Responding to Climate Risk

Making climate science work for society

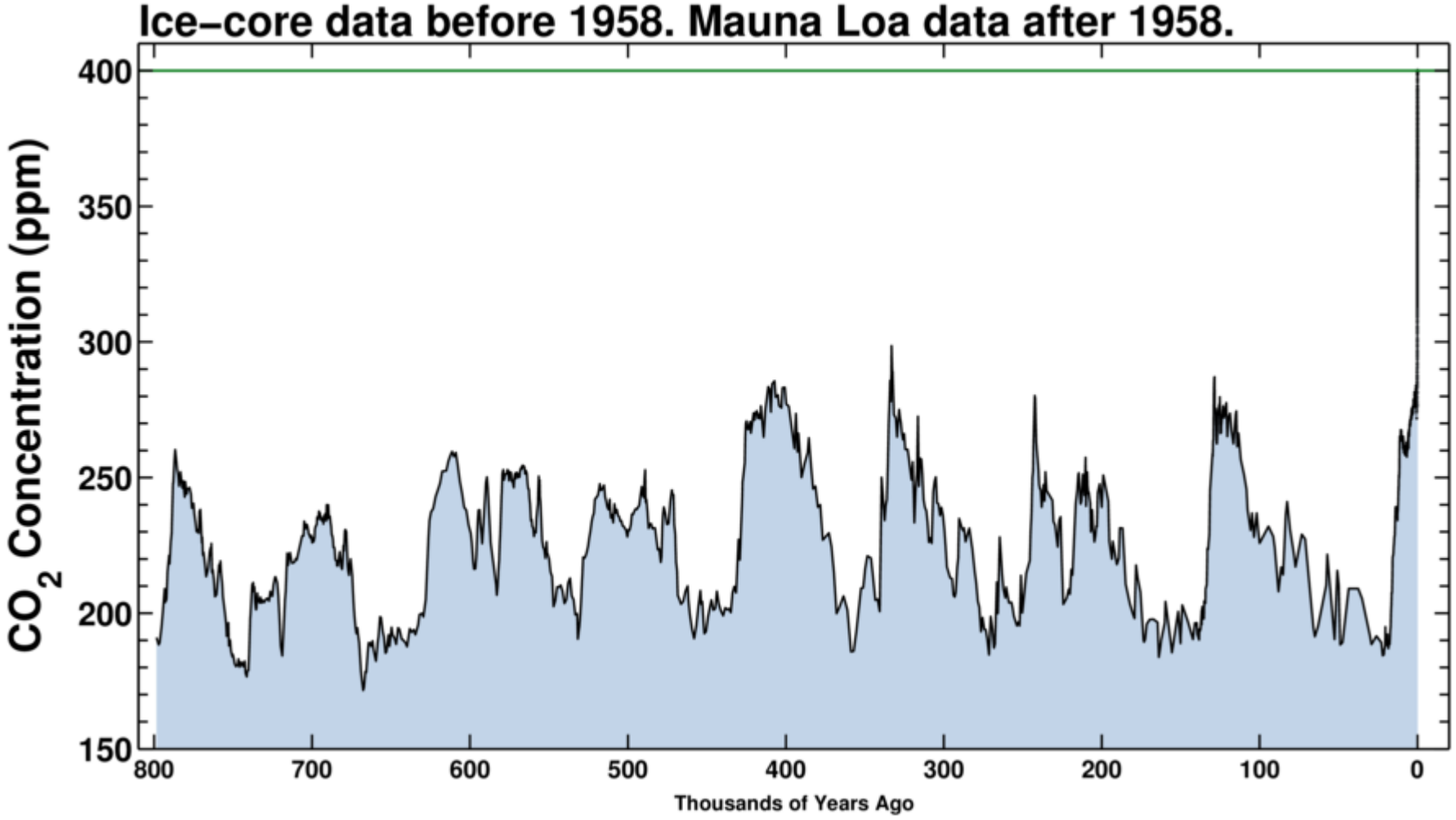
Putting Climate Risk in Context

'Circle of Securities'

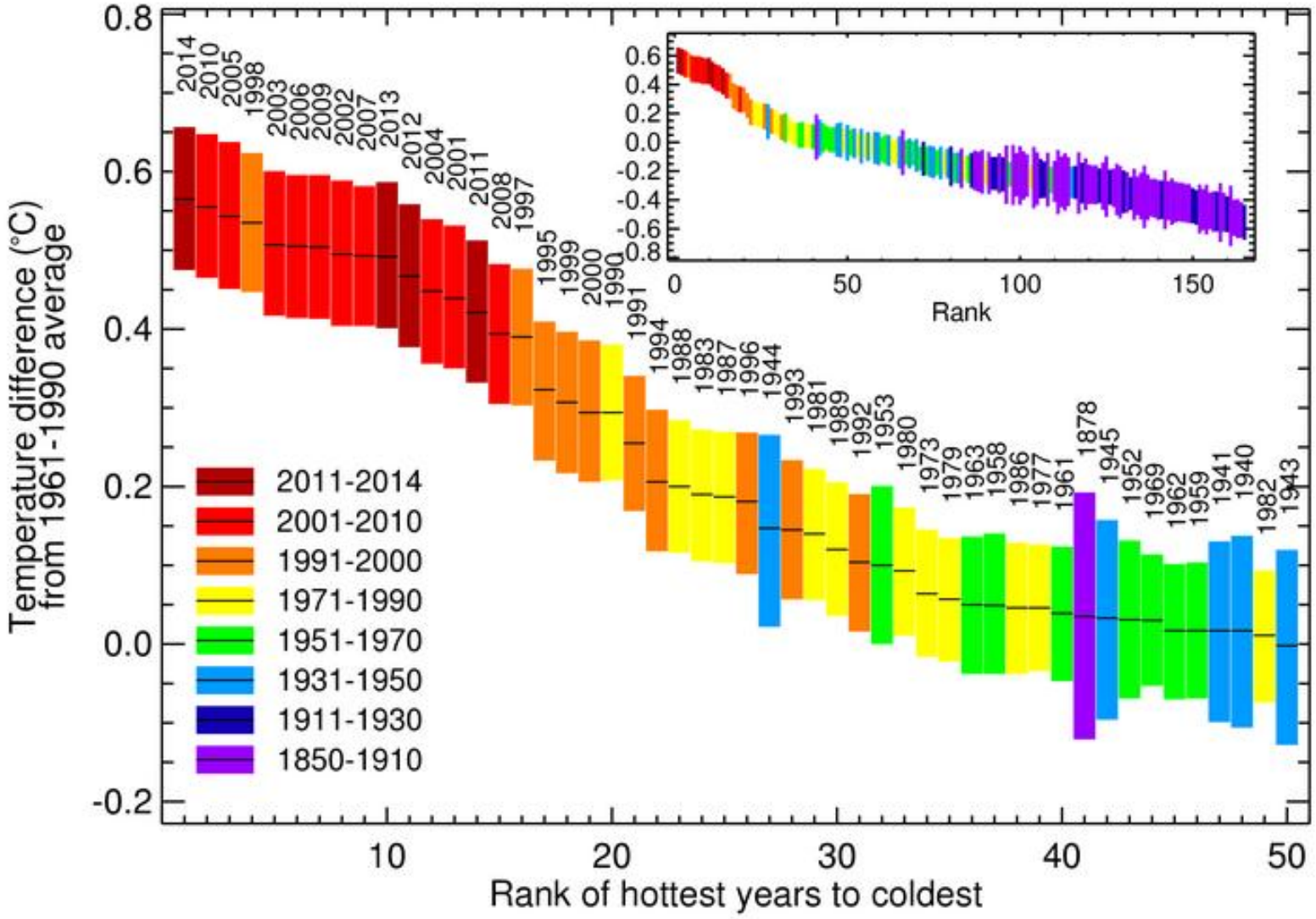
Sir John Beddington – 'The Perfect Storm'

- Can 9 billion people be fed equitably, healthily and sustainably?
- Can we cope with the future demands on water?
- Can we provide enough energy to supply the growing population coming out of poverty?
- Can we do all this whilst mitigating and adapting to climate change?

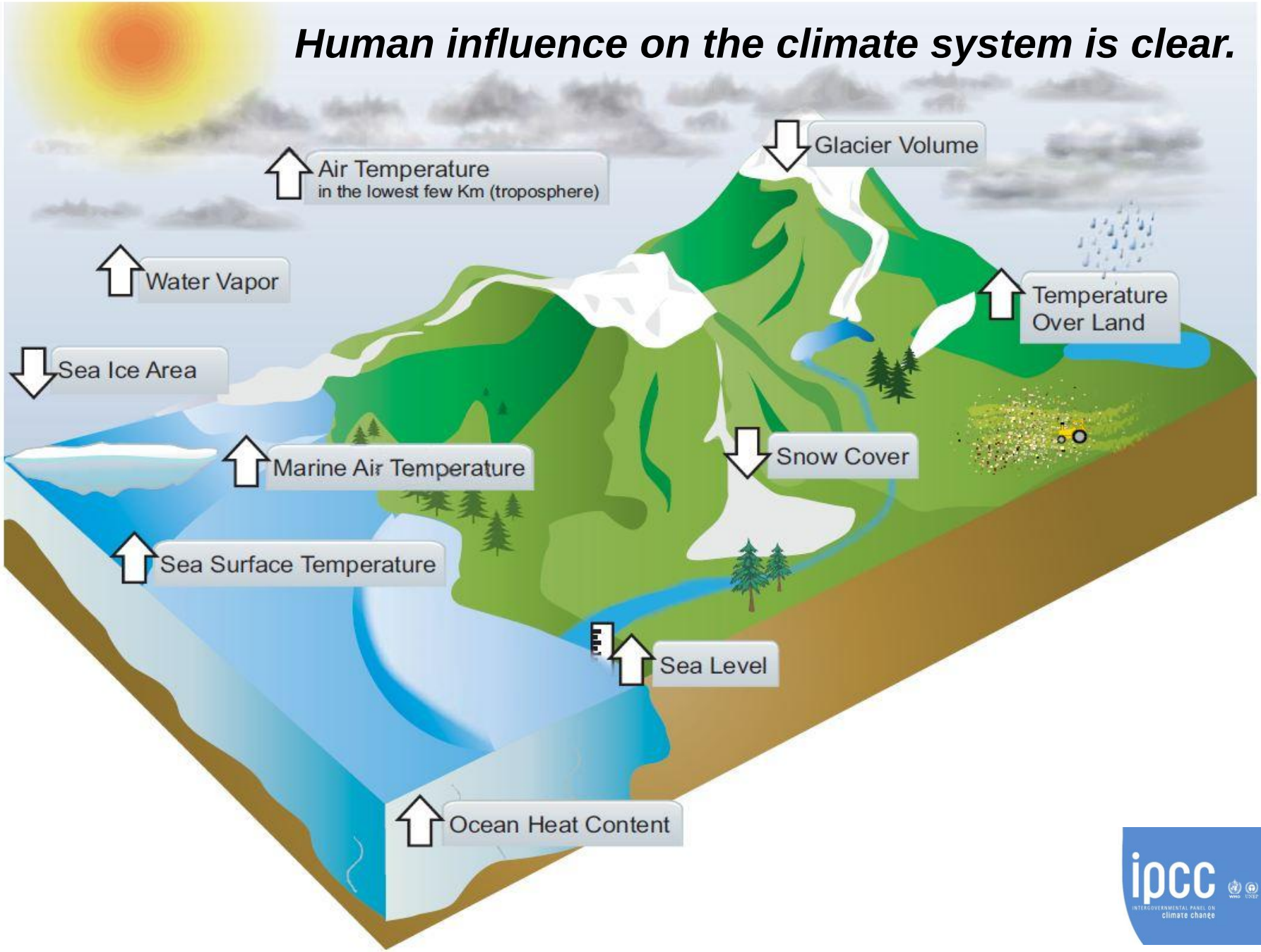
Taking the planet into uncharted territory



