

# INTERDEPENDENT AND INCREASINGLY VULNERABLE – How the world is responding to environmental change



Professor Julia Slingo  
Met Office Chief Scientist

**Recent natural hazards around the world have raised awareness of society's vulnerability to environmental change; challenged scientists' understanding of the role of weather and climate in environmental change; and questioned society's ability to predict and prepare for such events.**

Four key influences combine to increase society's vulnerability to environmental change: where people live, how people live, what they use, and climate change. It is a blend that Professor Sir John Beddington, Government Chief Scientific Adviser, has described as the 'perfect storm'.

Our planet's population is increasing, causing our cities to grow, often along coastlines. Here, people are not only more exposed to rises in sea-level and storm surges, many cities are built in zones where tropical cyclones regularly make landfall. Pakistan has a rapidly growing population with millions of people living along the Indus Valley. The floods that devastated the region in 2010 were not unprecedented – there was a similar level of flooding in 1929 – but the impacts in 2010 were far more serious: nearly 1,800 people lost their lives while 2 million were displaced; it destroyed 23% of the national crop and wiped \$5 billion off expected growth.

Our world is much more interdependent than it was. We rely on global telecommunications systems; source food

from around the world; and depend on efficient transport systems and a constant supply of energy and water. The way we live and the technology we exploit are exposing us to natural hazards that would have had very little impact in the past. This was brought home by the eruption of Eyjafjallajökull in Iceland in April 2010. While it wasn't a major volcanic eruption, it was the first of any significance since the growth in air travel over the last 50 years. Coupled with unfriendly weather, its impact on UK air travel and therefore on our economy was profound.

Due to population growth, we are now drawing more and more resources from the natural environment; particularly water for domestic use and agriculture, and land for food production. In the UK, for example, the population of southern England has grown significantly in the last 20–30 years while the use of water per capita has, for some time, been above the replenishment rate from rainfall. As a result, we are now faced with drought which could have an impact on agricultural production and prices.

The additional pressure of climate change creates a unique set of circumstances. While the sea surrounding the UK buffers us from some of the most serious effects of global warming, we are not immune to the impacts of climate variability and change in other parts of the world. Due to global interdependency, a changing climate has genuine consequences for the UK economy and lifestyle.

## THE ROLE OF WEATHER AND CLIMATE

The importance of the weather in our vulnerability to environmental change and forecasting what it may do next, have long been understood. Last year, the Met Office celebrated 150 years since the first public weather forecast; and, over that time, weather forecasting and its influence on the UK economy and our daily life has become part of our culture. Often the weather can be the instigator of a natural hazard but other parts of the Earth's geophysical system come into play, so we can no longer look at the weather in isolation. For example, the 2007 floods in the UK were both meteorological

and hydrological and cost the country over £3 billion in insured losses.

Having had an influence on nearly all of the natural hazards we've witnessed around the world recently, it is clear that the weather and climate are drivers of environmental change. As the climate changes the rate of change is likely to be greater than at any other time in our planet's history. This will impose huge stresses on the environment; and highlights the importance of models that represent the way the environment will change in all its aspects for telling us about the future, because these will be absolutely critical in decision-making.

## HOW SCIENCE CAN HELP IMPROVE RESILIENCE

The UK leads the world in many areas of environmental science. Met Office science and forecasting is envied around the world and there's increasing interest from other countries in using our modelling systems in their own operations. Advances in science have allowed us to improve weather forecasting accuracy so that a five-day forecast is as accurate as a one-day forecast was 40 years ago. In terms of being better prepared and more resilient, the impacts of this are huge; particularly when estimating the lives saved and costs avoided by knowing in advance that hazardous weather is on the way.

Take the Cocker mouth floods in November 2009. The Met Office had just introduced a new high resolution 1.5 km model for the UK. This level of detail proved invaluable in allowing us to issue warnings 24 hours in advance of what would be exceptional and unprecedented levels of rainfall over the Cumbrian Fells. A red alert

triggered a Cabinet Office Briefing Room meeting and emergency responders took the necessary steps to protect life and property.

Society's increasing vulnerability to variations in weather and climate presents the Met Office with complex scientific challenges in order to provide reliable predictions on regional and local scales, spanning timescales from hours to decades ahead. We are in a unique position to succeed in meeting them, with weather forecasting and climate prediction under the same roof, using the same science and modelling systems. Having built up several decades' experience in weather forecasting and communicating that intelligence for decision-making, we are now developing the same capability in climate prediction.

## TURNING SCIENCE INTO SERVICES

We have an understanding of our customers' needs across the public and private sectors and around the world. We supply everything from underpinning science to sophisticated bespoke products and services. It is our job to look at the impacts of environmental change to enable others to make informed decisions.

A unique aspect of the Met Office is the closeness of our weather and climate science to services, so the time between advances in science and the help it offers is short. 80% of our science has a direct and attributable benefit on our operational performance – unlike any other scientific discipline.

But as the latest Science and Technology Select Committee reported in February 2012, there is a lot more science "ready and waiting" at the Met Office. At the moment, we currently lack the supercomputing power to take it

through to the delivery of better services.

An area of predictive capability to have emerged at the Met Office over the last ten years is seasonal forecasting. In parts of the developing world, where our seasonal forecasts are increasingly accurate, they have a profound influence in helping societies to better prepare for events such as prolonged drought or food shortages.

We are also getting much more skilful and confident in making longer range predictions out to several decades, which is often the timescale for investment in major infrastructure. The Met Office has been doing detailed work on flood risk in the Thames Estuary, for example, looking at whether the Thames Barrier will hold fast and continue to protect London and the estuary communities.

## WORKING IN PARTNERSHIP

The challenges posed by environmental change involve a greater breadth of science than the Met Office can cover on its own. We recognise this and have started building partnerships across environmental science and with those government departments for whom this information is critical to decision-making.

We are working with DfID on a major programme called the Climate Science Research Partnership. This involves capacity building in different African countries to look at ways of improving the accuracy and utility of climate predictions.

We've also initiated the Met Office Academic Partnership, currently with three leading universities – Leeds, Reading and Exeter – to align our research and extract maximum value from UK's investment in

science. Our partnership with academia complements the Met Office–NERC Joint Weather and Climate Research Programme concerned with maintaining and developing the UK's national capability in science, observations and modelling.

At an operational level, the Pitt Review of the summer 2007 floods was the catalyst for a joint Met Office–Environment Agency Flood Forecasting Centre that brings together meteorologists and hydrologists from each organisation to deliver critical joined-up advice and flood warnings to the civil contingency community.

## THE FUTURE FORECAST

We've since extended this way of working to consider other natural hazards such as volcanic ash, space weather and health. We initiated the development of the Natural Hazard Partnership (NHP) – a multi-agency programme that brings together government bodies, science institutes and research councils to provide an authoritative voice and a consistent message when natural hazards strike. The NHP was recently asked to review the National Risk Register to make sure it took a consistent view of risks relating to the environment – not just weather and climate.

Beyond this, we have established an Environmental Science to Service Partnership to look at how we bring different aspects of environmental science into a broader range of products, services and advice for different customers. With the experience and infrastructure needed to run a 24/7 operational service, the Met Office has a key role to play here. We are very well placed to be a conduit of science into services to provide better advice to the UK and the world. This is critical at a time when society's vulnerability to environmental change has never been greater.

