Met Office

THE WHITE STUFF
Inspirational polar explorers

SNOW BUSINESS
Studying the Arctic

ANTARCTIC SUMMER
Forecasting on ice

Barometer

Issue 8 www.metoffice.gov.uk Met Office magazine

A familiar brand name to households across the UK and to many overseas, the Met Office touches the lives of countless people and provides ever more useful weather forecasts in a changing climate, explains John Hirst, new Chief Executive.

The wind of change

Whether you're at home or at work, the Met Office influences the choices you make today and tomorrow. Should you open the windows or turn up the heating, take to the seas or stay ashore, weather the storm or insure your assets against flooding? The weather can act as friend or foe and with climate change these decisions are even harder and the costs potentially much greater.

The Met Office is continually broadening the horizon of weather and climate science (see page 15 for instance). It is also responding to your need for more tailored information to guide the choices you make — from whether or not to take an umbrella to the choices that will determine how and where our changing climate will impact your business and community now and in the future.

Readers of *Barometer* will have an insight of the breadth and depth of our work — from warning airlines of the need to de-ice before take-off (issue 1) to forecasting the weather during the Wimbledon Championships (issue 2); and from providing detailed weather reports in criminal and civil investigations (issue 6) to supporting our Armed Forces in theatre with critical environmental information (issue 7). Whatever your needs, the Met Office can translate its weather and climate science in a way that is meaningful to you.

Keen readers will also notice a difference to this issue of *Barometer* — from the striking black and white cover image to the way some of the features have been treated. Welcome to the Met Office brand which we hope brings to life to what we do, how people like you can connect with us and how we can help you make the best choices. The brand will be applied across all of our communications; you may have already spotted a sharper, more prominent Met Office logo on some television weather bulletins.

Although it may look poles apart from previous issues, Barometer will still be familiar inside. With winter approaching and in the midst of the International Polar Year 2007–08, this issue throws Barometer into deep freeze and profiles inspirational Polar explorers of the past and present such as Captain Robert F. Scott (page 4), Pen Hadow (page 6) and Sir Ranulph Fiennes (page 18). It delves into the work of our sea-ice scientists and climatologists who study how the Arctic Polar Ice Cap freezes and thaws each year and what annual variances in this process may tell us about climate change (pages 11–12).

Barometer also looks back at the Great Storm of 1987 and recalls the memorable words of Michael Fish in his well-known television weather bulletin that day (page 5). Talking of famous quotes, Barometer has another from Army Captain Lawrence Oates who, in 1912, accompanied Scott and three colleagues to the South Pole (back cover). Afflicted by frostbite, as the group retraced its steps Oates stepped out of the tent and into a blizzard never to return. Scott, knowing that he too was doomed, famously left instructions to his wife regarding their son to "try and make the boy interested in natural history if you can." Indeed, one of the charitable trusts that Sir Peter Markham Scott went on to found is now known as the World Wildlife Fund of which Met Office Chairman, Robert Napier, was Chief Executive.

Throughout history the weather and climate have made their presence felt, but today's Met Office can let you know what's in store with ever greater accuracy and detail. It is a great honour to lead this inspiring organisation as its Chief Executive and, like Barometer readers, explore and shape its future capabilities.

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The Met Office tenders an unconditional apology to the BBC and MetService, New Zealand, for failing to accredit the image on the front cover of the previous issue of Barometer to the Metra Weatherscape XT System.

Staying on track

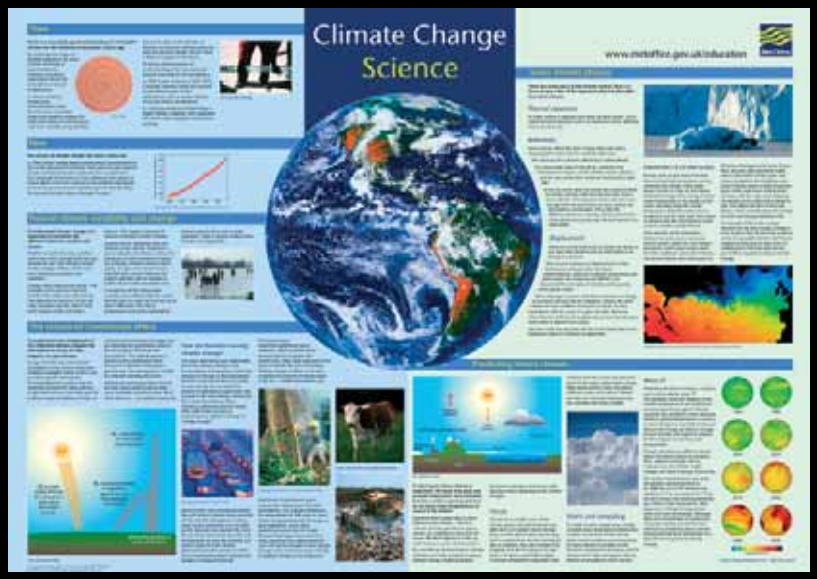
The changing seasons present different challenges for Network Rail with leaf-fall in autumn, snow and ice in winter and buckling railway lines in summer all seriously affecting rail operations and safety.

In September 2007, the company hosted three conferences in Manchester, Glasgow and London on 'Seasons Management', which focused on ways to keep Britain's railways on track — whatever the weather.

The conferences were an opportunity for train operators, suppliers and others to meet and share updates and ideas on managing seasonal weather that may benefit the rail industry. The Met Office was there to showcase the latest developments in risk-based forecasting.

Network Rail uses a weather forecasting tool from the Met Office called OpenRail. An updated version is being developed and trialled which looks at the probability of a particular weather hazard occurring, such as rain, wind or snow, that mirrors Network Rail's operational decision threshold; helping it to be more precise about weather risks to minimise the effects.

The Met Office also spoke on the topic of climate change, discussing the impacts on the rail industry and providing advice on how organisations can mitigate against the risks that it too presents.



Next generation

Two, new A1-size education posters will soon be available free of charge from the Met Office to help teach Key Stage 3 (11–14 year-old) schoolchildren about climate change.

Developed in partnership with the Department for Children Schools and Families, the posters are designed to encourage debate about climate change as part of the science and geography curricula.

The science poster looks at the history of climate change science and future climate projections as well as describing how our climate forecast models work. The potential environmental and human impacts of climate change across the globe are explained in the geography poster.

Together, the posters are intended to increase understanding of the science behind climate change and the potential impacts it will have, whilst highlighting where there are uncertainties. They are based on the latest climate change science and evidence from scientists at the Met Office Hadley Centre, who made a substantial contribution to the latest assessment report from the Intergovernmental Panel on Climate Change that was recently awarded the Nobel Peace Prize with Al Gore — see page 17.