Taking the planet into uncharted territory

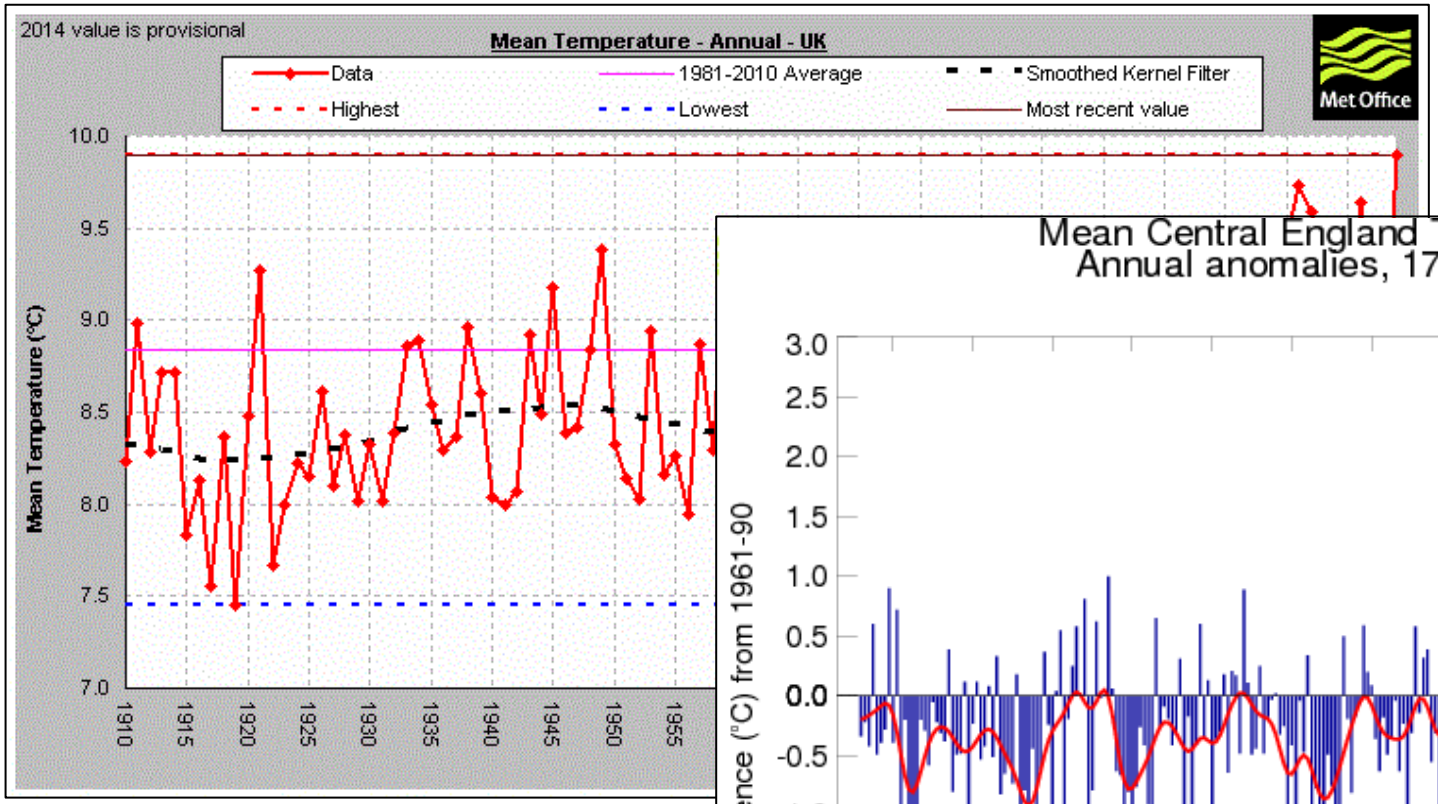


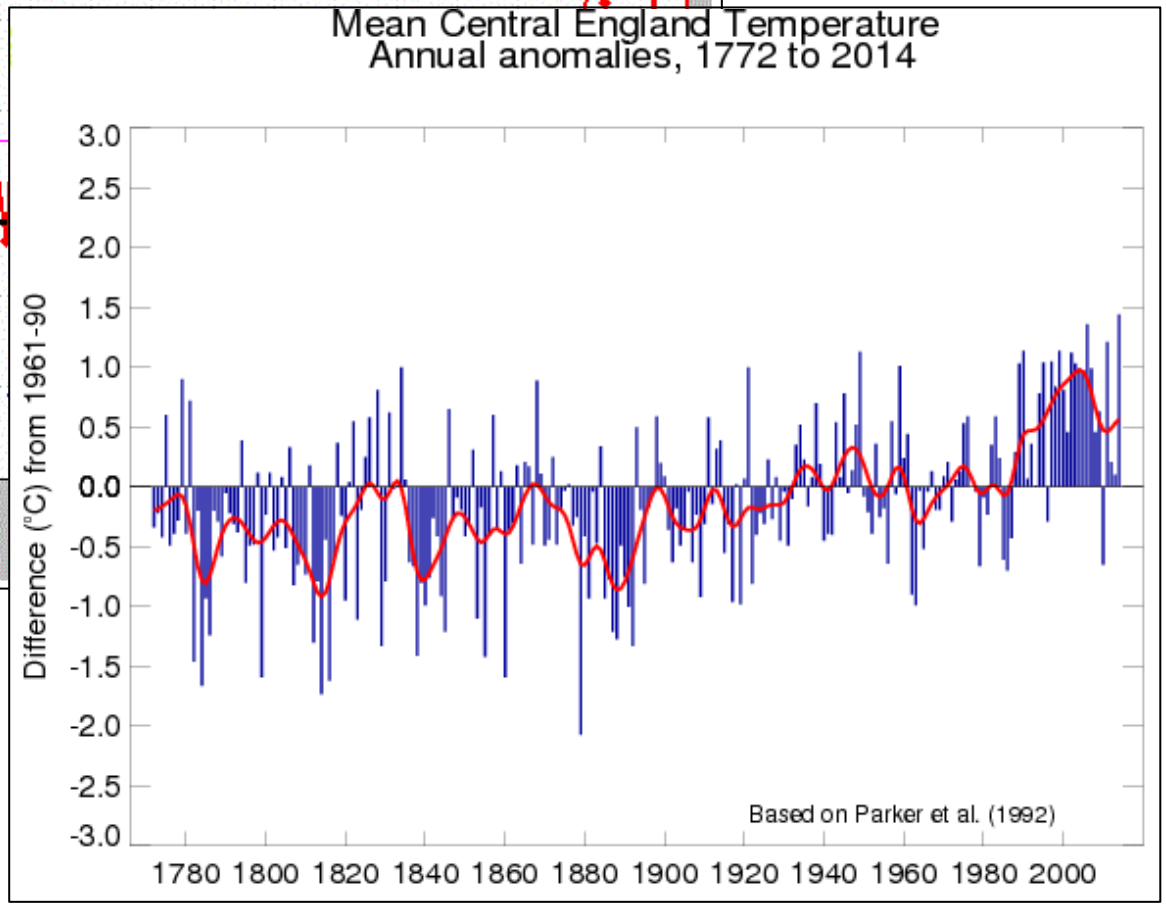
Human influence on the climate system is clear.



ipcc
INTERGOVERNMENTAL PANEL ON climate change

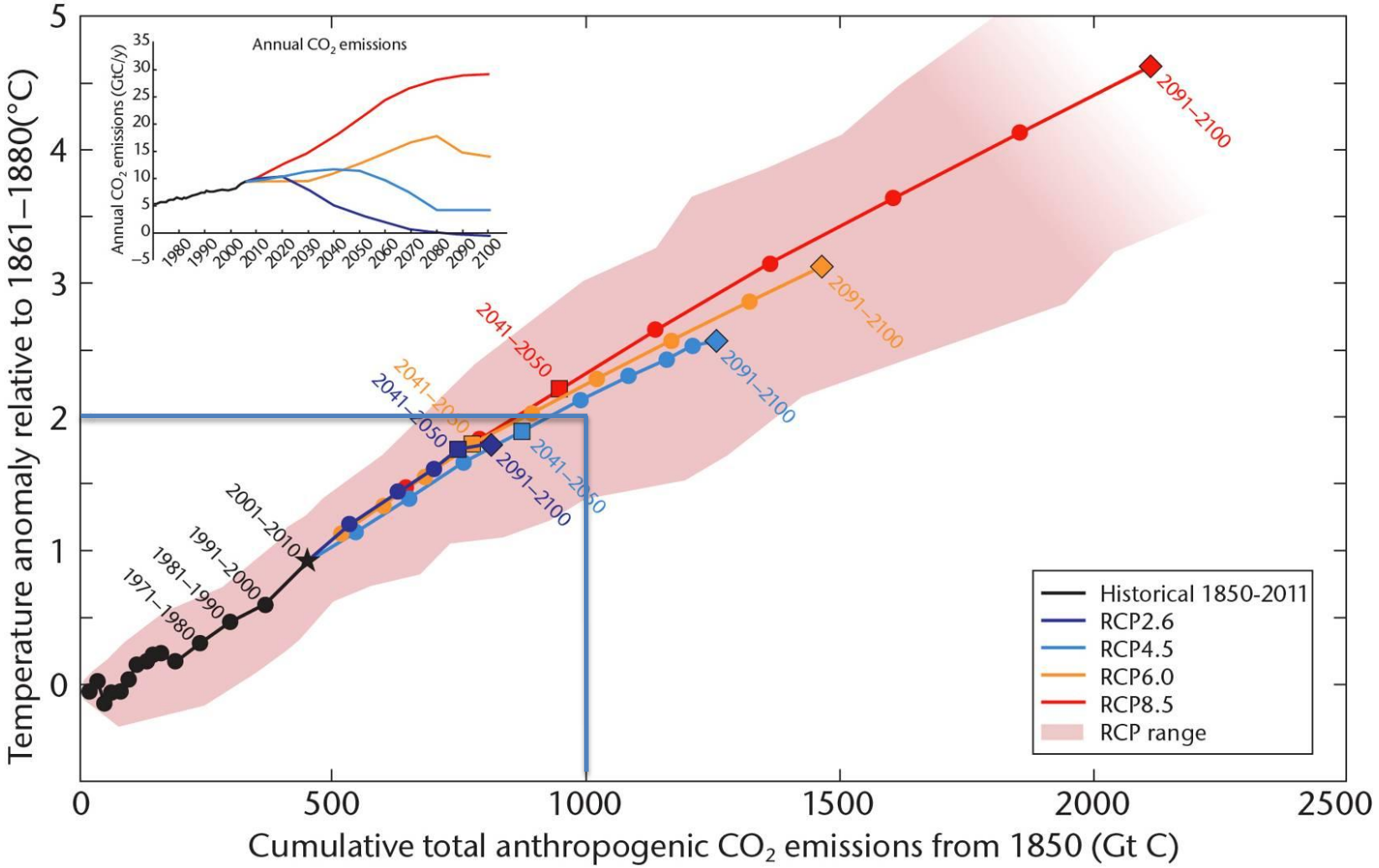
UK Annual Mean Temperatures: 2014 warmest year on record





