



COLD CONDITIONS  
Wintry weather warnings

HELPING HAITI  
Disaster relief effort

PROTECTING PEOPLE  
Forewarned is forearmed

# Barometer

Issue 17 [www.metoffice.gov.uk](http://www.metoffice.gov.uk) Met Office magazine





Our work is vital to the emergency services. Here, **Phil Evans**, Government Business Director, considers the breadth and essential nature of the Met Office's work.

# Shining light



This issue of *Barometer*, with its theme of critical services, represents the core values of the Met Office. Our work has a huge impact on people's lives and livelihoods. By turning science into things that are really useful to people, we provide crucial advice and support.

The value of what we do is especially apparent in winter when there's severe weather to deal with. During these periods it's clear that although our services are valued by the public, they are absolutely vital to the emergency response community which rely on us so they can make informed decisions.

We listen to our users so we understand how best to help them. We're moving from understanding not just the weather, but the specific impacts and how they vary depending on the place. For example, 5 cm of snow in Hertfordshire has different impacts to

5 cm of snow in the Hebrides. So we issue warnings because of impacts in a particular region.

Our severe weather warning service is changing (page 4). At the moment, when we show a hazard on our website it's for a regional area or county, which is quite a large area. Under the new scheme, specific impacted areas are shown giving much more local information.

Describing more than one hazard at one time makes it possible to identify impacts with varying levels of detail.

This helps to keep the country moving (page 6) which is particularly important during winter. Sometimes the atmosphere is predictable and sometimes it's unpredictable. We have a huge amount of forecasting information, and probabilistic forecasting is a way of providing much more value from the information we've

got. Our Public Weather Service (PWS) Advisors put forecasts in perspective for particular users. An interview with Iain Forsyth, Head of the Public Weather Service, highlights the importance of their work (pages 7–8).

Our forecasting for Haiti (pages 9–10) shows our global reach. While weather can have negative impacts in this country, its impacts in the developing world can be colossal in terms of life and costs. Weather has an impact on all sorts of things that you wouldn't expect. This winter, our Healthy Outlook® service (pages 11–12) for people with Chronic Obstructive Pulmonary Disease helped people to help themselves. By contacting patients directly and giving them local weather information via an interactive phone call, Healthy Outlook® empowers people — preventing hospital admissions, saving lives and money.

The value we provide as an organisation is our expertise and advice. Our integrated forecasters at RAF Lyneham (pages 13–14) show how we understand our customers and give them specific advice. Working with our defence customers, it's clear that understanding their needs is imperative.

This issue of *Barometer* is full of examples of deploying and using science. By delivering value from science through its application, we're not just a service and data provider — we have a pivotal role to play in understanding people's needs and giving them the support they require.

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## New Flood Forecasting Service in Scotland

The Met Office and the Scottish Environment Protection Agency (SEPA), with support from the Scottish Government, are establishing a Flood Forecasting Service for Scotland.

The new service brings together experts from the two organisations in partnership. It will provide better advice and warnings to the Emergency Response Community, enabling it to better prepare for and respond to floods. It will also improve Scotland's resilience in the preparation for and management of significant flood events.

Phil Evans, Director of Government Services at the Met Office said: "This partnership between SEPA and the Met Office, supported by the Scottish Government, will enhance flood resilience in Scotland. The Met Office and our weather forecasting team at Aberdeen are delighted to be supporting this new service. The Scottish Government's investment in the Scottish Flood Forecasting Service will allow SEPA's expertise in flood warnings and advice to be brought together with the Met Office's experience in weather and other environmental hazards to ensure Scotland has the best advice possible."



Photo: PA Photos



## Academic Partnership

The Met Office, University of Exeter, University of Leeds and University of Reading have joined forces to form the Met Office Academic Partnership.

Pulling together world-class expertise, the formal collaboration aims to tackle key challenges in weather and climate science and maximise return on the UK's investment in research and development.

The Partnership combines the strengths of the universities and the Met Office to secure the UK's world-leading position in weather forecasting and climate prediction. It also provides an outstanding environment to develop the atmospheric science leaders of the future.

Professor Julia Slingo, Met Office Chief Scientist, said: "This is the first time that a group of universities has joined forces with a leading government organisation to form a

cluster of research excellence aimed at accelerating science research to benefit society. This is just the start of what I hope will be an exciting joint venture and only one element of our collaborations, both here and overseas, aimed at maximising the benefit of the UK's world-class expertise in weather forecasting and climate prediction."

➔ For more information see [www.metoffice.gov.uk/research/partnership](http://www.metoffice.gov.uk/research/partnership)

## More the merrier

We've recently made a significant change to our forecasts, increasing the number of location forecasts to 5,000.

Previously, we generated around 480 site-specific forecasts for the UK. Normally updated twice a day or sometimes more, these produced the forecasts shown, for example, on our website, iPhone app, and the BBC.

The advantage of having 5,000 sites is that we can now produce forecasts for nearly all population concentrations and other points of interest across the UK. This means you can now get forecasts closer to your exact desired location – sometimes literally down the road. More locations provide a more complete picture so our forecasts will be even more consistent.

All our public forecasts will soon use data from the 5,000 sites. Currently, you can access all 5,000 sites through our mobile phone weather pages, the Weather Widget, or from the Invent area of our website.



Invent showcases our plans for presenting web-based weather forecasts. Simply type your location or postcode into the search box and you'll be given a choice of the sites closest to you.

➔ See [www.metoffice.gov.uk/public/pws/invent/weathertext/](http://www.metoffice.gov.uk/public/pws/invent/weathertext/)

# New dawning for warnings

Changes to our National Severe Weather Warning Service will make our warnings even more effective. **Pat Boyle**, Public Weather Service Assurance Manager, describes the new National Severe Weather Warning Service.

The National Severe Weather Warning Service (NSWWS) was set up in 1988 following the Great Storm to save lives and property. In 2009, the Public Weather Service Customer Group asked the Met Office to review the service by consulting the public and emergency responders.

Through public focus groups, surveys and emergency responder workshops, we found that warnings should be impact-based, describing the likely impacts of the weather. The need for improved communications was also identified, making the language simple and easy to understand. Graphical presentation of the warnings also needed attention, with a need for 'risk of disruption' maps on our website.

From the end of March 2011, our warnings will provide a combination of the potential impact the weather will have and the likelihood of the weather happening. We've worked with partner agencies to develop a risk matrix to assess the impact severe weather might have. This assessment will take into account geographical factors — for example, will wind have the same impact in the north-west Highlands as in South East England?

