the BTCC, and with wet weather affecting racing conditions, the Met Office can claim a part in the team's success. Going into the second half of the season, Darren Turner and team-mate Jason Plato were both in the top five. With the Met Office and the powerful Leon TDI behind them, the outlook for SEAT Sport UK looks bright — even when the weather doesn't.

With a horizontal resolution of 1.5 kilometres and 70 vertical levels, the Met Office's new "convective scale" UK weather forecasting model will become operational in 2009. The challenge now is to find ways of assimilating radar reflectivity observations into the new model.

Forecasting thunderstorms comes into radar range



Real and simulated 3D radar reflectivities of a band of rain

Photo: Science Photo Library

The new convective scale UK model will produce much better and more precise forecasts of small-scale weather features, including the intense local storms that can cause flash floods. But such forecasts depend on our ability to provide the model with accurate initial conditions and ground-based radars have the potential to deliver some of the high-resolution observations required.

For many years, the Met Office has operated a UK-wide weather radar network. The radars scan the atmosphere at several elevations and measure how much of the transmitted signal is returned (known as radar reflectivity). However, until now, only the lowest elevation scan has been used routinely (to estimate surface precipitation). The challenge is to exploit the full 3D capability of the radars in the new Numerical Weather Prediction (NWP) model; incorporating data about clouds and precipitation throughout the depth of the atmosphere, not just at the surface, using scans at all elevations. Using a technique known as "variational assimilation", we also need to choose the best parameters from the radar observations for the model.

The Met Office's variational assimilation system is a complex set of programmes that combine the available observations with a previous (6-hour) forecast to produce a model analysis. The assimilation system does not attempt to fit the model state to the observations exactly but, using estimates of the errors both in the model fields and in the observations, adjusts the model state to the most probable initial conditions. Some instruments, such as radiosondes, directly observe model variables (e.g. temperature and humidity) but remote sensing systems, such as satellites and radars, only observe model variables indirectly as they actually measure electromagnetic radiation, the properties of which are related to the atmospheric state. Therefore, for radar data we use an "observation operator" to simulate the measurement, given the existing model state. The assimilation system then adjusts the model state to give the most probable approximate match between the simulated and actual radar measurement. The observation operator must include all the factors that affect the radar signal, such as noise and attenuation as well as the reflection from hydrometeors (ice and water).

We plan eventually to assimilate the radar reflectivity signal directly using 4-dimensional variational assimilation ("4D-Var"). 4D-Var is so called because it assimilates observations at their locations in the three spatial dimensions, at their time of occurrence. It's the most complex and computationally expensive of the variational techniques used by the Met Office. However, significant further developments in the Met Office's 4D-Var system are required to accommodate the radar reflectivity data, and its implementation for the new NWP model awaits the availability of a more powerful supercomputer. As a first step, and following a methodology well established for other types of observations, we have developed an indirect approach which first derives estimated profiles of temperature and humidity in individual atmospheric columns. Using a theoretical relation between these profiles and precipitation in the column, a simpler variational retrieval method (1D-Var) is used to adjust the profiles to achieve an optimal match between calculated and observed precipitation. The resultant pseudo temperature and humidity profiles can be assimilated in the model, as though they were directly observed profiles.

Work is being carried out in parallel by the Met Office on exploiting other types of information from the radars. Doppler processing will give information about winds, and investigations are being carried out into the extraction and use of radar refractivity data, which have the potential to provide information on the horizontal variation of humidity and temperature in clear conditions.

All in all, 2009 promises to break new ground in weather forecasting, with the Met Office able to provide much better forecasts of exceptional rainfall over the UK — forecasts that will continue to improve as we learn to exploit the full potential of the new techniques being developed.

Science profile

Nicolas Gaussiat,
Research Scientist

''As a child I was fascinated by the dramatic clouds and thunderstorms in the mountains.''

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

Research Scientist Nicolas Gaussiat grew up in the French Pyrenees, where he developed a passion for mountaineering — and for the weather. "As a child I was fascinated by the dramatic clouds and thunderstorms in the mountains. The mystery of these phenomena and a desire to learn more about the complexity of the world inspired me to study Physics."

Nicolas spent a period at the University of Reading, where he completed postdoctoral research into the development of radar and lidar techniques to observe clouds. In February 2005, he joined the Met Office's Satellite Applications Group located at Reading University, though he has worked mainly at Exeter since April 2006.

Working with a number of different teams, including the Radar Development Group, the Data Assimilation Group, the Joint Centre for Mesoscale Meteorology and the Data Assimilation Centre, Nicolas is investigating ways in which measurements of the strengths of radar reflections from clouds and precipitation can be used to improve the detailed forecasts produced by the Met Office.