Record-breaking UK temperatures have become more than ten times more likely as a result of human influence on the climate

Total CO_2 emissions are strongly linked to total warming



If warming is to be limited to 2˚C, total CO_2 emissions need to be limited to ~1000 Gigatonnes of Carbon ('Trillionth Tonne').

Taking the planet into uncharted territory

- Do we know what levels of climate change could be dangerous, where and for whom?
- Can we provide society with a ‘road map’ indicating what climate variations and changes may be expected to occur, where, and with what implications?
- How can we make society more resilient and better prepared for hazardous weather and climate extremes arising from climate variability and change?
- What should society do to mitigate and adapt to climate change to avoid its worst impacts?

Facing up to future extreme weather

Are natural variations compounded by global warming causing more damaging extremes?

Protecting ourselves against damaging floods

Should we expect more intense rainfall in the coming decades and how bad will it be? What will it mean for drainage systems, river management?

Sustainability of India's economic growth

What will the Indian monsoon be like next year? Will the monsoon arrive later than usual? Will there be more monsoon breaks under global warming? What might this mean for managing water resources and supporting farmers?

Food security under a varying and changing climate

Will El Nino become more or less frequent, more or less intense under climate change? Will its global impacts change? What will this mean for food crops around the world?

Staying healthy in a changing climate

Will there be major outbreaks of vector-borne or water-borne diseases in the coming months? Will vector-borne diseases migrate under a changing climate?

Climate proofing our infrastructure

Will winters become windier and what will happen to the frequency of damaging wind storms? What will this mean for infrastructure and building design? How should the insurance industry respond?

Economic Growth and Well-being

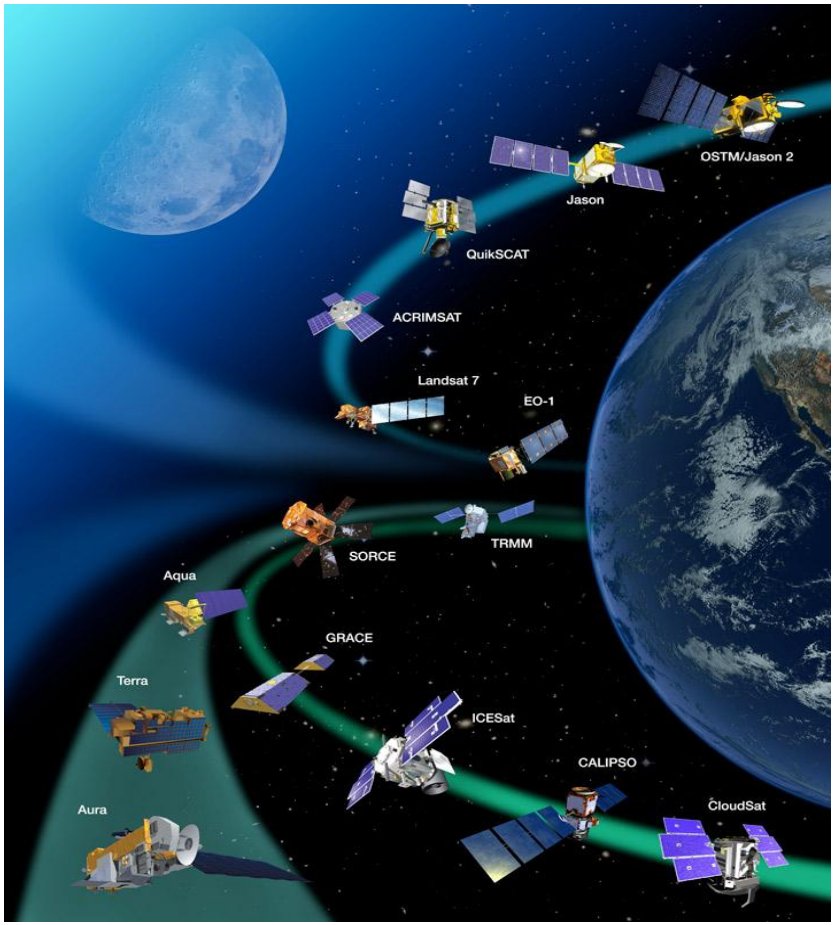
Supporting business to be:

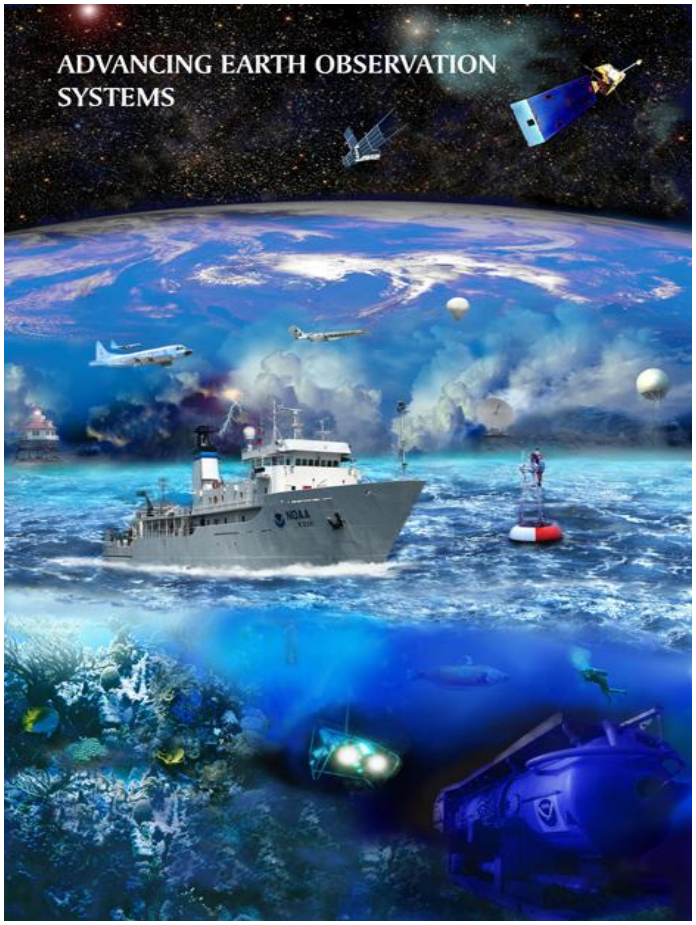
Resilient – ***better able to adapt to the risk and impacts, both direct and indirect, of hazardous weather on their business, both now and in future.***

Competitive – ***better able to exploit weather and climate intelligence to deliver more efficient and reliable services***

Sustainable – ***enabling more resource-efficient practices, and enabling businesses to be better prepared for future environmental risks and opportunities***

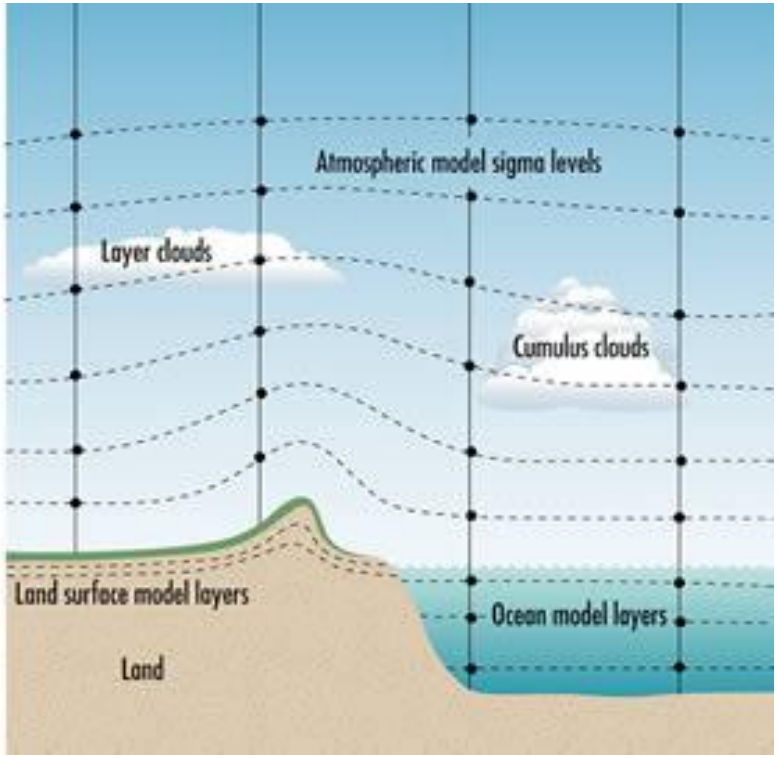
Climate Science Coming of Age: *Earth Observation*