The assessment will also consider how unusual the severe weather is, bearing in mind the recent weather. After strong winds, for instance, lower wind speeds might be more significant than usual due to structures being weakened. For rainfall, we'll discuss flooding impacts with the Flood Forecasting Centre in England and Wales and the Flood Forecasting Service in Scotland to ensure consistent assessments.

We'll continue to assess the likelihood of severe weather using our computer models combined with the Chief Forecaster's skill. A colour will be assigned to the warning which is a combination of potential

impact and likelihood. Traffic light colour-coding, introduced into our warning system a few years ago, will remain with the same general messages. An assessment from the Chief Forecaster will explain in clear language why a warning has been assigned a particular colour and if there is any uncertainty, for example, in timing or location.

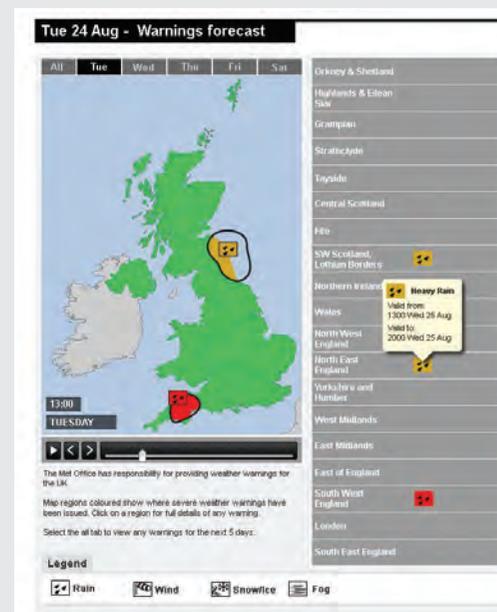
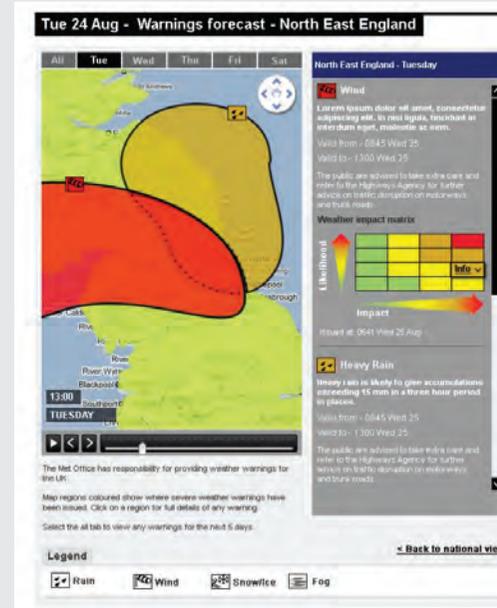
The weather never sleeps, so it's possible for alerts and warnings to be issued at any time of day, although every effort will be made to issue them during normal working hours.

Changes to the NSWWS should make our warnings even more useful. One thing is for certain, the new service will continue to be vital to safeguard lives and property.

## Easy to see

We're making our severe weather warnings easier to understand. Currently, severe weather warnings are shown on our website by colouring whole counties with the appropriate colour of the warning. The new system will show a polygon around the area most likely to be affected. This will make it easier to see — particularly for larger areas — the more vulnerable locations.

Clearer web pages will show multiple warnings for different weather elements at a glance, using symbols for different weather elements. Icons will indicate the type and severity of warnings. Visitors to our website will be able to navigate using both map and tabular list. Animations will help to see warnings evolve and a zoom functionality will make it easy to distinguish between parts of counties or local authority areas.



*Changes to the National Severe Weather Warning Service mean that warnings will be shown differently on our website, making them easier to understand*



In late November 2010 an Arctic blast swept across the UK and continued throughout December. During the prolonged spell of wintry weather, government organisations, businesses and the public relied on our accurate forecasts and weather warnings.

# Deep freeze

The extensive snow caused travel disruption with roads, railways and airports all struggling to cope. Freezing conditions continued into the Christmas period with severe frosts and heavy snow in some areas.

December 2010 was the coldest across the UK since the national series began in 1910. The mean temperature for the UK was  $-1.0^{\circ}\text{C}$ , well below the long term average of  $4.2^{\circ}\text{C}$ . The previous coldest December in the series was  $0.1^{\circ}\text{C}$ , in 1981.

The onset of the cold weather from late November was highlighted well in advance using our monthly forecasts. Since the wintry weather set in, our website had millions of visits every day, peaking on 20 December when our web pages were viewed around 13 million times. December also saw the highest number of visits to our website for a single month with more than 44.5 million visits — more than double for an average month.

Our Customer Centre answered 5,000 calls in just over a week; with 1,019 calls in a single day on 29 November. Our iPhone application received 32 million hits in November. Our press office took nearly 200 media calls each day. We also issued a daily weather ‘story’ on our website to supplement routine forecasts and warnings.

## Regular briefings

Our Public Weather Service Advisors provided regular briefings to emergency responders across the country. We supplied regular forecasts to many local authorities and the Highways Agency. Met Office forecasters operating from the Highways Agency control centre helped to keep the nation’s roads safe and moving. Our OpenRoad service provided advice on road surface temperature to road engineers across the UK.

We issued aviation warnings and forecasts as part of our Civil Aviation Authority contract, supplemented by commercial services. For example, some airlines and airports used our OpenRunway system which offers 24-hour access to forecast information such as runway temperature, rain and snow amount — all vital in determining the right time to apply anti- or de-icer.

We continued to provide operational services and severe weather warnings to the energy industry to help predict demand and plan resources. Several companies acknowledged our role in helping to maintain supplies during the severe spell.

All 19,000 patients registered for the Met Office’s Healthy Outlook® service for Chronic Obstructive Pulmonary Disease (COPD), were warned of the

“...December also saw the highest number of visits to our website for a single month with more than 44.5 million visits — more than double for an average month.”

cold spell well in advance (see page 11 for more on Healthy Outlook®). Working with the Department of Health and the Department for Work and Pensions, we produced and distributed a postcard to GP surgeries offering advice on winter weather services (COPD, winter fuel, cold weather payments) for vulnerable members of the public.