Butterfly effect

Met Office forecasts are generated by a system called Numerical Weather Prediction (NWP). This uses a mathematical model of the atmosphere based on the laws of Physics, which is processed by a supercomputer. The model's predictions are checked against actual observations, many of which come through radar.

"In order for a model to produce accurate forecasts, it must be given detailed and precise initial conditions," explains Nicolas. "Therefore, besides improving the model processes, what we need is to use a greater density of observations. For instance, failure to specify precise temperature and humidity profiles in an area of rapid development could result in a failure to predict a big storm further away."

Assimilation of new observations

As well as producing synthetic radar reflectivity observations from the model and comparing them with real observations from the UK radar network, Nicolas is developing new means of using the radar data to improve the description of the state of the atmosphere at the start of the model run. His aim is to "assimilate" radar observations directly into the new high resolution model that will run on the next supercomputer.

"One of the greatest challenges in my job is to maintain an innocence and a natural curiosity for trying something different, while at the same time having a clear understanding of what other people have done before me," says Nicolas.

This challenge shapes Nicolas' day. "Once I've attended to any urgent business, I devote my mornings to research, which energises and excites me. I use the afternoons for interacting with colleagues or attending seminars. This way I achieve an equilibrium between my independent self-drive and my enjoyment of working in a team. I find it very rewarding when I am able to share my research and collaborate in a confident way."

Natural reverence

Nicolas read Physics at Paul Sabatier University in Toulouse, France, where he also completed a Masters in Physics and a PhD in Atmospheric Physics before relocating to the UK in 2002. At the University of Reading he was involved with the CloudNet project, which focused on evaluating the representation of clouds in European weather forecast models.

These days, thunderstorm clouds are no longer such a mystery to him. "A lot is known about the physics of individual clouds. The challenge for scientists now is how to push the technical limits of dealing with the complexity of meteorological systems."

"Nevertheless," admits Nicolas, "though many of its secrets have been unveiled, I am still amazed by the beauty of the world."

"Clouds always tell a true story", wrote the Victorian meteorologist Ralph Abercromby in 1887, "but one that is difficult to read." Though he was referring to the influence of clouds on the weather, Abercromby's comment can just as aptly be applied to the relationship between clouds and climate.

Clouds and climate change

Over 120 years after Abercromby, Richard Hamblyn — author of the award-winning The Invention of Clouds — has written The Cloud Book in association with the Met Office, published by David and Charles. As these excerpts from his afterword on clouds and climate change attest, clouds are entirely unknown quantities when it comes to predicting long-term climatic changes:

"...Will clouds turn out to be agents of global warming, serving to veil us in an ever-thickening blanket of greenhouse emissions, or will they end up saving the day by reflecting ever more sunlight back into space? These, it turns out, are far from simple questions, and as the latest (2007) assessment report by the Intergovernmental Panel on Climate Change makes clear, clouds and cloud behaviour constitute major unknown factors in determining future climates.

'A change in almost any aspect of clouds, such as their type, location, water content, cloud altitude, particle size and shape, or lifetimes, affects the degree to which clouds warm or cool the Earth. Some changes amplify warming while others diminish it. Much research is in progress to better understand how clouds change in response to climate warming, and how these changes affect climate through various feedback mechanisms.'*

"But as is so often the case with climate science, much of this ongoing research yields apparently contradictory results. On the one hand, for example, many climate scientists believe that continued surface warming will see an increase in water vapour rising from the oceans, thus leading to an overall increase in cloud formation; while on the other hand, it has also been suggested that, in warmer latitudes, an increase in the water vapour content of our atmosphere would see large convective cumuliform clouds building up and raining themselves out far quicker than they do at present, thereby leading to a net decrease in the Earth's total cloud cover. We currently have no idea which outcome is the more likely, nor do we really know the kind of long-term influences that either would be likely to have. Even if, for the sake of argument, we assume that overall cloud cover will increase as the surface of our planet continues to warm, it remains unclear what kind of clouds (and thus what kind of feedback scenarios) are likely to predominate.

"For instance, high, thin cirriform clouds, such as cirrostratus, tend to have an overall warming effect, as they admit a lot of shortwave radiation in from above (in the form of sunlight during the day), while intercepting longwave back-radiation (warmth reflected from the sunlit ground) and despatching it back down to Earth. Any increase in cirrostratus cloud cover would therefore result in the addition of yet another warming mechanism to our climate. In contrast, however, bright, dense clouds, such as cumulus congestus, serve to cool the Earth by reflecting incoming sunlight back into space by day. At night, these same clouds can exert a slight warming effect, by absorbing or reflecting back-radiation, but their overall influence is a cooling one, especially when their summits grow reflectively dense and white.