We now know an immense amount about what is happening to the planet

Climate Science Coming of Age: *Climate Modelling*

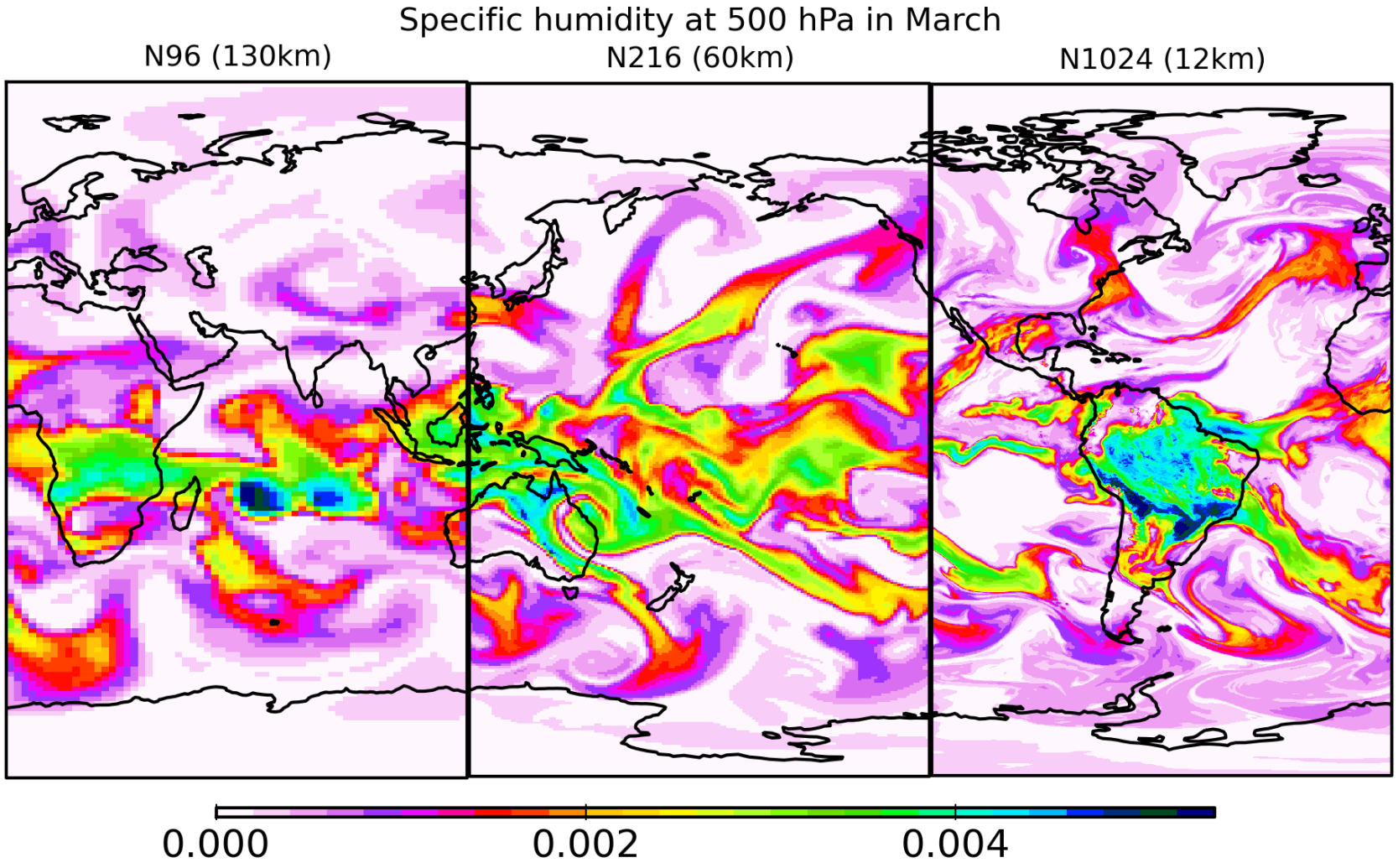


- Represent the earth by a grid of squares, typically of length 100 km or smaller.
- Atmosphere and oceans are divided into vertical slices of varying depths, typically 70 or more.
- 3-dimensional picture of the state of the atmosphere and oceans.
- Integrate equations of motion and thermodynamics forward in time.

Met Office

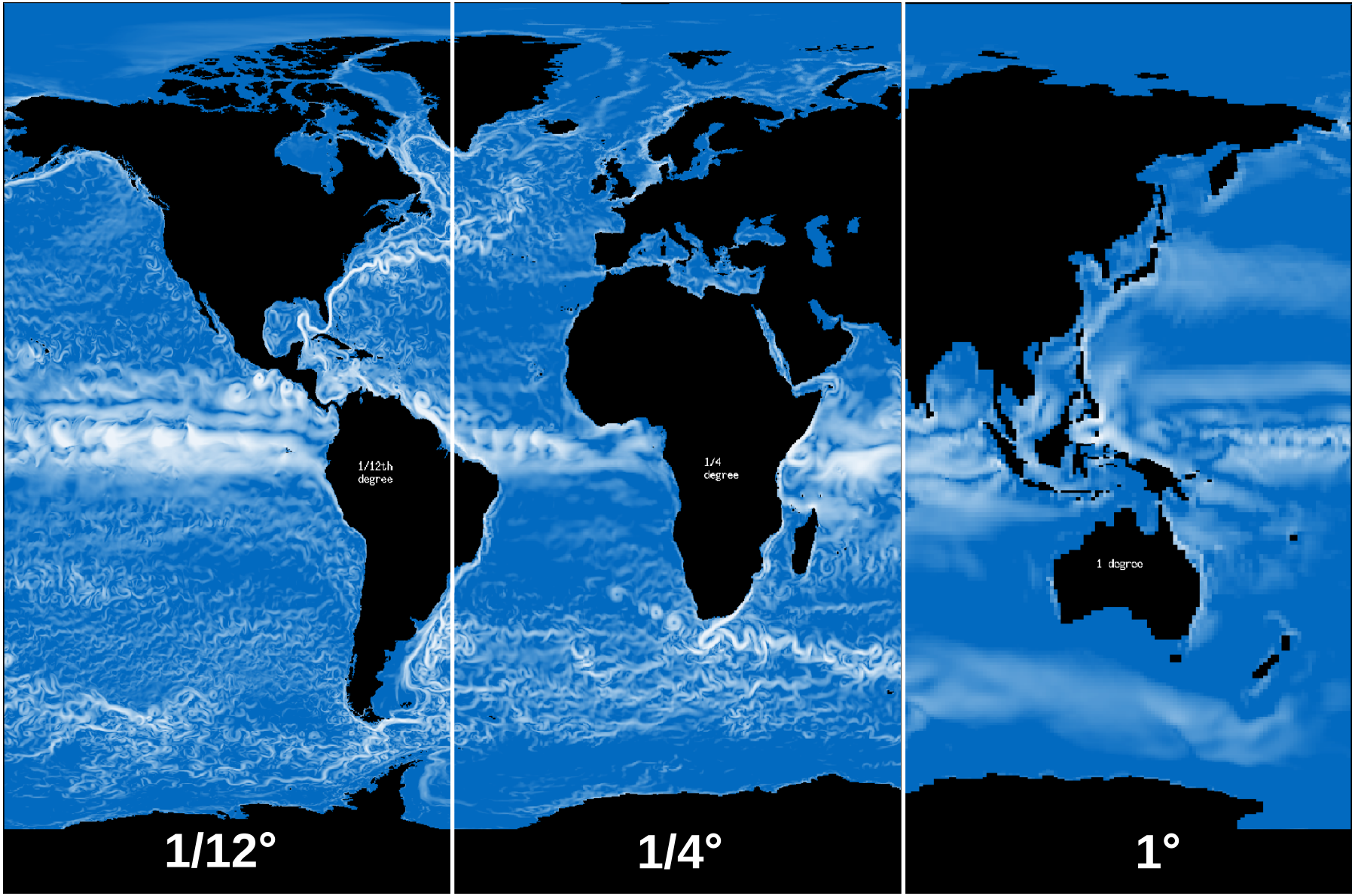
National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

Evolution of climate models over time: Resolution



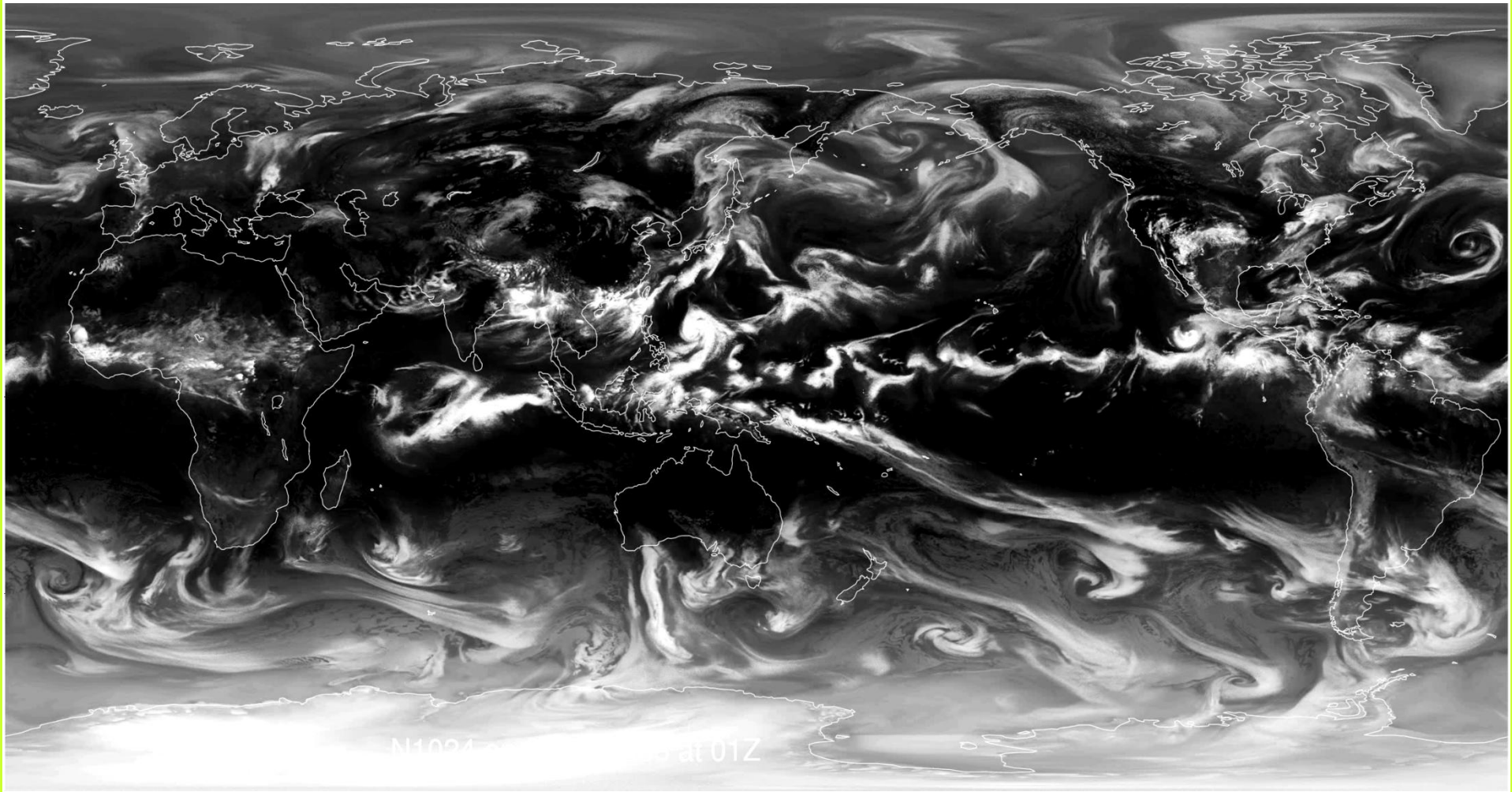
National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Evolution of climate models over time: Resolution