## Accurate predictions

Forecasting snow, and accurately predicting where it will fall, poses a tough challenge but our forecasters provided very good advice for 12 out of 13 big weather patterns that blasted the UK this winter — which is an outstanding performance. The high number of snowfall events over a prolonged period created an incredibly busy time for our weather experts.

The cold spell isn’t a sign of things to come as it is all part of natural variability. Before last year we’ve had a run of mild winters in the UK, while globally 2010 was one of the warmest years on record, set in the context of long-term climate change and shorter term natural variability.

Normally, our winds come from the west keeping our winters relatively mild. However, during November (like last winter) a large area of high pressure in the Atlantic caused a ‘block’ to the westerly winds that tend to keep us that little bit milder. This allowed very cold Arctic air to move south across mainland Europe, giving us the coldest December on record.

Find out more about how the Met Office performed with a timeline of the severe weather and our assessment of how we’ve done at [www.metoffice.gov.uk/about-us/who/how/case-studies/big-freeze](http://www.metoffice.gov.uk/about-us/who/how/case-studies/big-freeze)

# Keeping things moving

As the run-up to Christmas 2010 proved, the weather can have a huge impact on the way our planes, trains and automobiles operate. But it's not just snow and ice that affect travel in the UK. Other factors can also play a major role.

When setting out on a journey by car, most people take a few minutes to consider how the weather might affect their travel. Snow, ice and bad visibility create obvious hazards, while rain can often cause tailbacks on busy roads. But a new risk model being developed at the Met Office looks into the impact of a less obvious factor on road networks — the wind — and, specifically, how it can affect vehicles.

The model is being developed by Jo Robbins, a Weather Impact Research Scientist at the Met Office, and is designed to help organisations such as the Highways Agency in their decision-making process, well before adverse weather strikes. Jo explains: “The idea is we will be able to give our partner organisations accurate predictions of wind conditions up to two days in advance. So, for example, we could help them prepare for strong winds affecting specific vehicles on the M6 at 2pm, in two day’s time.”

## Understanding the elements

Many factors can influence how wind affects vehicles when they are on the road. It is important to factor in the type of vehicle — as high-sided trucks are affected more by wind than sleek sports cars. It's also critical

to know the altitude of the road, the number of tunnels and bridges and how many lanes run along each carriageway. What's more, certain roads will have different traffic distribution at different times of the day.

All these factors need inputting into the model to provide the most detailed and accurate information possible. This information can then be used by organisations such as the Highways Agency — that may decide to divert large trucks away from the motorway, reduce the speed limit along a specific stretch of it, or place more incident support teams on the road to deal with any problems quickly.

## From slipways to landslides

While Jo's model could provide a vital tool for helping keep motorists safe in high winds, she is keen to apply the theory to different situations, as she explains: “My aim is to prove that not only could the concept be used to assess the impact of wind on vehicles, it could also assess the risk of rain-induced landslides and how that affects vulnerable people in developing countries.”

This is something Jo has recently begun studying through a three-year PhD, the research for which is based in Papua New Guinea. This is an area renowned for its major meteorological and climate weather patterns, including El Niño.

“Although the meteorology is fascinating; how it interacts with different communities to cause a small weather event that is barely noted or a catastrophe costing billions of pounds is even more so. Hopefully, this research will help us understand this, so we can help people around the world be better prepared for the weather conditions that are critical to them.”

Back on home turf, Jo is waiting for her risk model to go through to the development stage. But once that's complete, she hopes it will be added to the Met Office's armoury of applications that all help keep Britain's traffic moving, whatever the weather.

## Tailored forecasting

For many people in the UK, a forecast of heavy rain can mean the difference between carrying an umbrella and dealing with the massive upheaval of a flooded house. So, while the Met Office already offers a tailored meteorological service to many of its customers, it is constantly striving to make forecasts more specific for everyone, helping people make the choice between a brolly and a load of sandbags.

The Met Office helps energy companies anticipate changes in demand, and the health sector prepare for increased pressure on its services from illnesses affected by certain weather conditions. It also helps its partners and customers by placing forecasters within their organisations. For example, there are Met Office forecasters based in RAF planning rooms around the country (see pages 13–14).

Empowering people to make decisions, based on the weather, is shaping the direction of the organisation's future — and will, inevitably, make our services invaluable to more people.



# Why we all count on the Public Weather Service

As Head of the Public Weather Service for the past three years, **Iain Forsyth** explains the crucial role the PWS Advisors play in saving lives and protecting the UK's infrastructure and economy from damage caused by the weather.



When severe weather strikes, we all rely on the Met Office's Public Weather Service (PWS) to warn us about it. Thanks to the dedicated work of the PWS Advisors, the Government, local authorities and emergency services are able to prepare and respond quickly.

## Q. Can you describe what the Public Weather Service does?

A. The PWS is a UK Government-funded operation that communicates the Met Office's day-to-day and long-range forecasts. If public safety is at stake, it also gives advance notice with its National Severe Weather Warning Service (NSWWS). We currently have ten Advisors in the PWS team providing critical support and advice for Category 1 and 2 Responders — namely the local authorities, emergency services such as the police and fire services, utilities, Environment Agency and Highways Agency. But the PWS isn't just about providing warnings. We help people

plan their leisure activities too for when conditions look fine whether they're planning to go surfing or find the sunniest spot for a picnic.

## Q. What is the main role of the Advisor?

A. It's safe to say that our Advisors are generally more out, than in. They spend a lot of time getting to know their community; what the local issues are and how best to prepare the town or village for extreme weather events. Many of them also take part in 'on the ground' training, such as 'Exercise Watermark' — run by the Environment Agency. It's already proved invaluable in equipping Advisors with the practical understanding needed to put plans in place and lessen the impact of severe weather.

## Q. Who do the Advisors report to?

A. PWS Advisors regularly take part in debriefings at high levels in the community and at ministerial levels. For extreme weather emergencies, they attend emergency COBR (Cabinet Office Briefing Room) sessions at No.10 with the Prime Minister, or with ministers and officials in the Devolved Assemblies. During the cold snap in December 2010 our Advisors were attending Cabinet Office meetings, either in person or by teleconference, almost every day — working closely with the Civil Contingencies Secretariat.

## Q. How does the PWS deliver information and warnings to the public?

A. Out of the thousands of routine forecasts we make every day, we issue hundreds of weather warnings in a year. As soon as observations come in from the Met Office's operational centre, Met Office forecasters immediately translate the data and transmit it via email, fax and text message to all emergency Category 1 and 2 Responders. At the same time, these forecasts and warnings appear on the web, radio, the BBC and ITV and on mobile phones for the public.