"So, in theory, an increase in high, thin layers of cloud would amplify the global warming effect, while an increase in low, dense, puffy clouds would exert a contrary cooling influence. In reality, of course, things are never so simple...clouds have a habit of behaving in complex and unpredictable ways."

*Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

➔ For your chance to win a copy of The Cloud Book simply complete and return the pre-paid card at the back of this issue of Barometer.

➔ Readers can order The Cloud Book for the special price of £7.99 (rrp £9.99) with free p&p (UK only), by calling 0870 9908222 or emailing dcdirect@davidandcharles.co.uk quoting code D0041.

Golden dreams Georgina Harland

Four years ago, pentathlete Georgina Harland won a bronze medal for Great Britain at the Athens Olympics. Today, she is competing to secure a place in the team for London 2012. Here, she tells Barometer why the pentathlon is an unsung hero of the Olympics and what it's like to fence in 45 degree heat.

Photo: Action Images

The pentathlon was created in 1912 by the founder of the modern Olympic Games, Baron Pierre de Coubertin. The idea of the event was to simulate the skills needed in a 19th century cavalry soldier — just as the ancient games were modelled on the martial skills of that time. The result is a gruelling combination of five disciplines: pistol shooting, fencing, swimming, show jumping and running. Competitors accumulate points over the first four disciplines that count towards a handicapped start for the final event, the run.

"It's an incredibly exciting event," explains Georgina. "The tension builds during the day and it's not until the first runner crosses the finish line that the spectators know who's won the whole event."

Georgina was first fascinated by the Olympics when, at the age of 11, she saw the opening ceremony of Seoul in 1988. But it wasn't until 14 that she found her route into the pentathlon, when she joined a pony club. Already a keen swimmer and competitive runner, her all-round skills were spotted by a coach, who suggested the pentathlon could be a way to the Olympics.

It is this all-round ability that sets the pentathlete apart. From the composed concentration of the pistol shooting to the explosive aggression of fencing, or the endurance of swimming and running, competitors must be incredibly adaptable. Then, of course, there is the skill of show jumping that adds an entirely different — and slightly unknown — element. At events, competitors draw lots to determine which animal from a pool of horses they will get to ride. "You get just 20 minutes with a horse prior to an event and are allowed five practice jumps" explains Georgina.

The diversity of the event means a varied and gruelling training pattern. Georgina will train for most of the disciplines almost every day. That equates to between four and five runs, swims and shooting sessions a week, riding and going to the gym twice and fencing three times. But a tough training schedule is essential for the mental and physical stamina needed for an event — especially as all disciplines are completed on one, very long day.

"Events usually start early — at around 7.00 am — and end at around 6.30 pm. Basically, you're competing from dawn until dusk."

The gruelling demands of the pentathlon mean that athletes have to be strategic about the way they train, as Georgina explains. "You can't be at peak physical fitness for 12 months of the year — so you target a couple of competitions a year."

Although only two of the disciplines are completed outside, the weather and climate can still play a major part in any competition. The unpredictability of competing on a horse you've never ridden before is only exacerbated by wet or muddy ground, especially through tight corners. But even the indoor events can be affected.

"One of the toughest challenges the weather presents is when we're competing in very hot and humid countries that often don't have air-conditioned venues. This can be especially tough for fencing — the protective gear we wear can make it hard work when you're competing in a hall that's 45 degrees, for three hours. Staying hydrated becomes a challenge in itself."

The ultimate goal of any athlete is to be on the Olympic podium so Georgina's training is now focused on London and on making that dream a reality, for a second time.

Cloud boutique

This excerpt from The Cloud Book, written by Richard Hamblyn and published by David and Charles in association with the Met Office, introduces the reader to clouds as "objects of delight and fascination throughout history, their fleeting variability providing food for thought for scientists and daydreamers alike."

It goes on to describe, "'The patron goddesses of idle men,' as the playwright Aristophanes described them in 420 BCE, clouds and their ever-changing patterns have long stood as potent symbols of nature's restlessness and grandeur.

"But in contrast to all other earthly phenomena, from microbes and minerals to the greatest plants and animals, every known species of which had been classified and reclassified many times over since early antiquity, clouds (at least in Western culture) remained uncatalogued and unnamed until the early nineteenth century, when the Latin terms that are now in international use — 'cirrus', 'stratus', 'cumulus', and their compounds — were bestowed on them by Luke Howard (1772–1864), an amateur meteorologist from East London."