Weather in a Climate Model

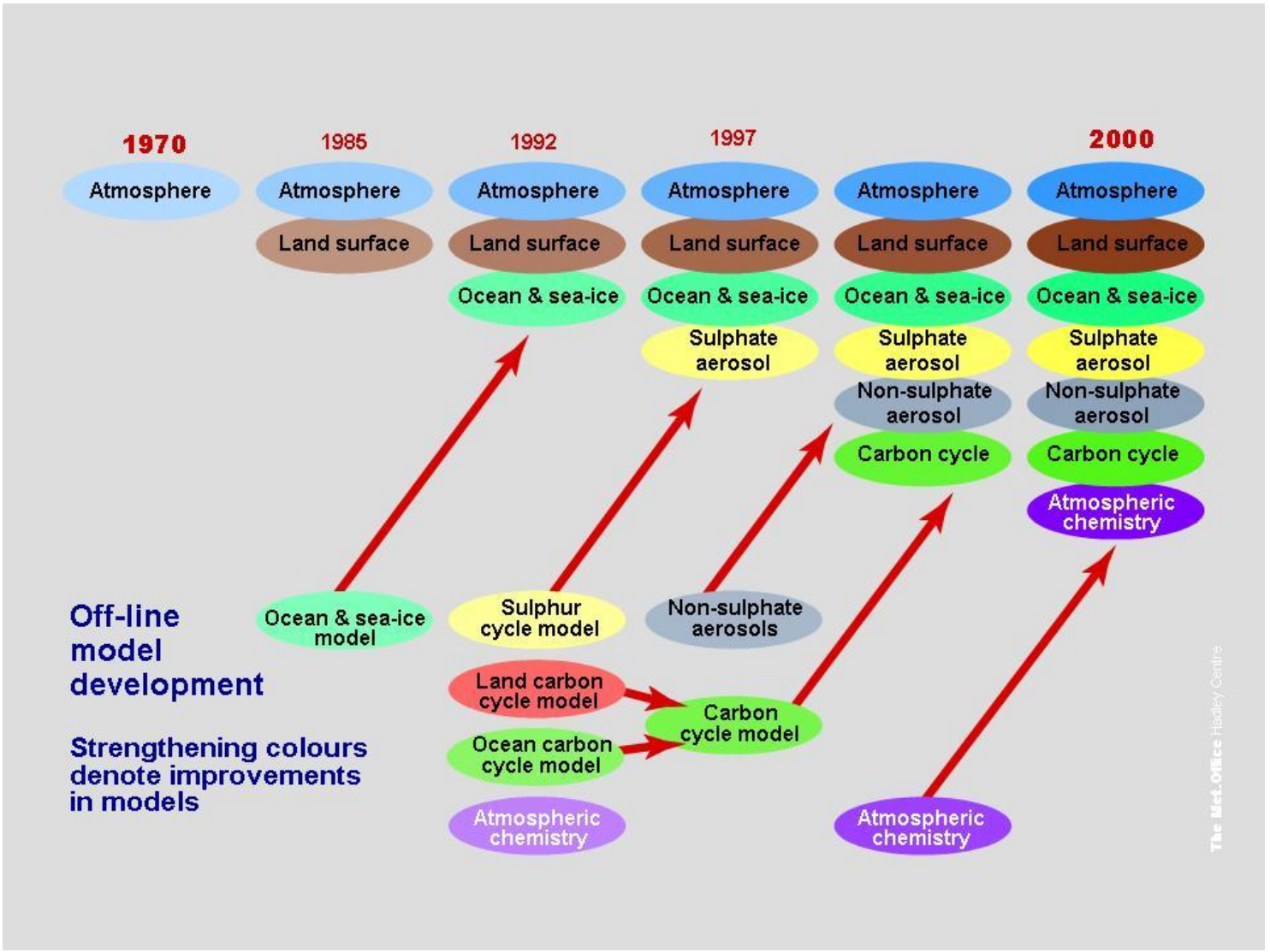
Met Office Climate Model simulation at 12km







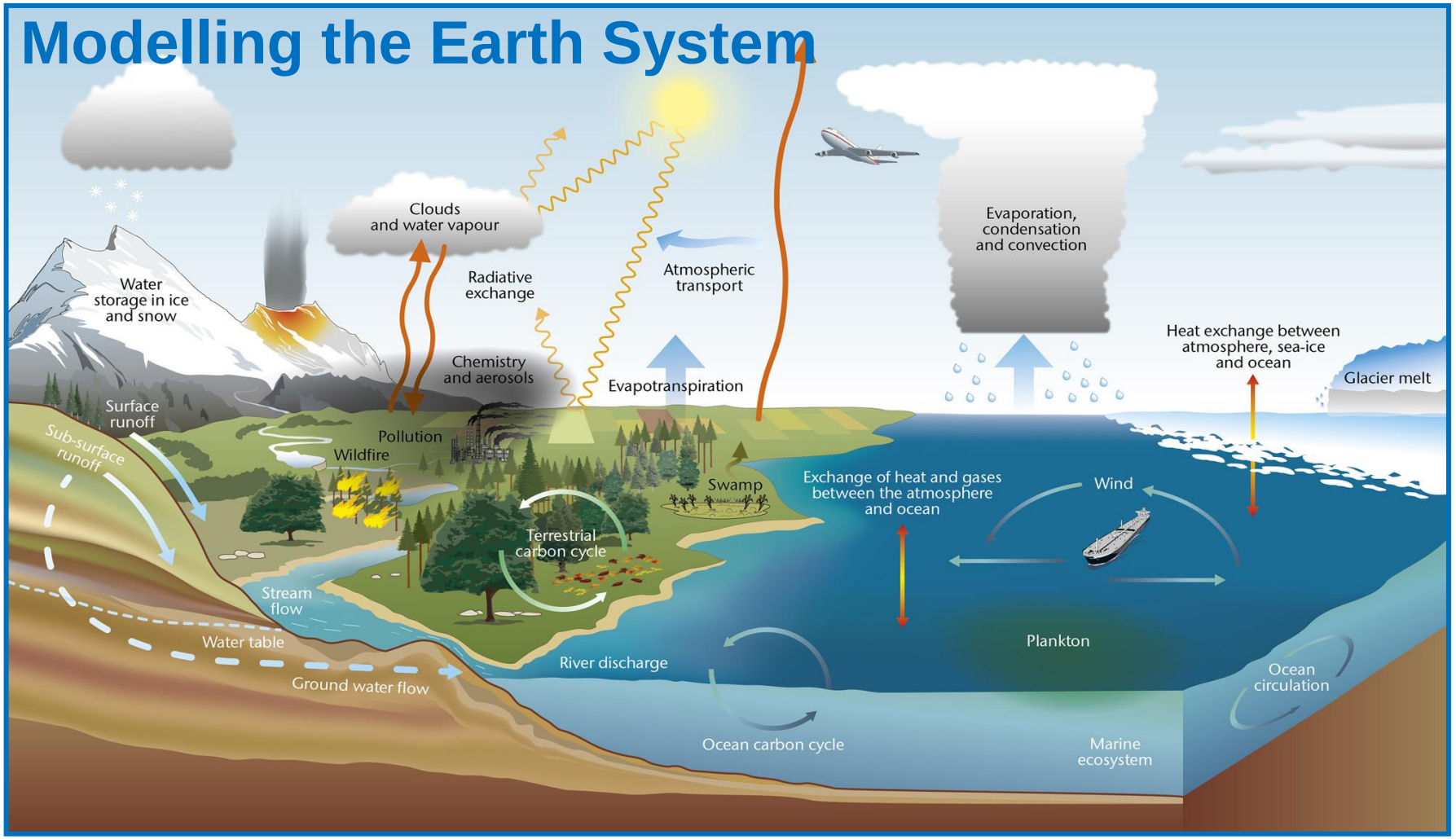
Evolution of climate models over time: Complexity