## Q. Who are the Public Weather Service Customer Group (PWSCG) and what is their role?

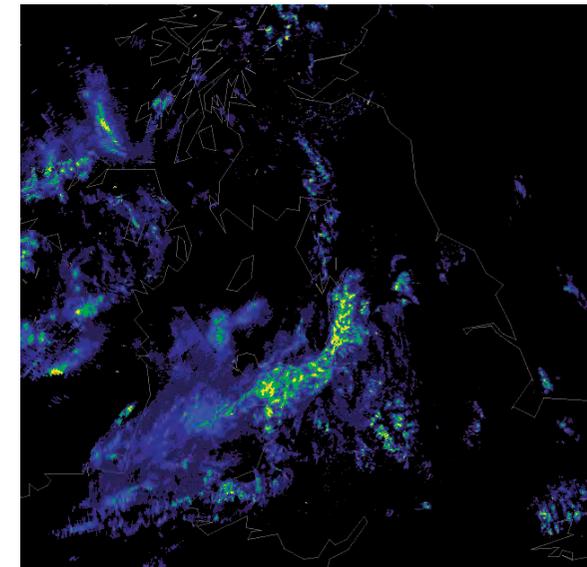
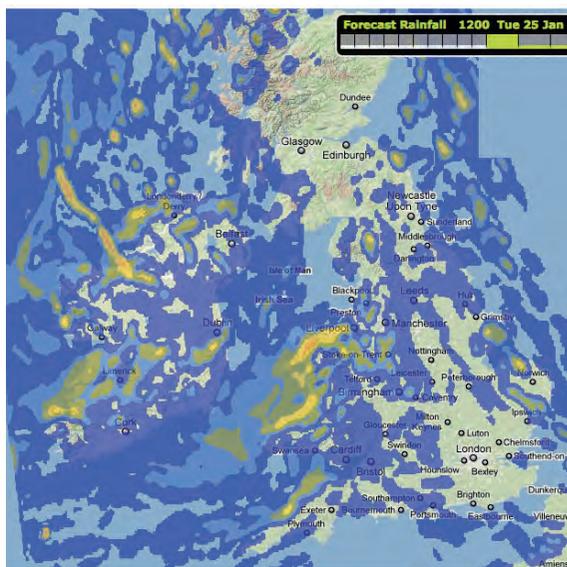
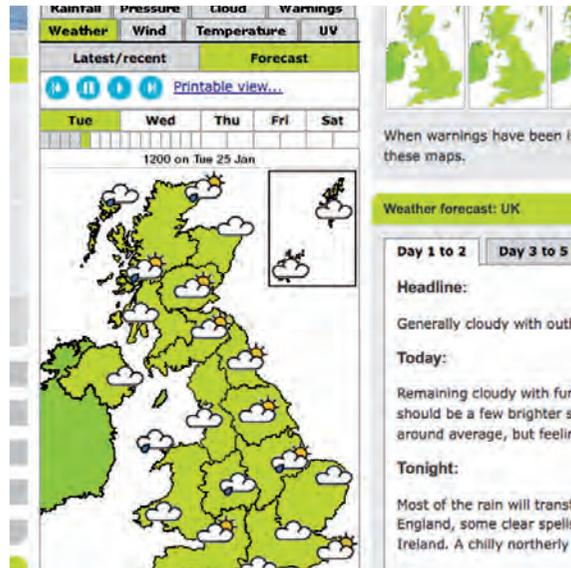
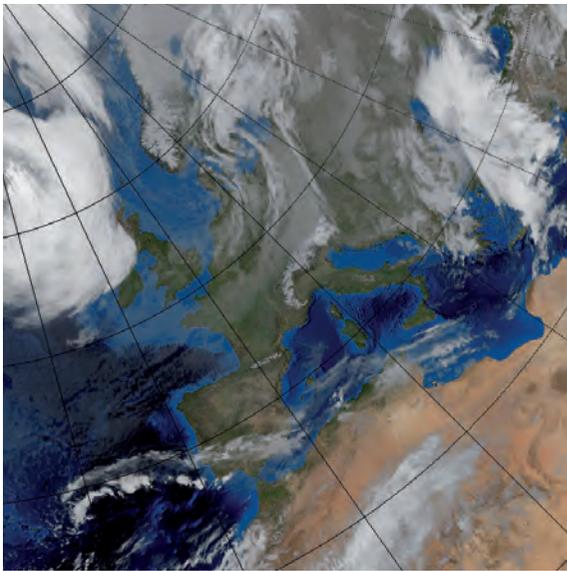
A. The PWSCG's main role is to oversee the PWS on behalf of the public. For concerns such as public transport and flooding defences, the PWSCG helps decide what the general population and responders need to deal with weather emergencies. Importantly, they ensure the PWS meets everyone's expectations in terms of quality and value for money — especially when it involves efficient use of resources, like road salt supplies. In fact, from a return on investment perspective, the PWS has consistently shown the economic value it creates is many times higher than the funding it receives.

## Q. Where would you like to see the PWS heading in the future?

A. During the 2007 floods, the PWS made massive strides forward, working with the Environment Agency. But our long-term goal is to fully integrate our advice with other agencies and create a consistent, 'one stop shop' source of information. Also, PWSCG research has shown that people want their daily weather forecasts presented in a format they can use on the move. So in January last year we released a free Met Office iPhone Weather app, which has been a phenomenal success.

Overall, it's exciting to see that, as weather forecasting continually evolves, so have the Met Office's technological capabilities. In one month alone, we've gone from forecasting weather across 480 locations on the Met Office website, to 5,000 locations throughout major towns, cities and places of interest in the UK. It's innovations like these that will help the Met Office provide highly accurate information on an even wider scale, which ultimately will result in more lives and money being saved in the future.

➡ **Pat Boyle**, Public Weather Service Manager at the Met Office, discusses on page 4 how subtle weather changes are making an impact on the National Severe Weather Warnings.



In the UK, severe weather makes roads dangerous, closes schools and disrupts work — and, during long spells, even affects the economy. But when severe weather collides with a natural disaster in a developing country like Haiti, the effects can be devastating.

This was something Met Office forecaster, Eleanore Hunt faced first-hand when she joined an international weather team to help in Haiti — a far cry from her usual role based at MOD Boscombe Down.

