A TASTE OF THINGS TO COME?

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As the Intergovernmental Panel on Climate Change (IPCC) publishes its Fifth Assessment Report on climate change science, the impacts on human and natural systems, and the options for adaptation and mitigation, UK scientific expertise in weather and climate is more important than ever before. From water resources to food security, rising sea levels and more extreme weather, the IPCC Report showed that climate change impacts are already widespread.

This winter highlighted how vulnerable we are to extreme weather. We know the weather was unusual and we understand how it was related to weather patterns elsewhere in the world. The big question is did climate change contribute to the severity and impacts of the storms and should we expect more of the same in the future?

Sea levels are rising as the Earth warms due to increased greenhouse gases in the atmosphere, adding to the risk of coastal inundation from storm surges. A warmer atmosphere holds more water, so a storm

... how vulnerable we are to extreme weather ...

today gives more rainfall than the same storm 50 years ago.

Severe storms have always affected the UK and are well documented in historical records. Throughout history, societies have adjusted to climate variability and extremes with varying degrees of success. What is different now is our exposure and vulnerability to changes in the climate and weather we experience. There are many more of us on the planet, and we rely more than ever on critical infrastructures to protect our lives and livelihoods and to deliver reliable supplies of water, food and energy. We live in an interdependent world, so climate change, whether it's in the UK or elsewhere, touches all our lives.

... We live in an interdependent world ...

RESPONDING TO THE CHALLENGE OF CLIMATE CHANGE

Since its establishment by Margaret Thatcher in 1990, the Met Office Hadley Centre for climate prediction and research has provided Government with the scientific evidence to inform climate change policies. Our science has been critical in demonstrating that our climate is changing and that this is largely due to human activities. Of course, it is not just about science – it is really important that we are able to communicate and help integrate this knowledge into decision-making, whether that be in the context of regional and national infrastructure or on the world-stage at the United Nations Conference of the Parties.

The Met Office Hadley Centre's work has been fundamental to setting UK policies on mitigation in terms of controlling emissions. As evidence grows around the impacts of climate change on our lives, we must become better prepared and more resilient. Climate science must evolve to respond to this shift in demand.

THE EVOLVING LANDSCAPE OF CLIMATE SCIENCE

For too long the climate change debate has focused on global mean temperatures as a simple metric to guide international negotiations on reductions in carbon emissions. We frequently hear that a world that is 2°C warmer than in the mid-19th century is dangerous – but dangerous to whom, when and where? For some, the warming of 0.8°C that has already occurred is dangerous,

... Climate science must evolve ...

as many of the small island states faced with rising sea levels would attest.

This fixation on global mean temperatures has not helped the communication of the seriousness of climate change. People do not generally relate to small rises in global mean temperature. They relate to what

happens to their region or them personally; add to that a growing appreciation that some of the most profound impacts of climate change will be felt through the intensity and frequency of extreme weather, like we experienced this winter.

Understanding regional implications of a changing climate is what matters to individuals, governments, businesses and the natural world. That means delivering a level of local detail that hasn't existed in scenarios of climate change so far. It means being able to quantify the changing

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risks of extreme weather, from floods, drought, storms and heatwaves.

Filling that gap has driven the Met Office Hadley Centre programme in the last five years – to get the same level of detail in climate predictions as in our weather forecasts. Just as we could give early warnings of severe weather this winter to Network Rail, enabling them to take mitigating action, we also need to be able to say how often we'll be confronted with severe weather events in future and what that means for investments in our transport infrastructure, coastal protection and flood defences. That level of granularity is essential; only then can society understand future risks, invest in the right places and take adaptation decisions that use financial resources wisely.

... as yet no definitive answer ...

OPENNESS AND TRANSPARENCY: COMMUNICATING UNCERTAINTY IN CLIMATE SCIENCE

The IPCC Fifth Assessment Report was another milestone in understanding climate change and its consequences. The scale of the endeavor is unmatched in any other branch of science. In Working Group I alone, which considered the physical science basis, 250 scientists reviewed 9,000 papers and addressed over 50,000 comments.

This sort of consensus on climate science cannot happen often. In the meantime, science advances at pace – climate models improve, we gather more observations, and our understanding of the Earth system develops. We must have confidence in the integrity of new science as it emerges; the rigour and robustness of the peer review process is crucial in this regard. Last year we published 324 peer-reviewed articles co-authored with scientists from 196 institutions across 31 countries, emphasising the collaborative nature and international reach of weather and climate science.

... severe weather events in future ...

It is understandable that, with so much at stake, many are entering the debate on the science of climate change. This is to be welcomed. Scientists are sceptical and continually question our understanding and the evidence behind it.

A good example is the debate on climate sensitivity – how much the planet will warm if carbon dioxide concentrations are doubled. Some claim climate model estimates are wrong – and too high – because 'observations' suggest a lower sensitivity. The truth is that climate sensitivity cannot be observed directly, but only deduced from observations through making assumptions about, for example, how the oceans take up heat and how much aerosols – small particles that typically reflect sunlight – have cooled the planet. Simple models are used to make these deductions, but there are uncertainties in the assumptions that underlie these models because of the complex processes they seek to emulate.

... integrity of new science ...

Conversely, climate sensitivity produced by full climate models is an emergent property of the complex, non-linear dynamics and thermodynamics of the full climate system – atmosphere, ocean, land and ice. There is uncertainty here too because our understanding of the climate system is incomplete and the granularity of our models – often referred to as resolution – has been limited by supercomputing power. We must have an open debate on the fundamentals and uncertainties of climate science, rather than the 'black and white' debate that often ensues.

WHERE NEXT?

In the last decade the world has experienced extremes of weather and climate that exceed those in living memory, and increasingly affect us as individuals either directly or indirectly. Impacts of these events around the world have been profound. The UK has not been exempt from this. Challenging weather – from cold winters and drought to the wettest summer and wettest winter on record – has asked more of our science than ever before.

Whilst there is as yet no definitive answer on whether climate change contributed to the severity of these events, the impacts on all of us – individuals, businesses and policymakers – brought our vulnerability into sharp focus. More than ever, weather and climate have considerable direct and indirect impacts on us – our livelihoods, property, well-being and prosperity.

... Simple models are used to make these deductions ...

There is increasing advantage in the UK being the best at global environmental science and I accept the responsibility that the Met Office has, with its partners, to maintain our leadership on the international stage. We will drive our models to greater detail so that we can give more definitive answers on the changing risks of high impact weather and extreme seasons. Through our understanding of customer needs for weather services, we will seek to understand the nature of the risks that society will be exposed to as our climate changes. More and more, our climate research must place customer needs at its heart – making climate science work for society.