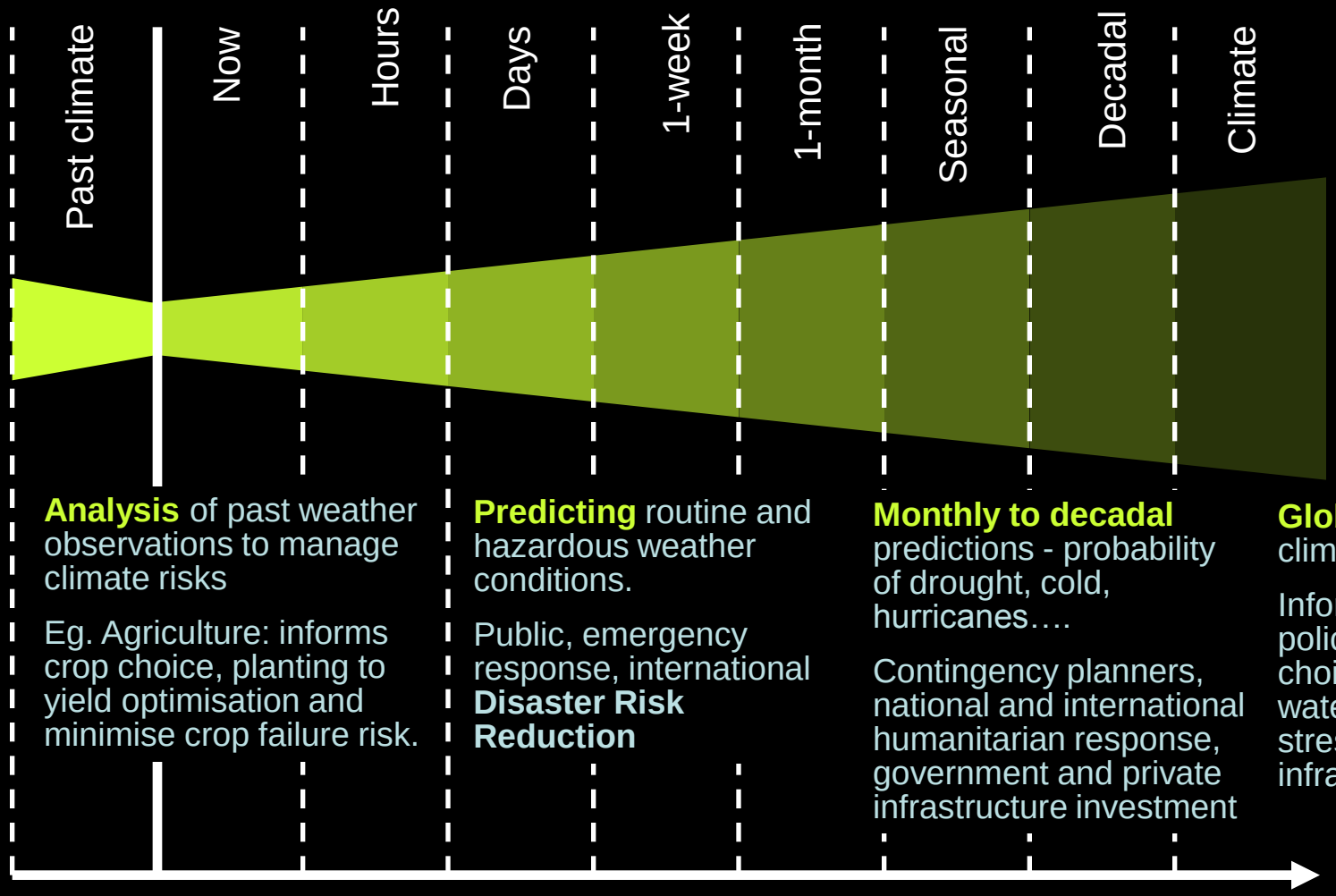
Met Office

Helping us to:

- *Explain the Past*
- *Understand the Present*
- *Predict the Future*



Decision making across all timescales



Analysis of past weather observations to manage climate risks

Eg. Agriculture: informs crop choice, planting to yield optimisation and minimise crop failure risk.

Predicting routine and hazardous weather conditions.

Public, emergency response, international **Disaster Risk Reduction**

Monthly to decadal predictions - probability of drought, cold, hurricanes….

Contingency planners, national and international humanitarian response, government and private infrastructure investment

Global and regional climate predictions.

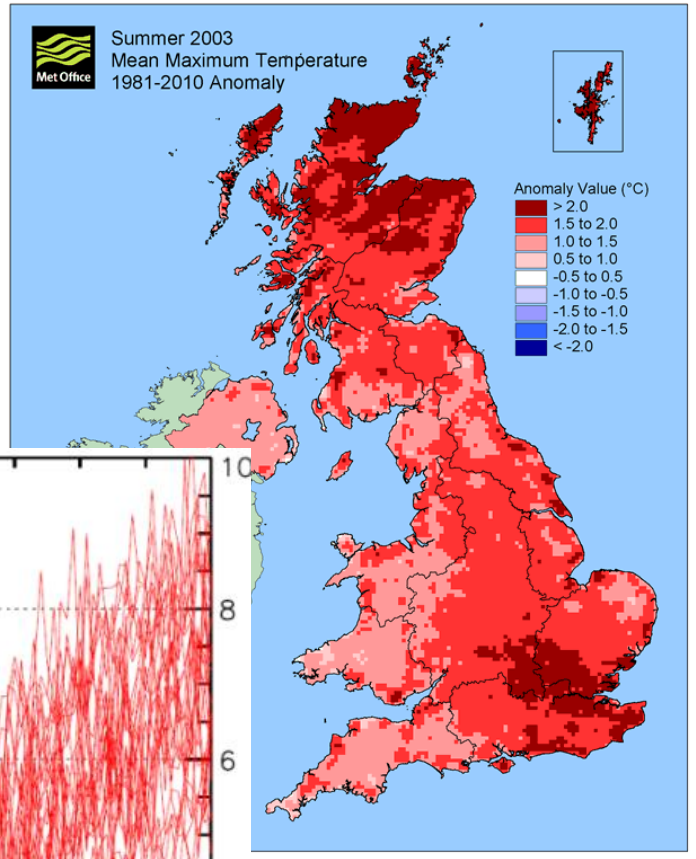
Informs **mitigation** policy and **adaptation** choices. Impacts on water resources, heat stress, crops, infrastructure.

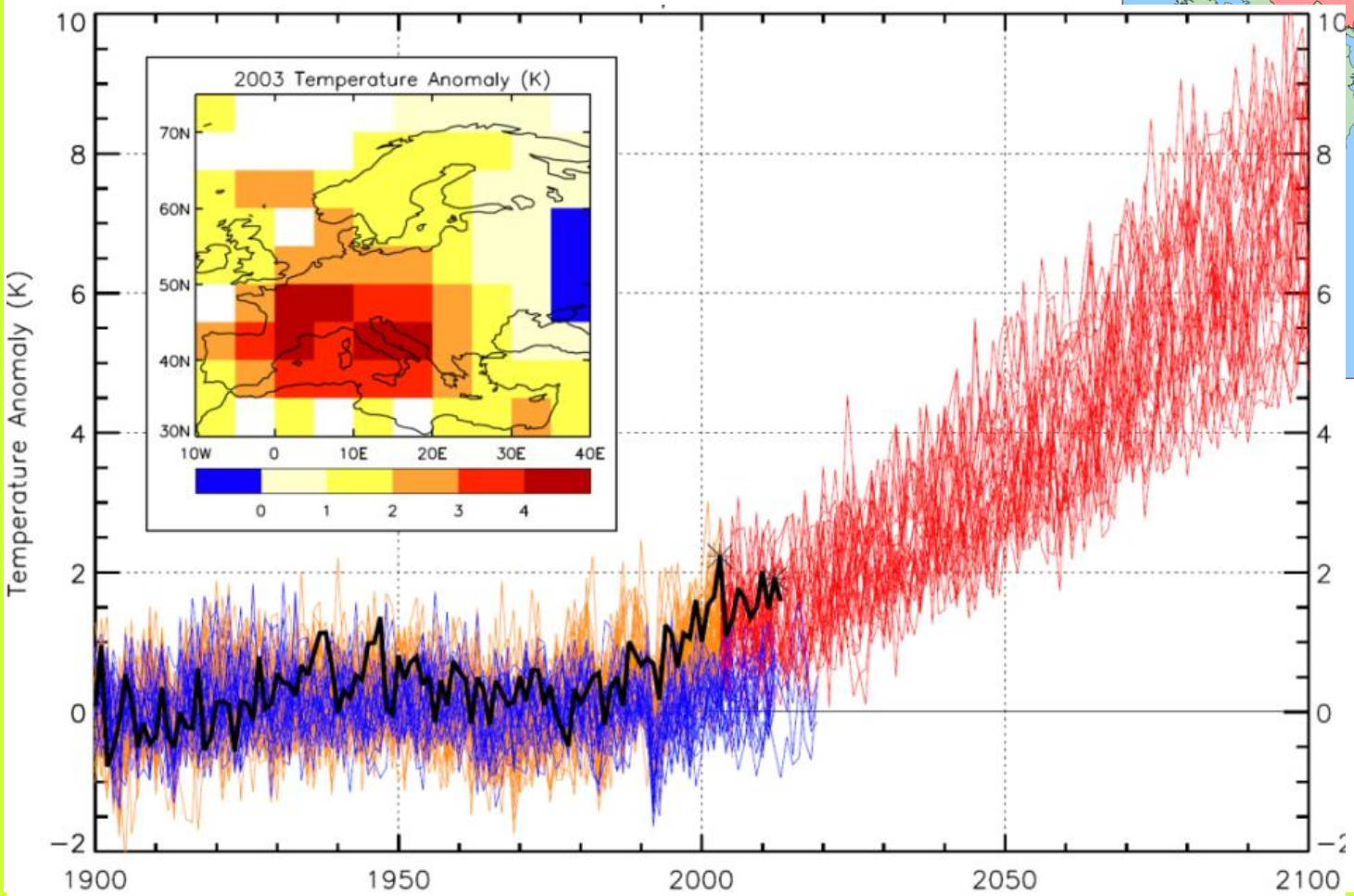
Summer 2003

Met Office Hadley Centre

Hottest summer in Europe since 1540

20,000+ deaths





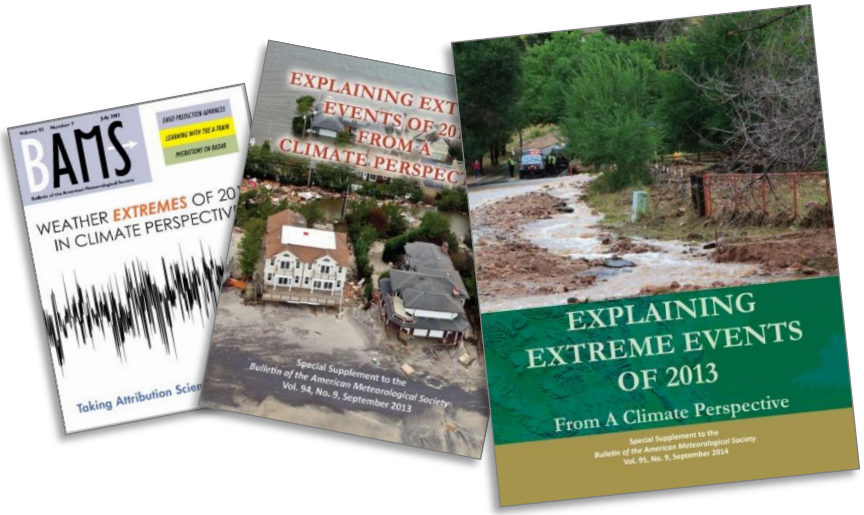
Risk of heatwave of this severity has at least doubled due to climate change

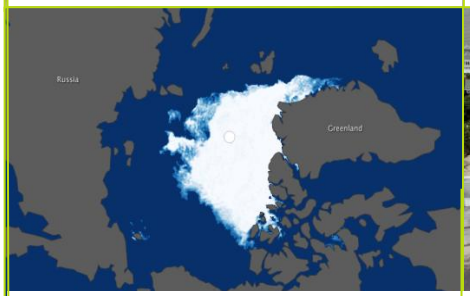
Attribution of Extreme Events:
Is Climate Change making a Contribution?

Korean heatwave, Summer 2013

Indian rainfall, Summer 2013

All these events display some evidence that human induced climate change was a contributing factor.