Eleanore's role was to liaise, in French, with the two surviving Haitian forecasters, Météo-France and the Meteorological Service of Canada and provide daily forecasts and monthly rainfall predictions. The Haitian forecasters then passed this information on to charities and aid organisations. Haiti was left in a very vulnerable position following the earthquake, so accurate weather predictions and advance warning were critical to saving lives, as Eleanore explains:

“There were millions of people living in tented villages. But because of all the deforestation in Haiti, you get landslides and flash floods when it rains. And with the hurricane season running from June to November, there's also the potential for very, very strong winds as well. All of these things are huge problems for the tented villages.”

Eleanore was based in the Caribbean for eight weeks, but even in that time two potential severe weather events — a tropical wave and a hurricane (Earl) — just missed Haiti. Then a third event, Hurricane Tomas actually hit the country head on, causing widespread panic and killing seven people. With the Met Office's help, officials had been able to issue warnings in time and evacuate most people to higher ground, which helped keep fatalities to a minimum.

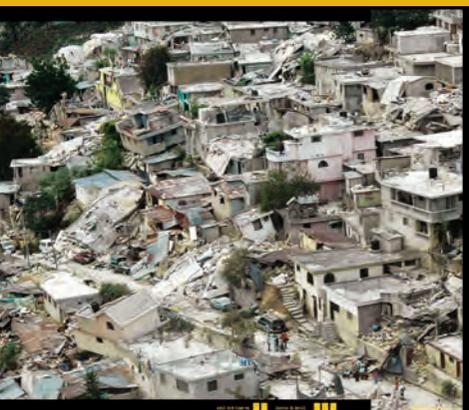
The disaster relief effort in Haiti was a concerted effort of several organisations, including international charities, many of which relied on reports from the Met Office to do their work. One of which was

ShelterBox, a Cornwall-based charity that delivers emergency shelter, warmth and dignity to people affected by disaster worldwide. Alf Evans, Operations Manager at ShelterBox, said: “The Met Office gave us early notice of the possible risk of the hurricane, and we were able to start planning contingencies with our team in Haiti ahead of the game. So we were in the best possible position we could be.”

#### Ongoing work

Today, Eleanore's work is far from finished. In fact, she's returning to Haiti for three and a half months — joining the international effort to rebuild and equip the Haitian meteorology centre.

But she will be careful to make sure there's no interruption to forecasting services while they move. “There's still the potential for severe weather, even though the hurricane season is over. In order to save lives, it's really important we keep the people of Haiti informed.”



# Disaster relief

When the catastrophic 7.0 magnitude earthquake struck Haiti on 12 January 2010, the Haitian National Meteorology Centre and many of its forecasters were among its victims. With their forecasting capabilities in ruins — and the effects of the earthquake leaving them particularly vulnerable to bad weather — Haiti needed international help. So, alongside other weather services from around the world, the Met Office stepped in to provide forecasts from nearby Martinique, and help relief agencies complete their critical work. We hear how one Met Office forecaster, **Eleanore Hunt** (pictured above), was involved.

As there are only two surviving forecasters in Haiti, Eleanore will train new forecasters until they're able to take over the reins and provide an effective, 24/7 service. Eleanore is under no delusion:

"There's still a lot of work to do and it will be a long process. Things like setting up observing systems — so that there are actual observations of Haiti — could take years. But for now, the Met Office is concentrating on helping the two Haitian forecasters become confident with the new technology."

More than a year on, over 1.3 million Haitians are still living in tented camps and parts of the country are also battling a cholera epidemic. So it's crucial that the Met Office continues to do its part in helping Haiti get back on its feet. Uninterrupted weather forecasts and helping establish a new Haitian meteorological service could really help save lives in both the short- and long-term.

### Challenging circumstances

The Met Office frequently forecasts in challenging circumstances around the world, whether taking part in initiatives run by the World Meteorological Organization, or supporting the military in its operations.

One of the ways the Met Office does this is through the Mobile Met Unit (MMU), the Met Office's military branch. Members of the MMU undergo rigorous military training that includes how to brief others, team leadership and living in difficult circumstances. They then deploy alongside the Forces, providing forecasts from war zones.

Eleanore Hunt, who is normally based at MOD Boscombe Down, trained with the MMU, so she was well placed to take on the Haiti assignment: "Going out to a new meteorological office, in a part of the world I've never been to before, working with people I've never met, forecasting in a different type of meteorology, in a foreign language, is quite daunting. In that respect all the training has been a huge help."

Photos: Photoshot



# in Haiti

"The Met Office gave us early notice of the possible risk of the hurricane, and we were able to start planning contingencies with our team in Haiti ahead of the game. So we were in the best possible position we could be."

Alf Evans, Operations Manager,  
ShelterBox

For sufferers of Chronic Obstructive Pulmonary Disease (COPD), even subtle changes in the weather can mean the difference between life and death, which is why the Met Office runs Healthy Outlook® — a world-leading service that lets people with COPD know when difficult weather is on its way.

# Health alerts save lives

COPD encompasses a variety of respiratory illnesses, including chronic bronchitis and emphysema. It affects around 900,000 people in the UK and costs the NHS a massive £900 million a year. The cold weather can make symptoms much worse, but so can less obvious factors, such as humidity, the seasonal ebb and flow of diseases and air quality — particularly in summer months. Patients even report difficulties when battling against the wind.

Healthy Outlook® comes into its own by helping to make COPD sufferers forewarned and therefore forearmed. It sends out automated phone calls to 19,000 registered patients, giving them a four-day warning that adverse weather is on its way and cautioning them to take action such as checking their medication, keep their home warm and, if possible, to plan to stay indoors.

The phone call initially tells them that they are at increased risk of becoming unwell over the next two weeks followed by a couple of questions which require a spoken ‘yes’ or ‘no’ answer. These include whether they are feeling ill and if they have enough medication. Patients are also given a ‘patient pack’ — a highly regarded booklet containing advice from the Department of Health, on how to stay well if you have COPD. The phone advice refers the person to this pack.

## Lifting the health burden

Healthy Outlook® is a prime example of how the Met Office’s services reach beyond weather forecasting as Wayne Elliott, Head of Health Forecasting explains: “The warnings are far more than a temperature forecast. They are a health forecast — and a vital service for thousands of people in the UK. The service saves lives and helps reduce costs for the NHS. COPD affects the economy too — removing a percentage of the older population from the workforce who are still young enough to work, but can’t due to ill-health.”