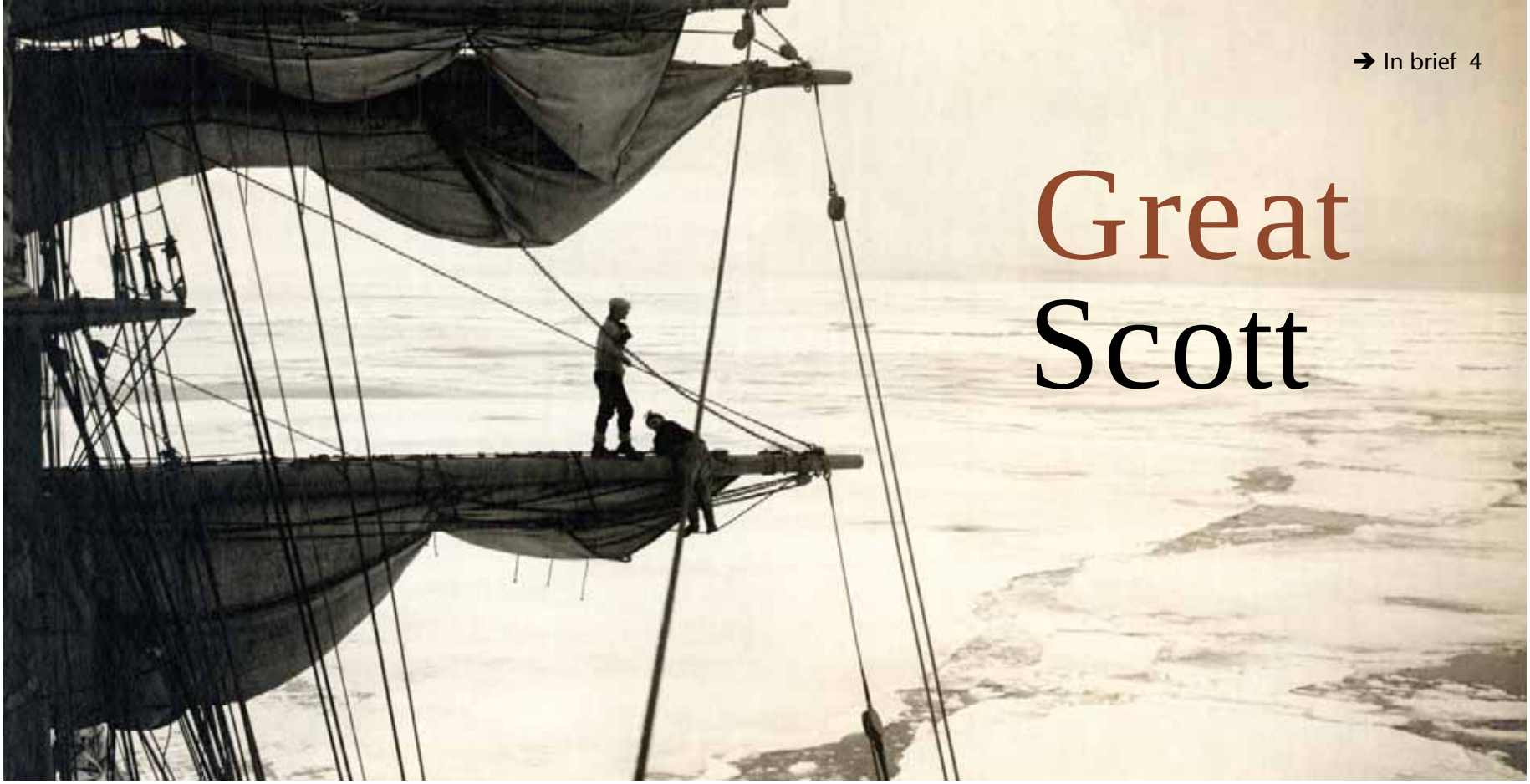
Both posters will be available on request from the education pages of the Met Office website at www.metoffice.gov.uk

Along the open road

For more than 15 years, the Met Office has provided essential weather information to the road transport industry through our OpenRoad service; helping it ensure that Britain's road network stays safe and open.

To build on our forecasting expertise in this area, the Met Office has been surveying parts of the road network to further understand variations in road temperature and state. By working with our customers, we've also gained a clearer picture of their issues and future requirements.

Based on this research, an improved service has been developed which will be trialled with a small sample of customers from November 2007. Delivered via an interactive website, it will include forecasts of the temperature and state of the road along chosen routes. With winter approaching, forecasting what lies ahead in even greater detail will help local authorities and managing agents for the Highways Agency minimise the effects of the weather on the country's roads.



Great Scott

Picture a desert and your mind may conjure images of an arid terrain where rain rarely falls on to the hot, baked earth. In fact, although it is primarily water, Antarctica is the world's last great wilderness.

On average, Antarctica is the driest continent on Earth. 99% of it is covered by ice, more than 3 miles thick in places, and there is very little precipitation except on the coasts. It is also very windy and exceptionally cold. The interior can plummet to a minimum temperature of -80 °C to -90 °C (-112 °F to -130 °F) in winter, while coastal areas can reach a comparatively balmy 5 °C to 15 °C (41 °F to 59 °F) in summer. Britain could fit into the reaches of this vast and icy continent more than 50 times.

For decades, scientists the world over have studied this hostile environment. Today, the British Antarctic Survey — one of the world's leading environmental research centres — is responsible for the UK's national scientific activities in the region where it is conducting a series of long-term studies and observations (see page 13–14).

Much of this current research is made possible by the earlier work of polar pioneer Captain Robert Falcon Scott (1868–1912) who, in 1901–04, was one of the first people to explore Antarctica extensively by land.

Scott's ill-fated second voyage departed on the **Terra Nova** from England in June 1910 to find out more about the weather, geology and animals of Antarctica and, ultimately, be the first to reach the South Pole.

After a year undertaking research and laying provisions en route to the Pole, a five-man party struck out to reach their goal. They arrived in January 1912 only to find that Norwegian explorer, Raold Amundsen, had been there a month earlier. Tragically, Scott's party succumbed to the unusually bitter weather that winter and perished on the return journey.

The meteorologist on Scott's expedition was George Simpson (later Sir George Simpson) 1878–1965, who was appointed Director of the Met Office in 1920. Retiring in 1938 Simpson was our longest-serving Director and, amongst his many other achievements, it's thanks to him that the Beaufort Wind Scale was adapted for use over land. Will John Hirst, our new Chief Executive (see page 1), remain in his post as long?

Did you know?

- 2000 years ago, Greek writers named a mass of land they imagined in the southern-most reaches of the world 'Anti-Arktos' (today's Antarctic).
- They had never seen it, but believed it must exist to balance land they knew about in the northern half of the world — Arktos (today's Arctic).
- Arktos is the Greek word for bear and some believe that the Arctic is named after the Great Bear constellation of the northern sky.
- Since the Arctic is home to polar bears, others suppose that Anti-Arktos literally describes a land devoid of the animal.
- In fact, no life forms exist in the Antarctic except cold-adapted species such as mosses and lichens, penguins and fur seals, which are only found on the milder coasts.
- Boreal forest is found in the Arctic but there are no trees in the Antarctic — its interior Dry Valleys are the most lifeless regions on Earth.

Then, now and to come

Heavy rain, well forecast this summer, left swathes of the UK under water and led to tragic consequences. With thousands of people stranded and even more left without power at the time, many wonder what happened to the UK weather and what lies ahead.

The soggy weather was largely caused by the position of the jet stream — a ribbon of strong winds in the higher atmosphere that drives weather systems across the Atlantic. From June to August 2007, the jet stream was further south and stronger than in a typical summer which brought low pressure systems or depressions with wind, cloud and rain to many parts of the country. But while the majority of the UK had well above-average rainfall from June to August and, noticeably, the coldest August since 1993, with a mean temperature of 14.1 °C the summer was very close to the long-term average.