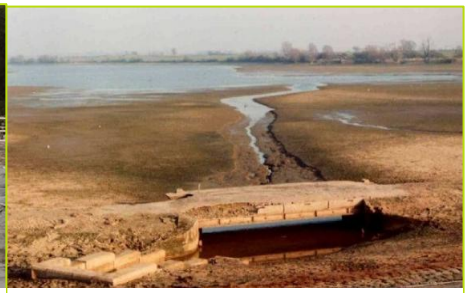




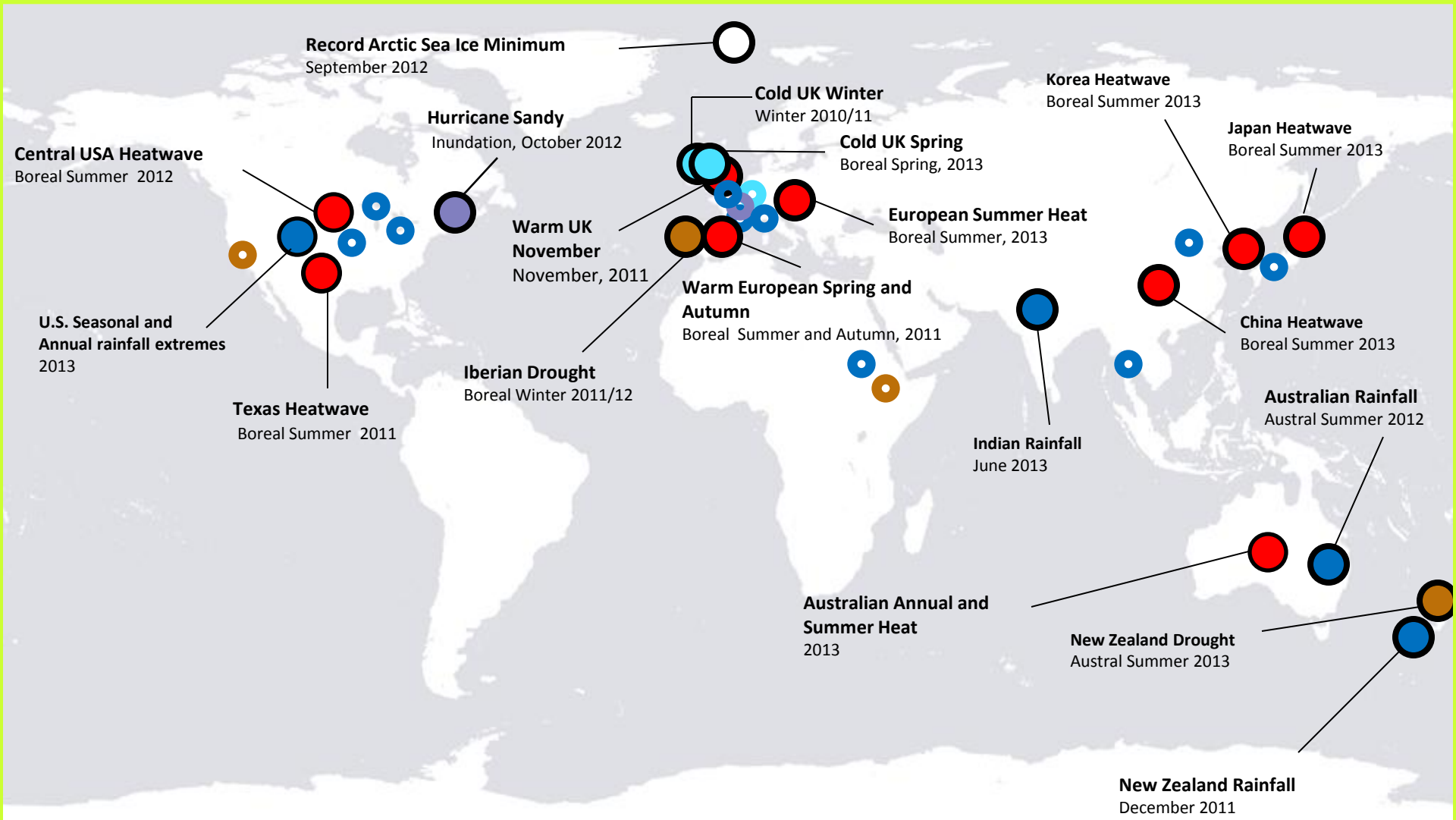
Arctic sea ice minimum, Summer 2012

Inundation from hurricane Sandy, autumn 2012

New Zealand rainfall winter 2011



Iberian drought winter 2011/12



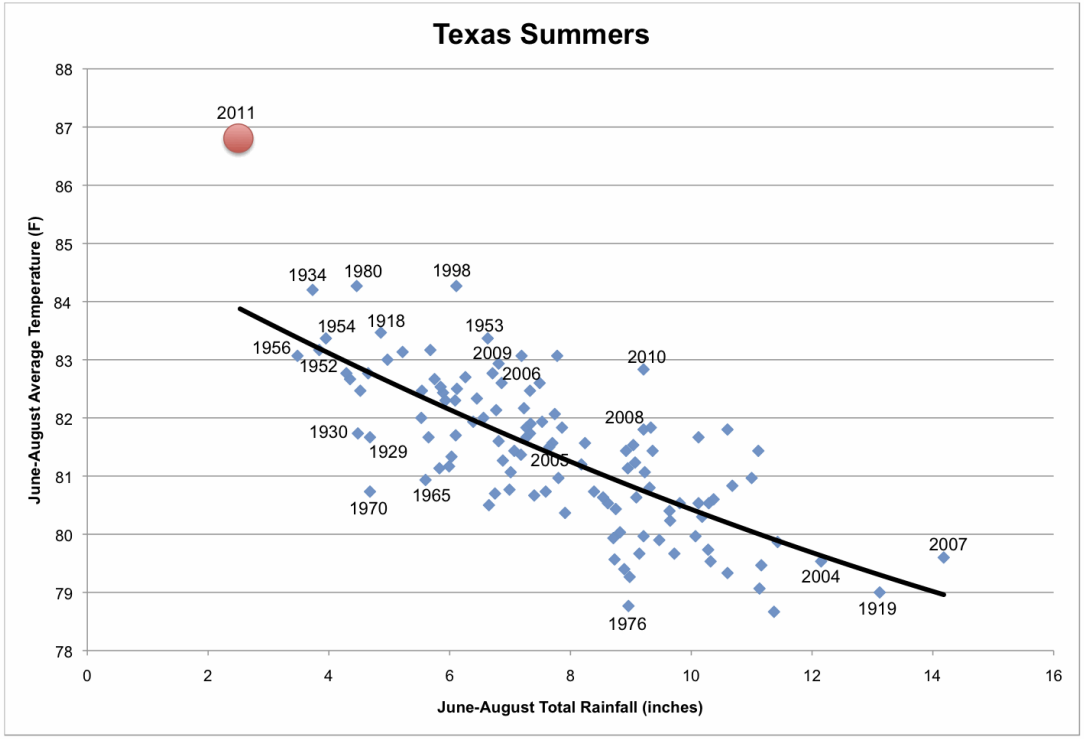
Extreme Events 2011-2013

Detected human influence on likelihood of event occurring

- Heat
- Precipitation
- Storms
- Cold
- Drought
- Sea ice

Small coloured circles indicate that an event attribution study has taken place, but that human influence on the likelihood of that event occurring was not found.

Severe dry spells are 20 more times likely during a La Nina year today than a La Nina in the 1960s



Drought in Texas 2011/12

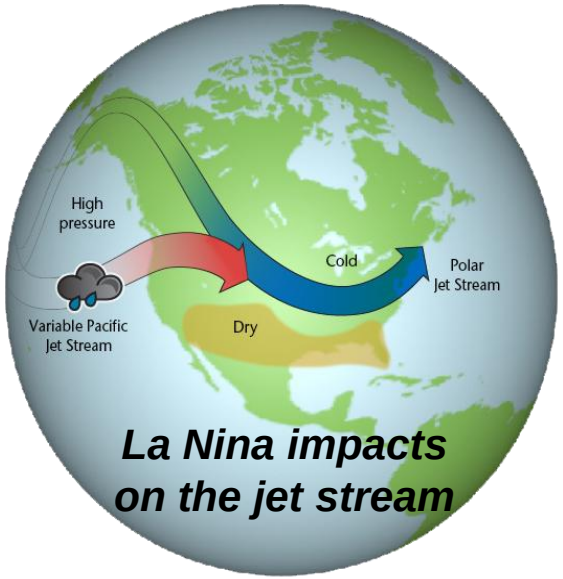
- Worst drought on record for over half of Texas counties
- 3 million (of 170 million) acres lost to wild fires
- $10 billion losses to crops, livestock and timber
- Failure of rice production