## Keeping doctors informed

To provide the Healthy Outlook® service, the Met Office calls on its expertise in both weather forecasting and its understanding of respiratory virus levels in the community — it’s this combination of factors that can put people at risk.

“The health forecast is calculated on a weekly basis,” Wayne adds, “by combining health data from sources such as the Health Protection Agency with weather data.” This produces either a ‘normal’ or an ‘elevated’ state. If the forecast is for elevated risk, the service is activated and the calls are made.

One of the real benefits of this is that GPs participating in Healthy Outlook® can access the results on the Met Office website. At the click of a mouse, they can see how their patients have responded to the Healthy Outlook® alert and whether they might need a new prescription or flu jab. The service also supports national initiatives such as the Department of Health’s ‘keep warm, keep well’ campaign. We sent a postcard (shown right) to GP surgeries advising vulnerable people how to find out more about services provided by the Department of Health, the Met Office and the Department for Work and Pensions.

## Significant success

It’s important to ensure Healthy Outlook® is continuously effective, which is why the Met Office Health Programme ran a randomised control trial during the winter of 2008/9. There were 77 patients taking part in Devon and all were given the patient packs, while half were randomly selected to receive the alert calls. This helped correctly identify periods when people were at increased risk.

Following the trial, Healthy Outlook® was piloted by 11 practices within NHS Bath and North East Somerset (B&NES) — with outstanding results. Emergency admissions dropped by 51% and 85% of patients surveyed said they found it helped them manage their condition better. This led B&NES to decide to commission the service for the next three years.

In 2011, 40,000 patients have been signed up to receive Healthy Outlook®. But the Met Office is hoping this number increases to 250,000 people. Not only will patients get the advice they need to keep themselves safe, but the NHS can look forward to some very healthy financial savings too.

COPD sufferers in the UK

900,000

Annual cost to the NHS

£900m

Drop in emergency admissions  
in pilot project

51%

Patients found it helped them  
manage their condition better

85%



“The warnings are far more than a temperature forecast. They are a health forecast — and a vital service for thousands of people in the UK. The service saves lives and helps reduce costs for the NHS.”

Wayne Elliott, Head of Health Forecasting



#### Planning ahead

Some patients have a tendency to mentally shut down when the doctor tells them they have COPD — a relatively new umbrella term for chronic inflammatory conditions which cause over 30,000 deaths a year. The patient pack, given at the same time the person is signed up to receive alerts, explains and reinforces any information provided by the GP about the disease. But as Wayne explains: “Our research has shown that the older generations, particularly the over 70s, need to be steered away from the Victorian mentality of ‘cool rooms and open windows are healthier’, when, in fact, this is the worst thing someone with COPD can do.”

Non-pharmacological advice in the patient pack includes common-sense tips such as eating well, getting enough vitamins, keeping warm and not going outside in the freezing cold. Working with this advice, the alerts help the patient plan ahead. For instance, when they receive an alert, they have the chance to buy vital groceries and pick up their prescription before a cold weather front arrives. Two room thermometers included with the pack also help keep the bedroom and living room at an optimum 18 °C. Just six degrees under this temperature can kill a vulnerable person with COPD.

# It's all in the detail



For RAF flight crews, adverse weather is not just an inconvenience – it can directly affect their ability to do their jobs, which is why having a Met Office forecaster based in their planning room is proving an invaluable resource.

“While a public weather forecaster needs to be broader in scope, I have to narrow down exactly where, for example, cloud will be, and see whether they can fly beneath or around it. I’ll even help them plot an alternative route if necessary.”

Joanna Pitt, Met Office forecaster at RAF Lyneham

The Met Office has always worked closely with its defence customers, but this year has seen the launch of a trial service — one that places its forecasters in the actual planning and operation rooms on military bases throughout the UK.

Joanna Pitt (pictured right) is one of the Met Office’s new ‘integrated forecasters’ based at RAF Lyneham in Wiltshire. Lyneham is home to the UK’s fleet of Hercules, an aircraft used mainly to transport supplies, personnel and freight, as well as for reconnaissance missions. Most of the flights Jo helps plan are for training purposes, and involve weather-sensitive exercises such as air-to-air refuelling or low-level flying.

“Since being based here, I’ve gained first-hand insight and become far more knowledgeable about the sort of weather information the crews need for different missions. I make sure the conditions are within certain parameters and help them gain valuable flight time.”

Jo begins her day picking up a general weather report from the main forecast office on the base and then heads down to the planning room to compare the forecast with the day’s flight training programme.

There are usually nine or ten training flights leaving the airfield in any one day. Each of the aircrews will spend up to two and a half hours in the planning room assessing their route and mission, with Jo on hand to make sure conditions are suitable for the duration and purpose of their flight.

### Accuracy matters

A typical exercise may last for up to three hours and could involve, for example, a supplies drop over Salisbury Plain, anywhere from 250 ft up to 12,000 ft above a designated drop zone. Jo will need to let them know the exact wind speed, changes in wind direction or turbulence, all of which will affect the safety of the drop — especially from higher altitudes. After completing the drop, the aircrew may carry out a low-level flying exercise at around 250 ft along the south coast of Wales, where cloud cover and visibility becomes more of an issue.

“While a public weather forecaster needs to be broader in scope, I have to narrow down exactly where, for example, cloud will be, and see whether they can fly beneath or around it. I’ll even help them plot an alternative route if necessary.”

This degree of accuracy and tailored forecasting has been a big asset to the air squadrons. In the past, the pilots would err on the side of caution if the weather conditions looked marginal. Now, with a dedicated forecaster providing up to date specific weather reports, they are more likely to fly in conditions previously deemed unsuitable and gain essential training time.

“The squadron here make us feel that we have a valuable role to play and are really part of their team. In fact, they have said they couldn’t see themselves not having the Met Office forecaster here now.”



**A natural partnership**  
Supporting the Armed Forces on their day-to-day training activities in the UK is just part of the service the Met Office provides its defence customers. It also works closely with the UK military and its allies on bases around the world.

### Human resources

From Cyprus to the Falkland Islands, Met Office forecasters advise the Armed Forces on the impact weather and other environmental factors may have on their operations — both for training exercises and on active service.

When troops are deployed to the frontline, they need to make quick and accurate decisions, often in hostile conditions, which is why the Met Office established an RAF-sponsored reserve unit called the Mobile Meteorological Unit (MMU).