A high pressure system finally returned to the UK in time for the late summer Bank Holiday weekend and replaced the unsettled conditions with lighter winds and sunshine from time to time. Temperatures reached 25 °C in parts of southern England — far more in keeping with the clear skies and fine weather that many hope for at this time of year. As we headed into autumn (September to November) temperatures remained close to or slightly above average, despite the chilly start to some mornings; although northern Scotland experienced its coldest September since 1994.

The relatively settled weather so far this autumn is in marked contrast to events of 20 years ago, that have been relived in the media. On 16 October 1987, a storm — which the Met Office expected to affect the English Channel and northern France — changed course and brought hurricane force winds to parts of southern England. Now referred to as the Great Storm of 1987, the winds blew down thousands of trees, cutting power, communications and transport links; tragically, eighteen people died.

To make matters worse, on the BBC One lunchtime news, now retired Met Office forecaster and BBC weather presenter, Michael Fish, made this famous statement, “Earlier on today, apparently, a woman rang the BBC and said she’d heard there was a hurricane on the way. Well, if you are watching don’t worry, there isn’t...”

In fact, Michael was referring to a tropical cyclone over the western part of the North Atlantic Ocean that day; so, strictly speaking, he was right because that storm never made it to our shores. As to what did unfold that night, Force 12 on the Beaufort Wind Scale defines hurricane force winds as 64 knots (72 mph) or more, sustained over at least 10 minutes. On 16 October 1987, hurricane force winds occurred locally but were not continuous or widespread. Local gusts are not taken into account but these exceeded 100 mph in places.

Despite not being classed as a hurricane, the Great Storm of 1987 was remarkable for its ferocity and the devastation that it caused — it was the worst storm to hit the UK for over 200 years.

Since the events of 16 October 1987, the Met Office has developed higher resolution forecast models which take into account more of the small-scale processes occurring in the atmosphere. Importantly, the National Severe Weather Warning Service now alerts the public to potentially dangerous weather. Observational coverage of the atmosphere to the south and west of the UK has also improved with ever increasing amounts of high-quality satellite data.

Today’s Met Office can indicate what the weather has in store for the next hour through to the season ahead and the future climate. Extreme weather events, though, such as the Great Storm of 1987, will always be difficult to forecast. This winter (December to February), our forecasters expect above average temperatures but it will not be as mild as last year. The last ten winters in the UK have been relatively mild and winter 2006/7 was the second warmest on record, with an average mean temperature of 5.6 °C. Updates to the winter forecast 2007/8 will be issued throughout the season.

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

Pole position

Scientists from around the world are contributing to the International Polar Year 2007–08, with a single goal — to understand the role that the Arctic and Antarctic play in global climate change. To mark this event, the Met Office is supporting British explorer, Pen Hadow, on a challenging 120-day expedition to the Geographic North Pole.

In the past two decades, Alaska, Siberia and parts of the Antarctic Peninsula have been the three fastest warming regions of the world. This has led to widespread concern for the future of the polar environments, ecosystems and societies. Consequently, polar research is now seen as crucial in understanding how our world works and how climate change is affecting it.

Faced with the threat of global climate change and the effect it will have on our people and planet, the international scientific community has come together for the International Polar Year 2007–08.

Frontier science

The International Polar Year (IPY) is the legacy of Hungarian scientist and naval officer, Lieutenant Karl Weyprecht, co-commander of the Austro-Hungarian Polar Expedition 1872–74. His experiences in the field led him to believe that the Earth's Poles held the answers to many fundamental meteorological and geophysical questions.

However, he realised that a true understanding of these remote polar regions would require the efforts of scientists from around the world. Sadly, Weyprecht did not live to see this dream come true. But, thanks to his vision, 12 countries took part in 15 expeditions — 13 to the Arctic, 2 to the Antarctic — during the inaugural IPY in 1882–83.

Since then, there have been three IPYs. The second (1932–33) involved 40 countries and focused on the global implications of the newly discovered jet stream. The third IPY, the International Geophysical Year 1957–58, used technology developed during World War II, such as rockets and radars, to advance research in the polar regions, particularly in the upper atmosphere.

Fifty years later, the International Polar Year 2007–08 is the most ambitious to date. Around 50,000 scientists from more than 60 countries are involved in over 200 projects in the Arctic and Antarctic, each of which is focused on understanding the influence that the polar regions have on climate change.

Icy territory

To mark the IPY 2007–08, the Met Office is supporting Devon-based explorer, Pen Hadow, on his 120-day expedition to the North Pole. Accompanied by top female polar explorer Ann Daniels and leading expedition photographer Martin Hartley, Pen will cross the Arctic Polar Ice Cap on foot, departing from Point Barrow on the north shore of Alaska, through the Northern Pole of Inaccessibility to the Geographic North Pole at 90° north.

During the expedition — the Vanco Arctic Survey — Pen will take measurements of the snow and ice thickness every 20 centimetres over 2,000 kilometres using specially-developed technology. In addition, he will core through the ice every 16 kilometres to obtain readings of ice density. This data will then be transmitted via a satellite internet connection to various institutions around the world, including the Met Office Hadley Centre.

"This will be the most detailed and accurate surface observation of ice coverage in the Arctic region ever undertaken," claims Pen. "While data from satellites and submarines can give scientists a good idea of sea-ice coverage, no observations are currently taken above 82° north or directly on the ice cap."

Since the Arctic Polar Ice Cap is in constant flux and sea-ice thickness can vary dramatically from one metre to the next, and from year to year, this data would be used in conjunction with other data sources. Scientists, as well as the global media, will be following Pen's expedition with interest.

Live wire

Through the Vanco Arctic Survey, Pen hopes to raise awareness of the issues of global climate change by bringing the realities of daily life in the Arctic into people's living rooms. As well as television broadcasts, there will be live web coverage of the expedition.

"One of our aims is to reduce the perception of the remoteness of the polar regions from people in their homes and offices," explains Pen. "The Arctic is about much more than polar bears and Christmas card scenes. We want people to understand what is happening on the ice cap and how it is responding to climate change."

To find out more about the Arctic Polar Ice Cap, turn to 'The big melt' on pages 11-12. For more information on the Vanco Arctic Survey, visit **www.penhadow.com**

weather satellite data

"Satellites are the only means of getting weather data from some parts of the world."

John Eyre, Head of Satellite Applications

"... to be useful, there must be less than three hours between the satellite data coming in and computer forecasts being produced."

Rick Rawlins, Manager of Global Data Assimilation

Come rain or shine

Every day, thousands of people watch, listen to or read their local weather bulletin live on television, radio and online. But, by the time it reaches your living room or office, the meteorological data has journeyed thousands of miles from satellite to the Met Office to the BBC studio.

While most people are asleep in their beds, Met Office forecaster and BBC weather presenter, Rob McElwee, is up at 4.00 a.m. to drive from his home in Buckinghamshire to the BBC Weather Centre in London to start his early shift at 5.00 a.m. On arrival, he has a five-minute handover briefing with his colleagues before a 5.05 a.m. conference call with the Chief Forecaster at the Met Office.

Along with a host of other national and regional weather presenters across the UK, Rob will be listening with careful concentration to what the Chief Forecaster has to say as this will form the basis of his working day. Following the conference call, Rob has just four hours to prepare his weather reports before broadcasting live on BBC News 24 at 10.57 a.m. This is followed by a continuous stream of live appearances on BBC television and radio stations until he delivers his final report back on BBC News 24 at 1.57 p.m.