The MMU is made up of around 70 specially trained forecasters that have undergone military training to get to grips with the challenges faced on the frontline. They can be called upon at any time to work alongside troops in areas such as Iraq and Afghanistan. See page 9 for an article about forecasting for Haiti.

### Technical support

As well as having forecasters based across the globe, the Met Office also works closely with the Ministry of Defence to identify how its science and technology can best be applied to further support military decision-making. This includes everything from predicting how environmental conditions will affect military sensors to advising strategic planners on the impacts of climate change on future defence requirements.



Photo: Corbis

# Complex cocktail

In April and May 2010, the Eyjafjallajökull volcano in Iceland erupted explosively emitting a complex cocktail of ash and gases into the atmosphere. The resulting plume was blown into UK and European airspace causing disruption to aviation, leaving tens of thousands of passengers stranded and causing considerable costs to the airline industry and the global economy. Here, **Jim Haywood**, Met Office Aerosol Research Manager, provides an insight into the observations and science of the volcanic ash plume.

The Met Office London Volcanic Ash Advisory Centre (VAAC) is responsible for monitoring and forecasting the movement and dispersion of volcanic ash originating from volcanoes in the north-eastern Atlantic including Iceland. Volcanic eruptions are extremely complex to model and are influenced by many geophysical factors. Eyjafjallajökull was particularly complex because of the interaction of the molten magma with the overlying glacial ice which led to the production of small ash particles.

The Met Office's Numerical Atmospheric-dispersion Modelling Environment (NAME) is used to model a range of atmospheric dispersion events, including volcanic eruptions. When modelling such events, it is important to know both the total mass of ash emitted and the ash particle size distributions because large

particles are removed from the atmosphere more quickly than small particles via gravitational settling. Gravitational settling rates also depend on the particle shapes and densities. Additional observations are vital for forecasters and researchers to be able to validate and add value to the model forecasts. Observations were provided from the Met Office, European National Meteorological Services and the university research communities. They came from a variety of sources including laser cloud-based recorders, research lidars, satellite imagery, balloon-borne ash sensing instruments, and aircraft instruments.

Among the most equipped aircraft of the European research aircraft fleet is the FAAM BAe 146-301 which is run jointly by the Met Office and the Natural Environment Research Council (NERC). It performed

a series of 12 flights between 20 April and 18 May. In compliance with Civil Aviation Authority regulations, the FAAM aircraft was not permitted to fly in areas where volcanic ash concentrations were greater than 2 milligrams per cubic metre, so the aircraft targeted areas where concentrations forecast by the Met Office NAME model were in the range 0.2 to 2 milligrams per cubic metre.

The FAAM aircraft was equipped with remote sensing equipment including a compact backscatter lidar which emits laser light and measures the intensity of the light backscattered from particles in the atmosphere. This enabled mapping of the geographic distribution of the volcanic ash plume without the aircraft having to penetrate the plume. The lidar was also able to provide information on the altitude of the volcanic ash layers and on the size and shape of the ash particles which enabled them to be distinguished from sulphuric acid particles, another component of the plume.

When forecast levels were below 2 milligrams per cubic metre, the FAAM aircraft was able to fly in areas of volcanic ash to measure the mass concentration. However, this is not a straightforward operation. Aerosol particle sizes are typically measured by Optical Particle Counters (OPCs) that bounce laser light off each particle and measure the scattered light which is proportional to the particle size. Many thousands of particles may be measured per second. OPCs are calibrated using spherical pure glass beads. This presents a complex problem; volcanic ash particles are not spherical or composed of pure glass so corrections have to be made that typically double the derived mass of the particles.

Other instrumentation used to estimate the volcanic ash mass included a nephelometer which measures the scattering of light not from individual particles, but from bulk samples of volcanic ash laden air and if the particle size distribution is known from the OPCs, then the mass may be determined.

While the measurements were able to provide quantitative information as to the validity of the NAME model forecasts, much work is still ongoing to improve the accuracy and the speed that mass concentrations derived from the lidar, OPCs and other measurements so that accurate near-real-time measurements can be provided for model validation should future eruptions occur. Given the frequency of explosive volcanic eruptions in Iceland is around once every five years, we may not have long to wait.

# Science profile

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



**Kate Turnbull**  
Aerosol Scientist

Since joining the Met Office as a trainee forecaster in 2003, Kate Turnbull's career has been both wide and varied. Whether developing and maintaining atmospheric research instruments for use on an aircraft or working in her current position in the Aerosol Research Group, two days have rarely been the same for Kate.

### Career highs

Weather forecasting runs in Kate Turnbull's family. It was her Dad, a forecaster for the Navy, who first sparked her interest in the subject. So it was a natural step for Kate to join the Met Office where she eventually specialised in marine forecasting. But, having developed an interest in measuring the atmosphere during her PhD where she built a device to measure water vapour from balloons Kate decided to return to her more scientific roots as an Instrument Scientist at the Facility for Airborne Atmospheric Measurements (FAAM).

### Head in the clouds

FAAM is a collaboration between the Met Office and the Natural Environment Research Council (NERC), set up to provide a modified aircraft which gathers data for atmospheric research. As an instrument scientist, Kate was responsible for maintaining, calibrating and operating the instruments on the aircraft during flights. One of the biggest challenges she faced was in the summer of 2010 when the Eyjafjallajökull volcano erupted in Iceland.

Kate and her colleagues quickly got the aircraft airborne and were able to measure the location and concentration of the ash. This vital information was passed on to the Civil Aviation Authority that used the data to determine when and where they could open airspace; and, ultimately, get stranded passengers off the ground.

Through her work with FAAM, Kate has travelled to many exotic locations. She measured rainforest emissions in the tropical heat of Borneo and monitored the radiation off snow in the freezing temperatures of Alaska both of which brought unique challenges for aircraft and instruments alike: "I've faced a lot of challenges hanging underneath aircraft wings and fixing things in all weathers. A lot of the time, I learn on the job, and I'm always gaining new knowledge. That's what makes my job so interesting."

### Staying grounded

In Kate's current role as an Aerosol Scientist, she uses observations from the FAAM research aircraft to understand the impact of aerosols on atmospheric radiation. Aerosols are tiny particles suspended in

the air that scatter and absorb the sun's radiation and can modify temperatures and the characteristics of clouds. The Met Office uses Kate's measurements to help validate and improve the performance of models used to predict radiation in the atmosphere called radiative transfer models. These models, in turn, are used in weather and climate predictions.

Recently, Kate has been working on a project to study how emissions from London and traffic on the M25 influence aerosol and gaseous concentrations in the atmosphere. Called the Emission M25 (EM25) project, it involved collecting measurements over a series of circular flights around London in June 2009. Kate has since been analysing this data to gain a greater understanding of how humidity affects aerosols in the atmosphere and how this might also affect visibility on, for example, the roads. This may seem a little less exciting than flying over the rainforests of Borneo or icy plains of Alaska, but Kate has a different philosophy.

"Throughout my career, I've always pursued whatever interested me at the time. But my current role is my favourite so far. Right now, I've got my ideal job."



Science crew (including Kate, fourth from left) and the FAAM BAe 146-301 aircraft in Alaska



Photos courtesy of the Science Museum

# atmosphere

## exploring climate science

The Met Office was a major contributor to the Science Museum's new climate science exhibition, 'atmosphere: exploring climate science' which opened in December.

It was British physicist John Tyndall (1820–93) who discovered the link between greenhouse gases and global warming. He's also known for making physics accessible to the public in lectures and best-selling books. But perhaps what's most surprising is that the scientific terms 'greenhouse gases' and 'global warming' are so much part of today's vocabulary they hardly need explanation at all.

Taking a leaf out of Tyndall's book, the Science Museum's new exhibition, 'atmosphere: exploring climate science' presents information on climate science for everyone, no matter what their level of prior knowledge. Tyndall and other luminaries, past and present, get a mention among the exhibits, which include an immersive 'gallery world' with its own atmosphere and landscapes that imitate the Earth's complex system as they respond to visitors' interactions.

Bringing the science up to date, the exhibition explores methods used by today's climate scientists, such as those at the Met Office, to assess what's happening to the climate now and what the future may hold.

Opened by His Royal Highness The Prince of Wales, the exhibition aims to deepen museum visitors' understanding of climate science in an enjoyable, engaging and memorable way. The exhibition includes interactive exhibits and a variety of objects to explain how the climate system works, to show how scientists study the climate system, and to summarise the current state of knowledge about our climate.

The Science Museum worked closely with the Met Office in putting 'atmosphere' together. Met Office scientists provided in-depth information on how climate change is observed and modelled; projected temperature rises, and the impact of these rises. The innovative partnership involved Met Office scientists acting as expert advisers for the exhibition's content.

Exploring the ideas behind climate change, 'atmosphere' explains what is happening to the planet and the possible consequences of changes to its temperature. The gallery is divided into five zones focusing on different areas of climate science through interactive displays, key instruments used by researchers and reports on some of the latest news about the subject.

Professor Julia Slingo, Met Office Chief Scientist, said: "Met Office scientists are playing leading roles in formulating expert evidence on past and future climate change to international bodies such as the Intergovernmental Panel on Climate Change and across all sectors of UK Government and business. We're delighted to have contributed to this exciting new gallery bringing climate science to life. Visitors will be able to see how our climate is changing; understand what's driving these changes, and how these affect our planet — now and in the future."

# Rocks star

**Dr Iain Stewart** brought geology to the masses when his series 'Journeys from the Centre of the Earth' hit screens in 2004. Since then, his TV career has taken him to all corners of the planet — from the frozen lakes of Serbia to the freezing lochs of Scotland.



## Worth the gamble

Geology and risk. For most people, these are not two things that often go hand in hand. But for geologist Iain Stewart, a healthy approach to risk has been a common theme throughout his career.

While many academics would be content with a position as a lecturer, Iain left his post at Brunel University to pursue a career in television. It was a bold move, but one that's paid off. Since 2004, Iain has made several documentary series including 'Earth: The Power of the Planet', 'Hot Rocks' and, most recently, 'Making Scotland's Landscape' and 'Men of Rock'. Now he's got the best of both worlds — juggling his TV work with an academic position as Professor of Geoscience Communication at the University of Plymouth.

But Iain has continued to take risks — including abseiling into a live volcano for one of his documentaries. In fact, he's passionate about the more dramatic aspects of his science and much of his research focuses on earth hazards and natural disasters — in particular major earthquakes, tsunamis and volcanic eruptions in the Mediterranean.

"There's more to geology than just rocks. In four and a half million years of history, a lot of things have happened — earthquakes, volcanic eruptions, dinosaurs... all very exciting stuff."

But it's not just the big events in the history of the earth that interest Iain. He is also fascinated by the subtler ways in which geoscience affects how the planet works — and the implications this has for us as society: "Geology is about looking at what happened in the past so that we can get an understanding of what's happening now — and in the future."

In his series, 'Climate Wars', for example, Iain explored the history of climate change and how it impacts the planet today — an area he's particularly interested in exploring further. And the Met Office is the first place he turns for advice on the subject. As he says, when it comes to climate change: "People don't listen to academics, they listen to the Met Office."

## A sense of adventure

As a child, Iain dreamt of becoming an explorer. And his documentary work has allowed him to do just that, travelling to many far-flung places.

He's visited the volcano Erta Ale in Ethiopia — with its giant pools of moving lava — which, as Iain puts it, shows in miniature how the whole planet works. And he's seen for himself the frozen lakes of Siberia, which leak methane and shoot out jets of flame.

His latest series, however, was based a little closer to home — in his native Scotland. During the six months of filming, Iain trekked around the country, rediscovering places he once visited as a child on family holidays.

Iain's nostalgic trip made him appreciate his homeland all the more — so much so that he's planning to holiday in Scotland with his own family. But that might have to wait, as his next series is taking him round the globe once again — to discover how plants have changed the world. This is geology. But not as we know it.

### Snowflake man

"Under the microscope, I found that snowflakes were miracles of beauty; and it seemed a shame that this beauty should not be seen and appreciated by others. Every crystal was a masterpiece of design and no one design was ever repeated. When a snowflake melted, that design was forever lost. Just that much beauty was gone, without leaving any record behind."

**Wilson 'Snowflake' Bentley 1925**

Many of us remember being told that no two snowflakes are alike. This discovery was made in the small town of Jericho, Vermont by Wilson A. Bentley. By adapting a microscope to a bellows camera, Bentley became the first person to photograph a single snow crystal in 1885.

During his lifetime, Bentley captured more than 5,000 snowflakes. After his 1931 book, 'Snow Crystals', which contained more than 2,400 of his photographs, he became affectionately known as 'Snowflake' Bentley.