"Although I have been doing it for 17 years now, I still find the most challenging thing is finding a concise way of presenting a full forecast in sometimes as little as one minute," explains Rob. "Television is easier because you can give a visual representation of what's happening with the weather. But, radio is always the most difficult as you have to try and paint a picture with your words."

Eyes aloft

A Met Office-trained meteorologist and fellow of the Royal Meteorological Society, Rob uses his scientific expertise to transform complex weather data into an engaging broadcast that can be easily understood by the general public. However, he is not the only person involved in this process. Before Rob's reports reach your home or workplace via your television, radio or computer, the weather data has travelled thousands of miles in a very short time.

Orbiting the Earth at a height of 800 kilometres, polar satellites carry instruments measuring infrared and microwave radiation sensitive to the temperature and humidity of the atmosphere and transmit these data to receiving stations around the world, including the Met Office. Meanwhile, geostationary satellites orbiting at 36,000 kilometres transmit pictures of cloud movement every 15 minutes. These are the images often used by weather presenters such as Rob for television broadcasts.

tv, radio and online weather forecasts

"We rise to the daily challenge of producing the best possible forecast for the benefit of those who will make decisions based on it."

Nicholas Grahame, Chief Forecaster

"Delivering forecasts that will make a difference during times of extreme weather is one of the most satisfying aspects of my job."

Rob McElwee, Forecaster and BBC Weather Presenter

Images and data from both satellites are vital for forecasters. "Satellites are the only means of getting weather data from some parts of the world, especially from the oceans and sparsely populated regions," explains John Eyre, Head of Satellite Applications at the Met Office, whose team of 30 research scientists is responsible for converting the raw satellite data into a form that can be used in the forecast models.

Weather makers

After John's team, Manager of Global Data Assimilation at the Met Office, Rick Rawlins, takes the helm. He merges satellite with other observational data to produce an accurate analysis of the state of the global atmosphere. This is used as the starting point for the computer forecast model which predicts the weather for up to six days ahead. These computer-generated analyses can be displayed as meteorological charts and used by forecasters to show wind, rainfall and other aspects of the weather.

"This analysis takes just 20 minutes — to be useful, there must be less than three hours between the satellite data coming in and computer forecasts being produced," explains Rick. "With millions of data streaming in, our team must ensure that optimum use is made of the information in the time available. This is all part of the continuous weather forecasting process, 24 hours a day, 7 days a week, 365 days a year."

End of the line

The direct feed of data from the Met Office computer forecast model is then accessed by that day's Chief Forecaster, who makes any necessary modifications before delivering the forecast to the BBC Weather Centre during the conference call attended by Rob and his fellow broadcasters. Says Chief Forecaster, Nicholas Grahame: "We rise to the daily challenge of producing the best possible forecast for the benefit of those who will make decisions based on it, especially when a severe weather event is expected."

Indeed, it is the accuracy of the forecasts and the impacts that they may have on people's lives which excites Rob. "Delivering forecasts that will make a difference during times of extreme weather is one of the most satisfying aspects of my job," he says. "While no-one would wish for the consequences of this summer's flooding, the BBC provided warnings well in advance, based on sound forecasts from the Met Office."

So, the next time you tune into the weather you may think about how that forecast was created, not simply how it will affect your day ahead. After all, there are people like Rob who have lost sleep over it.

Shore thing

Founded nearly two centuries ago, the Royal National Lifeboat Institution is a charity, which relies solely on donations to fund its 24-hour ‘blue light’ service. Operating throughout the UK and the Republic of Ireland, it rescues around 8,000 people and saves over 200 lives each year, whatever the weather or conditions at sea.

During wild winter storms when gale-force winds, towering waves and monstrous surf lash against Britain's shores and coastline, the dangers of the sea are obvious. But, on a sunny day when the calm, glassy waters look harmless and inviting, many of us can be lulled into a false sense of security. Yet, anyone who ventures out to sea — whether for a swim or a sail — needs to be constantly aware of the weather and the tides, as conditions can change and lives can be lost all too quickly.

Nobody understands this better than Peter Chennell, Sea Safety Manager at the Royal National Lifeboat Institution (RNLI). Based at the RNLI headquarters in Poole, Dorset, he is responsible for over 600 volunteers as well as raising public awareness about sea safety.

"Recently, there has been an explosion in the number of people using boats for leisure — this includes everyone from sailors to windsurfers to sea kayakers," says Peter. "Consequently, this also means that there are more people out on the water who have little or no experience of the ocean."

"The sea has been killing people for thousands of years and it's not going to stop now. Therefore it's imperative that people understand how winds and tides, for instance, can affect their safety at sea. A strong offshore wind can make it harder to paddle a kayak back to the shore, while a changing tide can turn learner-friendly calm waters into a choppy cauldron for dinghy sailors."

Saving lives

Operating a 24-hour rescue service throughout the UK and the Republic of Ireland, the RNLI has saved over 137,000 lives since it was founded in 1824. Its lifeboat crews and lifeguards are ready to respond to emergencies in all conditions, whatever the magnitude of the weather, wind and waves. However, Peter and his team are committed to saving lives long before people have even arrived at the coast.

"We strive for proactive lifesaving," explains Peter. "Our central strategy is to help prevent people getting into trouble in the first place. We do this by reaching leisure boat users in every way we can, from giving talks at local clubs to meeting members of the public at boat shows and events."

The RNLI has five key sea safety messages, each of which is equally important. They are: wear a lifejacket; check your engine and fuel; tell others where you are going; carry some means of calling for help; and, keep an eye on the weather and tides. Peter also advises people to get proper training before they head out and to know their own limits.

In the know

Where you are going and how long you are going to be out for both affect what boat users need to know about the weather and tides. There are a number of ways in which people can access this information, including through the local Coastguard and Harbour Office, and services such as Marinecall.

A leading provider of Met Office weather forecasts, Marinecall is dedicated to sea safety. Every day, its customers can access over 250 individual forecasts for coastal areas, inshore and offshore waters and various European locations by telephone, fax, text message and online. However, the service also has another crucial role to play.

Supporting safety at sea

A registered charity, the RNLI is reliant on volunteers and public donations to support and fund its activities. In 2006, the organisation's running costs were around £122 million, or £335,000 per day, and covered everything from recruiting and training volunteer lifeboat crews and lifeguards to maintaining lifeboats and lifeboat stations.

Recently, Marinecall announced the launch of a new facility that directly supports the RNLI. By dialling unique telephone numbers dedicated to the RNLI, any sailor or seafarer using Marinecall will make a contribution to the charity. Typically, from the billed cost of each call, 60% of the profit is credited to the RNLI.

"Not only will members of the public, as well as RNLI members, supporters and staff, be prepared for the conditions, they will also be raising funds to support the RNLI's lifesaving sea search and rescue service, which relies on the generous support of companies and the public," says RNLI Corporate Fundraising Manager, Louise Assinder.

So, if you want to stay out of troubled waters and help keep the RNLI afloat at the same time, remember the RNLI's five key sea safety messages and use Marinecall.

➔ To become a member of the RNLI or to make a donation, call 0845 122 6999 or visit **www.rnli.org.uk**. To find out more about Marinecall, visit **www.marinecall.co.uk**

Did you know?

- The RNLI has an active fleet of over 330 lifeboats based at over 230 stations in the UK and the Republic of Ireland.
- Since the RNLI was formed in 1824 it has saved over 137,000 lives.
- Last year, the RNLI launched 8,377 lifeboats, rescued 8,015 people and saved 236 lives.
- In 2006, 51% of lifeboat launches were to leisure-craft users, 29% to people who were not using any kind of craft, 12% to merchant or fishing vessels and 8% to other sea users.
- RNLI lifeboats range in length from 4.9 metres to 17 metres and enable the service to reach at least 90% of casualties within 10 nautical miles of lifeboat stations and 30 minutes of launch in all weather conditions.
- There are 4,710 lifeboat crew members in the United Kingdom and Republic of Ireland, just 8% of whom are women.
- Crews are largely made up of volunteers from the local community who dedicate many hours of their own time training to be highly skilled and efficient crew members.
- The RNLI employs around 340 seasonal lifeguards and also has about 50 volunteer lifeguards at its regional units in the East, South and South West of England.
- In 2006, RNLI lifeguards were called to 9,411 incidents and saved 63 lives. Over this summer, they assisted no less than 10,448 people.
- The RNLI's annual running costs amount to around £122.3 million. For every £1 spent, around 85p goes on operations and 15p on generating voluntary income.
- There are around 1,100 RNLI fundraising branches and guilds throughout the United Kingdom and Republic of Ireland. Their support allows the institution to call on thousands of people from all walks of life, who raise money to help the RNLI save lives at sea.

The big melt

Every year the Arctic Polar Ice Cap partially melts in summer and refreezes in winter. But, if current trends continue, the summer ice may disappear completely by 2070. This region is now under close scrutiny, with scientists from the Met Office constantly developing and improving forecasts to further their understanding of the diminishing ice cap.

Covering 4% of the world's ocean, at its maximum extent the North Polar Ice Cap floats above the entire Arctic Ocean and parts of the North Atlantic and North Pacific. The floating ice is easily moved by wind and ocean currents so its consistency is in constant flux; forming walls, ridges, cracks and open water, as well as melting and growing with the seasons.

During winter, when there is constant darkness and air temperatures hover around -40 °C, sea-ice coverage is at its greatest. In summer, however, the ice cap begins to subside. With the sun in the sky 24 hours a day, melting begins in June and continues through to September when ice coverage is at its least.

This natural process of freeze and thaw of the Arctic Polar Ice Cap has been happening for millennia, but scientists have only started to observe and measure it in any significant detail since the end of the late 1970s. The majority of data comes from satellites orbiting above the region and, to a lesser extent, submarines venturing into its icy depths. Some data are also collected from ships and marine buoys.

On the retreat

While it is likely that there will always be sea-ice coverage during winter, the rate at which the Arctic Polar Ice Cap is shrinking each year is alarming. Since satellite records began in 1978, the rising incidence of warmer summers has led to increased melting of the ice across the Arctic. The Met Office climate model predicts that the decline in summer ice will continue and that the Arctic may be completely free of summer ice by 2070 — other global climate models suggest that this may happen as early as 2030.

"If the Arctic Polar Ice Cap continues to melt at the same rate during

Summer 2007

Source: Met Office Hadley Centre

Did you know?

- Sea-ice covers around 25 million square kilometres of the world — that's an area about 2.5 times the size of Canada.
- Unlike icebergs, glaciers, ice sheets and ice shelves, which all originate on land, sea-ice is simply frozen seawater that floats on the surface of the ocean.
- During late winter, sea-ice typically extends over 16 million square kilometres in the Arctic and 19 million square kilometres in the Antarctic.
- Much more sea-ice remains at the Arctic during summer than it does at the Antarctic. Both regions are important for the study of global climate change.
- While there are natural, extreme fluctuations in the year-by-year sea-ice coverage, satellite data shows the average sea-ice extent at the Arctic Polar Ice Cap is gradually shrinking.
- On 16 September 2007, the National Snow and Ice Data Centre, based at the University of Colorado, reported that Arctic sea-ice coverage had reached a record low of 4.14 million square kilometres.
- The previous absolute minimum of 5.32 million square kilometres was recorded in September 2005.

summer, it will have a huge impact on the region," says Jeff Ridley, a climate scientist at the Met Office Hadley Centre.

"The indigenous people will be cut off from food supplies; as plankton move north, there will be more biological activity around the North Pole; polar bear population may decline; and, with the opening of sea passages and new areas of ocean, there may be international disputes about ownership of the region and access between continents. The shrinkage will also expose new territory for oil prospectors."

Sea-ice also affects global climate because its bright surface reflects much of the sun's energy back into space. Oceans covered by ice don't absorb as much solar energy as other areas, which means that temperatures in the polar regions remain cool. If global temperatures continue to rise, this will increase the melting of sea-ice during the summer. More of the sun's energy will therefore be absorbed by the oceans and this may, in turn, further impact the global climate.

Cracks in the ice

In the face of such impacts, it is no wonder the spotlight is becoming increasingly focused on the big Arctic melt. Indeed, in February 2008, British explorer Pen Hadow will embark on a 120-day expedition to the North Pole to raise awareness about the phenomenon (see page 6).

Yet, while satellite data clearly show that the Arctic Polar Ice Cap is shrinking, relatively little else is understood about the changes taking place on the ice. For instance, it has been difficult to measure ice thickness by satellite and there remains an area of 2.7 million square kilometres beyond 82° north for which no satellite data exists.

That is why scientists at the Met Office are continually working to improve models and analysis centred around sea-ice coverage. An important development is the recently launched Operational Sea Surface Temperature and Sea Ice Analysis (OSTIA).

"OSTIA is designed to meet the requirements of high resolution weather forecast and ocean models. The analysis is run daily on the Met Office supercomputer, using a large number of observations from a variety of satellite and in situ measurement platforms," explains John Stark, Sea Surface Temperature and Sea Ice Scientist at the Met Office.

"Since the sea surface temperature (SST) has a strong influence on many air-sea exchange processes it is a key parameter for accurate weather prediction. By monitoring the sea-ice and SST, OSTIA provides data for scientists to validate their models and help them understand the processes that are driving sea-ice retreat."

Ultimately, this will make for more precise global and regional weather forecasts and climate change prediction models, furthering our understanding of the future of the world's climate.

Antarctica is the place to witness spectacular weather phenomena such as halos around the sun and aurora in the night sky. As the last great wilderness, its pristine environment also acts as a barometer for the world.

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Courtesy of Chris Gilbert (BAS) www.photo.antarctica.ac.uk

White out

Making up nearly 9% of the Earth's landmass, Antarctica is almost entirely covered by a vast sheet of ice that may be as much as 30 million years old in places. It's an awe-inspiring environment that is of great value to meteorologists and climatologists worldwide.

Surveying the Antarctic

The British Antarctic Survey (BAS), part of the Natural Environmental Research Council (NERC), is one of the world's leading environmental research centres and is responsible for the UK's national scientific activities in Antarctica. Managed from Cambridge in the UK, the organisation supports three stations in the Antarctic — Rothera, Halley and Signy — and two stations on South Georgia — King Edward Point and Bird Island.

Based on proposals from staff, including colleagues from NERC and secondees from other organisations such as the Met Office, the BAS's current research programme, Global Science in the Antarctic Context (GSAC) extends over five years from 2005 to 2010. It is made up of 19 projects, covering everything from ecosystems and biodiversity to glacial retreat and climate.

At home in the snow

From March through to November, Antarctica is plunged into darkness, with temperatures plummeting to -50 °C or lower. These conditions make it virtually impossible for the BAS to carry out supply operations and sometimes there may be as few as ten people living on the main stations. During summer, however, temperatures rise and with 24-hour sunlight these bases become home to plumbers, pilots, generator engineers and other essential ground staff, all of whom are working to support the field scientists and to deliver GSAC.

Field operations manager Rod Arnold has spent 14 summers in Antarctica. Based at Rothera, it is his responsibility to see that everything goes according to plan, down to the finest detail. This includes deploying scientists in the field with enough food and fuel to last the summer as well as ensuring that pilots are able to fly their aircraft safely in the region.

"The team I work with is one of the most inspiring aspects of my job in Antarctica. Everyone is highly motivated and everyone is of equal value because of their unique skills," Rod enthuses. "It's like living in a capsule — there's nowhere else quite like it."

Polar forecasts

Among the 100-plus members of the team at Rothera, there is always a meteorological expert who acts as the sole forecaster for BAS, providing support for all operations in the Antarctic.

Met Office forecaster Donald Campbell was seconded to Antarctica from late October 2005 until mid-January 2006. Working seven days a week, he was up at 4.30 a.m. every morning to study the weather charts and data in preparation for the BAS weather briefing at 8.00 a.m., which also goes out to scientists via telephone and satellite internet communications. Although he was occasionally able to sneak out for a few hours of snowboarding or a game of five-a-side football, he was on call throughout the day — often until 11.00 p.m.

"Often the weather at base was extremely good — crisp and clear with temperatures ranging between 0 °C and -5 °C. But I also had to be aware of what was happening with the weather as far as 1,200 miles away in any direction," he explains.

"For instance, if there were pilots flying down from the Falkland Islands I had to be on the phone to them 10 minutes before they reached the point of no return for their fuel reserves and advise them on whether or not to continue their journeys. At times like these I would be pacing up and down for the duration of the flight until I saw the plane land safely at base."

Barometer of change

While individual Met Office forecasters like Donald support BAS operations, the collaboration

Courtesy of David Walton (BAS) www.photo.antarctica.ac.uk

Courtesy of Chris Gilbert (BAS) www.photo.antarctica.ac.uk

between the two organisations also works in a much wider context. All kinds of meteorological and climatological observations are made across Antarctica at both manned and automatic weather stations, as well as by scientists out in the field. Data from voluntary observing ships, weather balloons, radars, spectrometers, ice core drills and numerous other instruments are fed directly back to the Met Office in the UK and form the basis of research into the impacts of climate change.

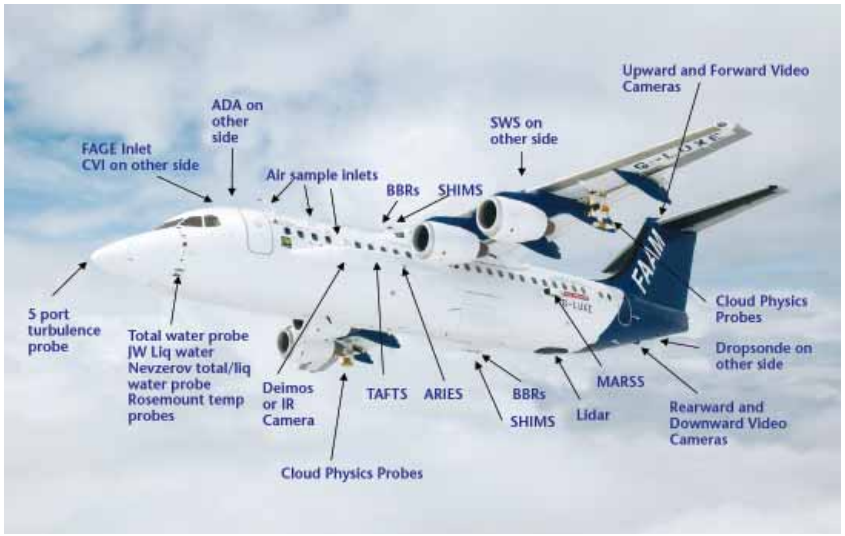
"BAS observations in the Antarctica Peninsula show that the region has warmed by 3 °C in the past 50 years, which is way above the average for the previous 750,000 years," says Jonathan Shanklin, Head of the Meteorology and Ozone Monitoring Unit at BAS. "This rise in temperature is a key indicator of climate change and we are now confident that the effect is man-made. At face value, it looks like we are committed to a further 5–6 °C rise in the future."

At first glance, Antarctica may appear a vast and desolate expanse of frozen wasteland, but look again and you'll discover there is much more to it than meets the eye. From the daily hustle and bustle of the scientists that live and work there to the greater mysteries it reveals about our world — past, present and future.

Did you know?

- The Antarctic region is an important regulator of climate change because its Southern Ocean acts as a sink for heat and carbon dioxide, buffering the effects of man-made climate change.
- If the atmosphere and ocean around Antarctica warm too much, the Antarctic ice sheets will melt and global sea levels will rise.
- The west coast of the Antarctic Peninsula has warmed rapidly in the past 50 years. Mean annual temperatures have risen by 3 °C, which is around 10 times the mean rate of global warming.
- The environmental changes on the Antarctic Peninsula have led to a decline in Adélie penguins and the increased colonisation of various plant species.
- Radar images from several European satellites show that glaciers on the Antarctic Peninsula are flowing faster, with a 12% increase in speed between 1993 and 2003. This is further contributing to sea level rise.
- BAS is the world-leader in research in the Antarctic and has an annual budget of £40 million.
- BAS runs nine research programmes and is responsible for five research stations, two Royal Research Ships and five aircraft in and around Antarctica.

➔ To find out more about the Antarctic region and BAS, visit **www.antarctica.ac.uk**



Broadening the horizon

The Met Office has been involved in airborne research since 1943 when a Spitfire was used to study aircraft contrails. **Dr. Jonathan Taylor**, Manager of the Atmospheric Radiation Research Group at the Met Office explains how the complexity and quality of atmospheric measurements has grown considerably since these humble beginnings.

Today, the Met Office shares access to a BAe146 four-engine jet aircraft to conduct meteorological research. The Facility for Airborne Atmospheric Measurements (FAAM) is jointly run and funded by the Met Office and the Natural Environment Research Council (NERC). The aircraft is owned by BAE Systems (formerly British Aerospace) and operated out of the airfield at Cranfield University.

From a distance, the FAAM BAe146 looks like any other short haul jet aircraft, the likes of which you might board to take a European break. But this is where the similarity ends. As you get closer you see a mass of inlets and probes on the outside of the plane, blister pods on the fuselage and pylons suspended under the wings, all bristling with scientific instrumentation. The instruments under the wings, for instance, can measure individual cloud droplets by scattering a laser beam off them. This may sound simple but is equivalent to measuring something one-tenth of the diameter of a human hair whilst travelling at over 300 kilometres an hour.

Onboard the BAe146 you are confronted with rows of racking housing instrumentation and computers with their operators squeezed in between — no reclining seats, tray tables and in-flight entertainment here. After take-off, with as many as 18 Met Office scientists aboard, the aircraft descends to 15 metres over the sea. That's when you really know this is far from a commercial flight — it's time to hold on tight as the mission scientist on the flight deck instructs the pilots to fly into weather they would normally try to avoid.

Our scientists use the BAe146 to conduct research in a range of areas, all aimed at improving the accuracy of the forecasts that the Met Office delivers. For example, as we develop higher resolution forecast models, the small-scale processes occurring in the atmosphere need to be better understood so that they can be more accurately represented in the models. Around the UK, FAAM flights may look at air quality one day and rainfall the next. The aircraft also operates on detachment to many locations around the world so that different weather conditions can be studied.

In February 2008, Met Office scientists will take the BAe146 to Fairbanks in Alaska to fly over its North Slope and out over the Arctic Polar Ice Cap, in a joint experiment with NERC. The Cold Land Processes Experiment II (CLPX-II) is an international effort involving scientists from the UK, USA and Canada in a study of the Arctic weather. The Met Office's focus is on better utilising satellite data in the polar regions; so, while the Canadian scientists brave the Arctic winter to dig snow pits and take detailed measurements on the ground, the BAe146 — equipped with instruments identical to those on a weather satellite — will take detailed readings above the surface.

Instrumentation onboard the BAe146

Satellite data are of critical importance to the Met Office, allowing us to observe the current state of the atmosphere and use this information as the basis of our forecasts for the next few days (turn to pages 7–8 for more detail). Translating satellite data taken over the open ocean is fairly straightforward as the surface is well characterised and structures in the atmosphere stand out clearly. Move over land and things become more complicated — particularly in the polar regions where satellites are looking down on a wide expanse of cold white snow or sea-ice. Helped by the CLPX-II, it is hoped that a new version of our forecast model will soon have a multi-layered snow model within it that can build up a snow pack over a winter and describe the snow grain-size, density and temperature as well as depth.

So next time you watch, listen to or read your local weather bulletin, spare a thought for the scientists who take to the skies. With its BAe146 — one of the best-equipped research aircraft in the world — FAAM is broadening the horizon of modern weather forecasting.

Science profile

Dr. Jonathan Taylor,
Manager, Atmospheric Radiation Research Group

The Met Office employs professionals and experts who are constantly expanding the boundaries of weather and climate prediction.

Dr. Jonathan Taylor has seen the world from a very different perspective to most people. As a mission scientist on the FAAM BAe146 (see opposite) and Manager of the Atmospheric Radiation Research Group at the Met Office, he has flown over many parts of the world at little more than 100 feet, skimming oceans and flying between mountains.

"One of my most memorable flights was flying from Trømso, through the Norwegian mountains and out to the Arctic Circle, where the transition from sea to ice was incredible," recalls Jon. "On another occasion, off the coast of California, we were chasing container ships to measure the impact of their exhausts on the clouds above. This was very exciting, as we had to swoop down low to the ships, and then pull back quickly and fly towards the clouds."

High flyer

A childhood of tramping through the hills and mountains of Wales and the countryside of the West Midlands, in every kind of weather, inspired Jon's lifelong passion for meteorology.

Graduating in 1988 from the University of Reading with a degree in Physics and Meteorology, he joined the Met Office. One of his early postings was at the Meteorological Research Flight (MRF) unit in Hampshire. During this time he studied for a PhD in the remote sensing of cloud properties and regularly flew aboard the C130 aircraft, which he used as his main research tool.

By 2001 he was manager of the Atmospheric Radiation Research Group at the Met Office and was flying onboard the FAAM BAe146.

Mission control

On a daily basis, Jon spends much of his time planning research, arranging flight logistics, and analysing data. But, when he's not at his desk, he's up on the flight deck, taking his seat behind the pilot.

"As a mission scientist I discuss with the pilot what I would like to achieve from the flight. We constantly have to adapt the flight pattern according to the prevailing weather conditions and the measurements that we need to take," says Jon.

Sea-ice taken from the BAe146 at 15 metres above the surface

"The average flight time is 5.5 hours, during which you have to be constantly alert. We have a flight attendant who brings us tea, coffee and sandwiches, just like on a commercial flight, but with so much going on there is little opportunity to take a break."

Pole star

Having recently returned from a campaign in Houston, Texas, Jon's next destination is one of the most remote regions of the world. In February 2008, he will be travelling to Alaska with a team of research scientists to determine how the Met Office can best use satellite data over polar regions to improve its forecasts.

"Our biggest challenge in Alaska will be the extreme weather. We need to know exactly what the conditions will be like so that we can make the most of the three weeks we have to conduct the research," explains Jon.

"Since we are trying to broaden the horizon of forecasting, this often means taking measurements in some of the worst weather. When you're flying in such tough conditions, you need a strong stomach — the turbulence makes for a bumpy ride."

But, while it is Jon's responsibility to manage the operation, he says that working with a team is one of the most rewarding aspects of his role at the Met Office. "Our research is a team effort which includes everyone from the pilots to the scientists to the ground crew. None of it could happen without them."

Few key influencers in politics and business now doubt that the world is warming, that man-made carbon dioxide (CO_2) emissions are largely responsible, and that there will be significant further warming over the next 30–40 years.

The pace of change

Readers of Barometer will know that scientists from the Met Office made a substantial contribution, as authors and reviewers, to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). As described in issues 6 and 7, the IPCC published its eagerly anticipated report in three instalments earlier this year, to present an objective overview of the scientific, technical and socio-economic facts about climate change. Based on its efforts to share knowledge on man-made climate change and what can be done to counteract it, the IPCC was subsequently awarded the Nobel Peace Prize with Al Gore.

Former Vice President Al Gore re-set the course of his life, in the wake of defeat in the 2000 American elections, to focus on an all-out effort to help save the planet from irreversible climate change. Gore's Academy Award-winning film, An Inconvenient Truth, is about his mission to bring the true scale of what he terms our 'planetary emergency' to public light, before it's too late.

Recently, the film made headlines for reasons other than the vexing issues it presents when it was sent, by the then Department for Education and Skills, to every secondary school in England. That decision was challenged in the High Court by a group sceptical of the widely accepted opinion that human activity is the main cause of climate change. It sought to prevent the educational use of An Inconvenient Truth on the grounds that schools are legally required to provide a balanced presentation of political issues. However, the court ruled that the film was founded upon solid scientific research and could continue to be shown with the context explained in guidance notes to be issued to schools with the film.

The Met Office helped all those involved in the case gain a complete understanding of what is known about climate change and where uncertainties remain. We have subsequently advised the now Department for Children Schools and Families on the guidance for schools. John Mitchell, Director of Climate Science at the Met Office, says, "I am pleased that the evidence for climate change has been accepted in a British court of law in line with the IPCC findings that warming of our planet is unequivocal and that it is very likely that most of this warming is caused by man-made greenhouse gases.

"We welcome the fact that such an accessible film is being shown to schools so that young people will be informed on climate change and encouraged to engage with the issues that will affect their future."

A new Integrated Climate Programme (ICP) was launched by the Met Office Hadley Centre at the Royal Society, London, on 11 September 2007. The five-year programme brings together, for the first time, the needs on climate change of the Department for Environment, Food and Rural Affairs and the Ministry of Defence. The ICP will deliver a stream of cutting-edge climate change science and guidance that will be used by the Government in its planning and policies. Other aims for the next five years include developing our predictions of how climate change will affect the UK; building into our forecast models even more variability in weather patterns to reduce uncertainty; and improving our forecasts of severe weather, such as the extremely heavy and prolonged rain which led to floods across the UK this summer.

High achiever
Sir Ranulph Fiennes

Described by the 1994 Guinness Book of Records as the world's greatest living explorer, Sir Ranulph Fiennes has broken numerous records, raised millions of pounds for charity, overcome incredible physical challenges and even found time to write 17 books between expeditions. So what drives him?

Sir Ranulph's Curriculum Vitae makes impressive reading: in 1969, he journeyed up the White Nile by Hovercraft. In 1986, he reached the furthest north ever by unsupported travel. In 1992-93 he led the Pentland South Pole Expedition, the first unsupported crossing of Antarctica that was also the longest. And in 1991, after numerous expeditions, he discovered the lost city of Ubar (once the frankincense centre of the world) almost by chance, just a few metres from his camp.

Then, in 2003 — only four months after a serious heart attack — he ran seven marathons in seven days on seven different continents. Says Sir Ranulph, "People said I was mad. But the surgeon who performed the operation advised me I should be fine as long as my heart didn't exceed 130 beats per minute."

Yet arguably his most famous achievement to date is the Transglobe Expedition that he completed with Charles Burton between 1979 and 1982.

Poles apart

Sir Ranulph and Charles were the first people ever to reach both North and South Poles by surface transport.

They were meticulous in their preparations — both in raising the £29 million they needed and in planning for the weather. In fact, one of their companions, Oliver Shepard, was trained extensively by the Met Office in weather forecasting and sent back his reports for three years from the polar regions.

After seven years of planning and three years on the expedition itself, they finally arrived back at their starting point, Greenwich, London, in August 1982 — having successfully circumnavigated the earth on its polar axis, something never done before or since. The expedition is something Sir Ranulph will never forget.

"When Charlie and I arrived at the North Pole on Easter Day, 1982, we knew we were the only people to have ever reached both Poles. Even now, 25 years on, I still re-live that moment."

The North Face

Sir Ranulph's most recent expedition was his ascent of the North Face of the Eiger, earlier this year. Renowned as one of the most challenging climbs in the Alps, this 13,025 feet elevation has claimed the lives of 50 climbers since 1935. For Sir Ranulph, the climb represented some unique challenges — he had little climbing experience, had lost all the fingers from the knuckle up on his left hand (due to an earlier frost-bite injury), and suffers from vertigo.

"My plan was to only look up — and think up," Sir Ranulph says, adding that when he was held back by the lack of fingers on his left hand, he would simply "use the other one".

Another challenge on the climb was the weather. They needed five clear days to complete the climb and were relying on forecasts from the Met Office and local stations. Bad weather could have been life-threatening.

"The Met Office forecasts were so accurate that we reached the summit after the five clear days they predicted only to turn around and see big black clouds coming in. Within 30 minutes, the weather had closed out."

Although the climb was a huge challenge for Sir Ranulph, he completed it on 17 March 2007, smashing the £1.5 million fundraising target for Marie Curie Cancer Care.

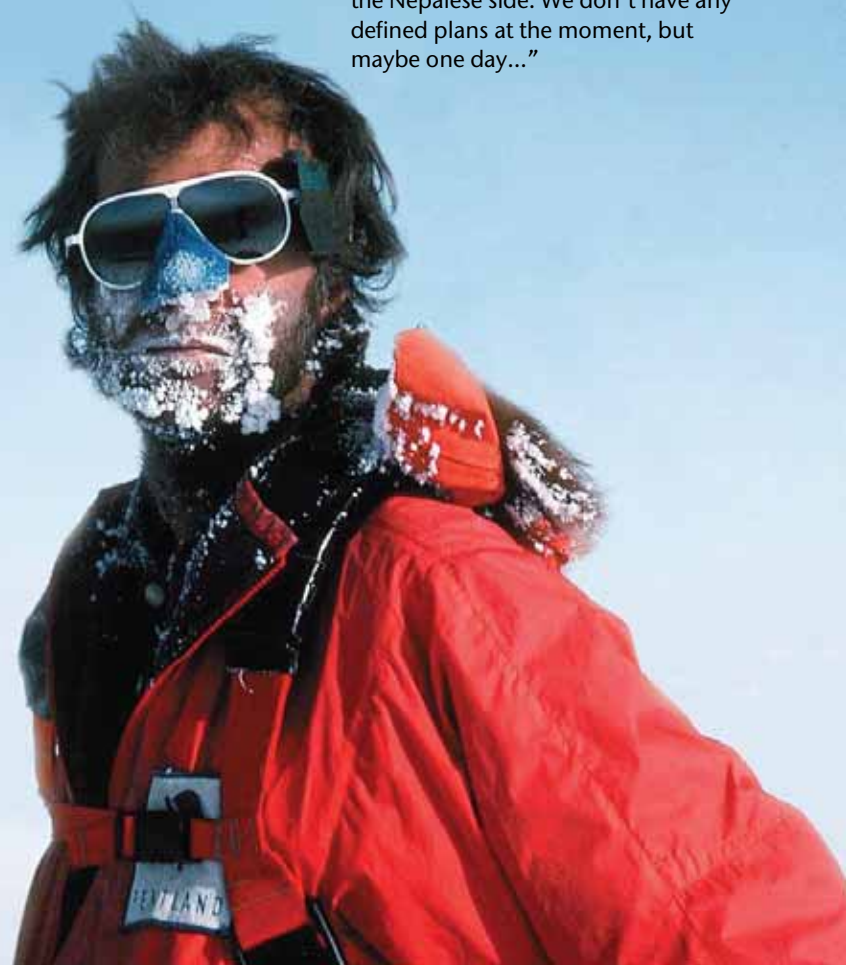
Strength of mind

Despite having put himself in so many potentially life-threatening situations, Sir Ranulph has never thought his time was up.

"I have certainly had moments of panic but I've never thought I was about to die. Instead I just think 'how on earth will I get myself out of this?'"

Perhaps it is this mental stamina that pushes the man on to greater challenges and to raise more and more money for worthy causes. But one challenge still eludes him. Since his 2005 attempt on Everest — from which he was forced to retreat 300 metres from the summit due to health problems — the world's highest peak has been on his mind. Is another attempt planned?

"Last time, we approached from the Tibetan side, but I believe I would have better chance of success from the Nepalese side. We don't have any defined plans at the moment, but maybe one day..."



Frozen in time

Even for the Antarctic, winter 1912 was unusually cold.

Having persisted through the most bitter and testing conditions, a five-man party — Captain Robert F. Scott, Lieutenant Henry R. Bowers, Dr. Edward A. Wilson, Petty Officer Edgar Evans and Army Captain Lawrence Oates — arrived at the South Pole. But Raold Amundsen had already been there and returned to his base in good order.

Scott's party left the Pole in worsening weather and, while retracing their steps, succumbed to injury, frostbite, malnutrition and exhaustion. In particular, Oates, afflicted by frostbite, stepped out of the tent and into the blizzard with the memorable words, "I am just going outside and may be some time." His body was never found.

News of Amundsen's success reached Europe before the fate of Scott's party was known. The Terra Nova, meanwhile, headed for New Zealand with the remainder of Scott's team onboard. Scott's expedition notes, which he kept during the voyage, are in the National Meteorological Library and Archive at the Met Office. A second volume on the scientific work of Dr. Edward A. Wilson and other members of the expedition accompanies Scott's observations.

To find out more visit the publications section at www.metoffice.gov.uk