January-February 2014: Exceptional storms and flooding

Somerset

Surrey

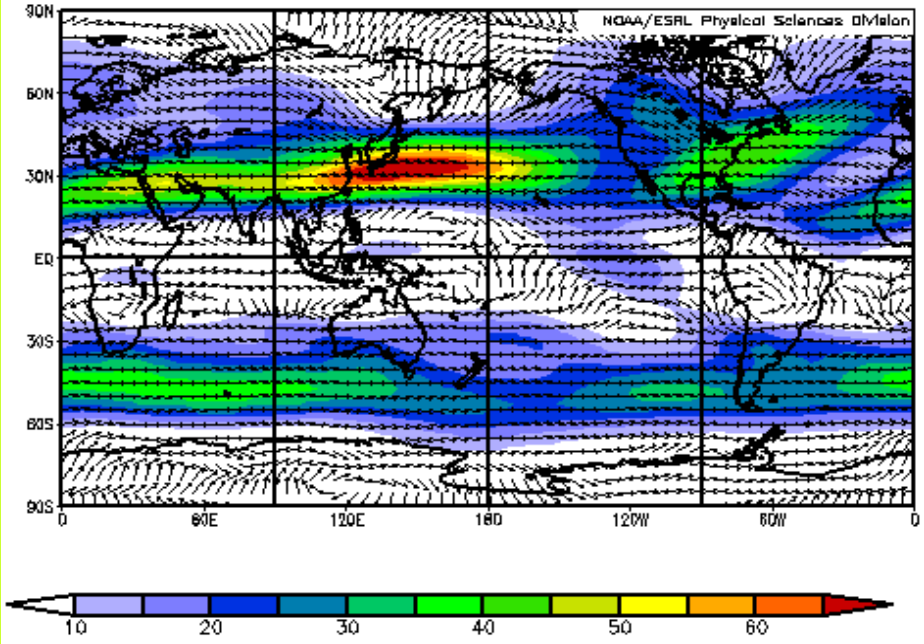
Global Context of UK's severe weather



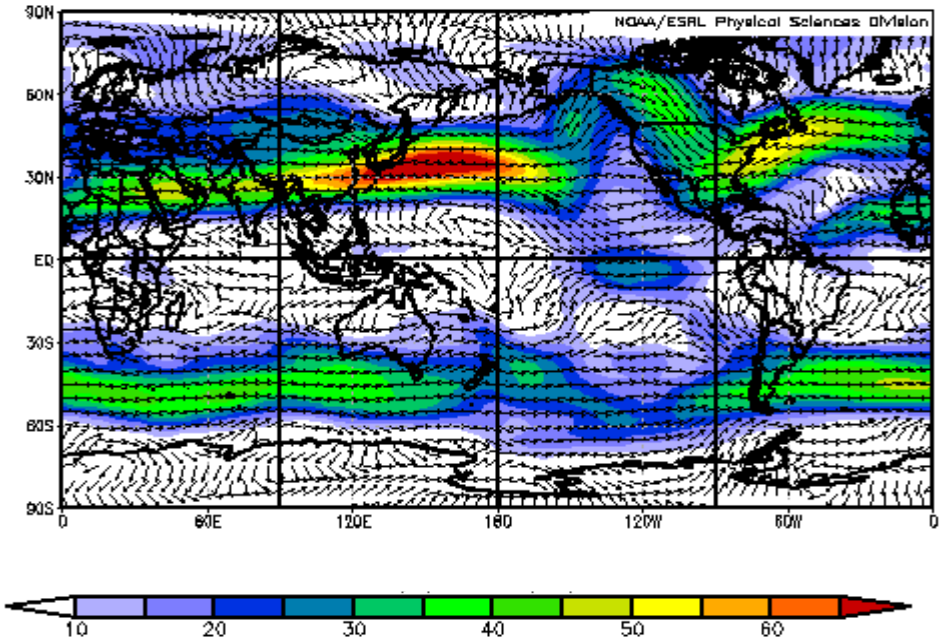
La Nina impacts on the jet stream

Winds in the upper troposphere (250 hPa)

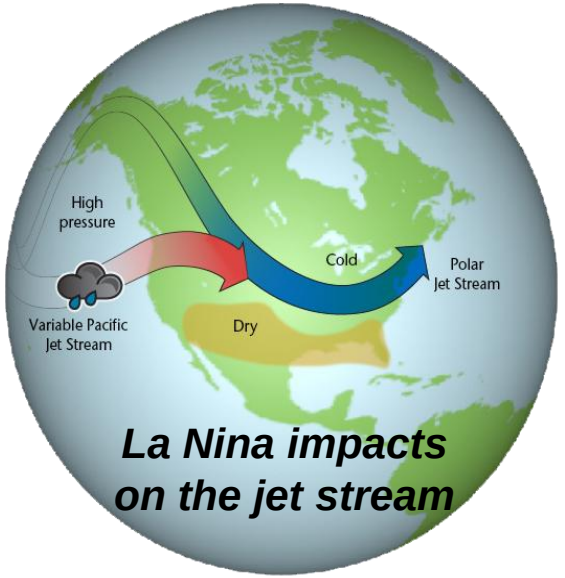
Climatology



January 2014

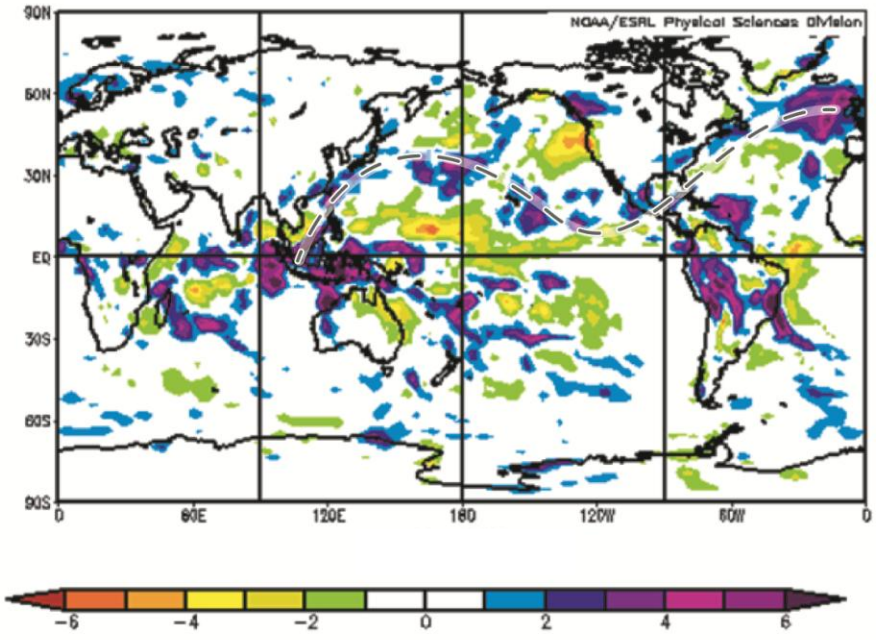


Energy from West Pacific rainfall driving UK extremes

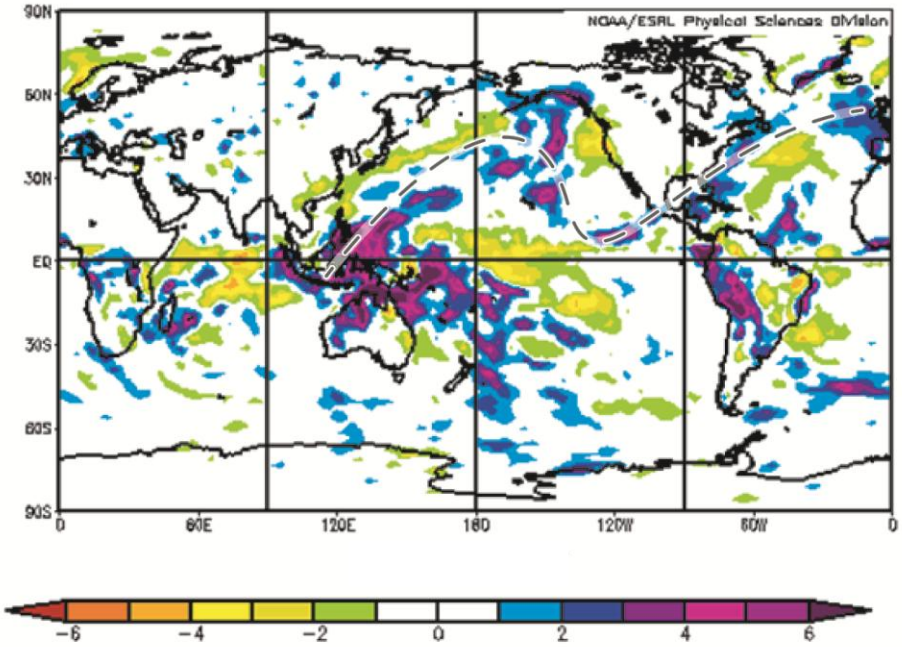


Rainfall anomalies (mm/day)

December 2013

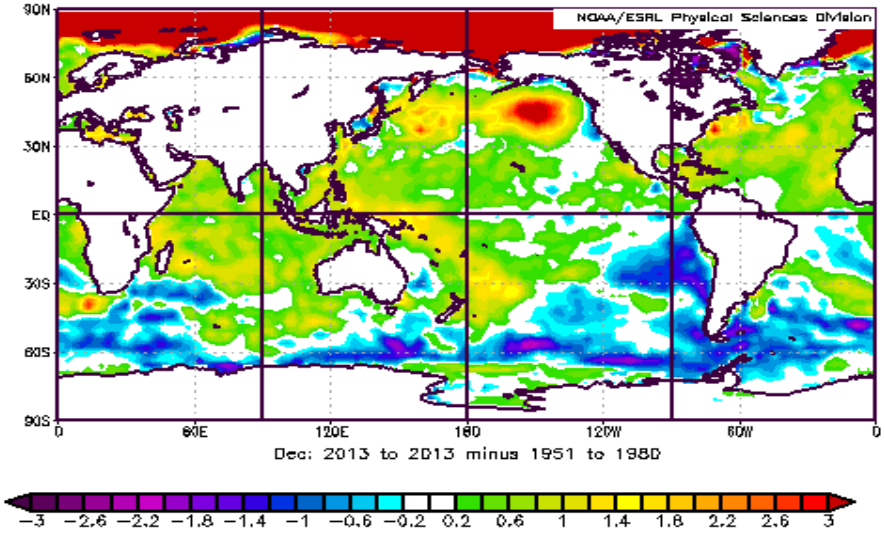


January 2014



Did Climate Change play a role in last year's severe weather?

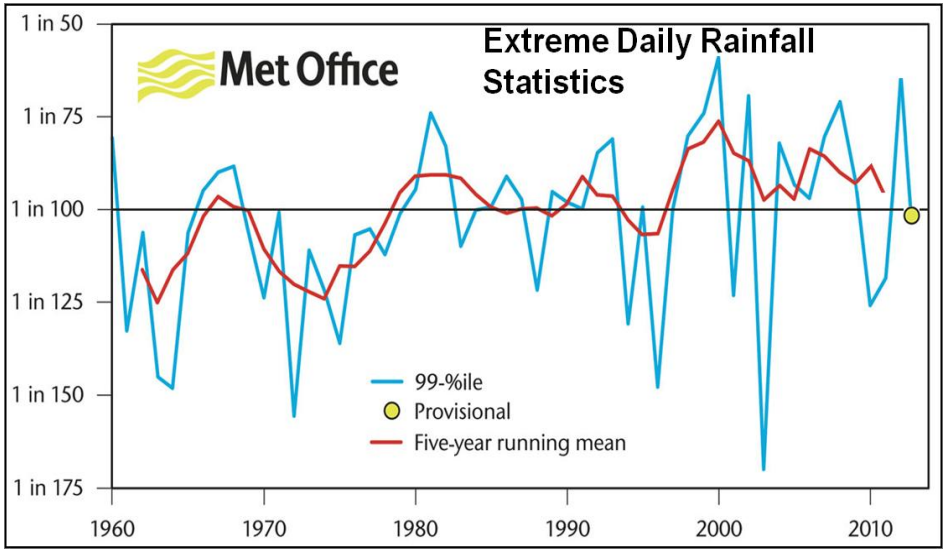
Surface ocean temperature differences from 1951-1980



- Warming oceans
- Rising sea level
- More intense rainfall
- More extreme events
- Increased storminess?

Since 2000:

- 10 times as many hot records as cold records.
- 67% of all hot records in the series from 1910, but only 3% of cold-records.
- 45% of all wet records in the series from 1910, but only 2% of dry records.



Kendon, Weather 2014.

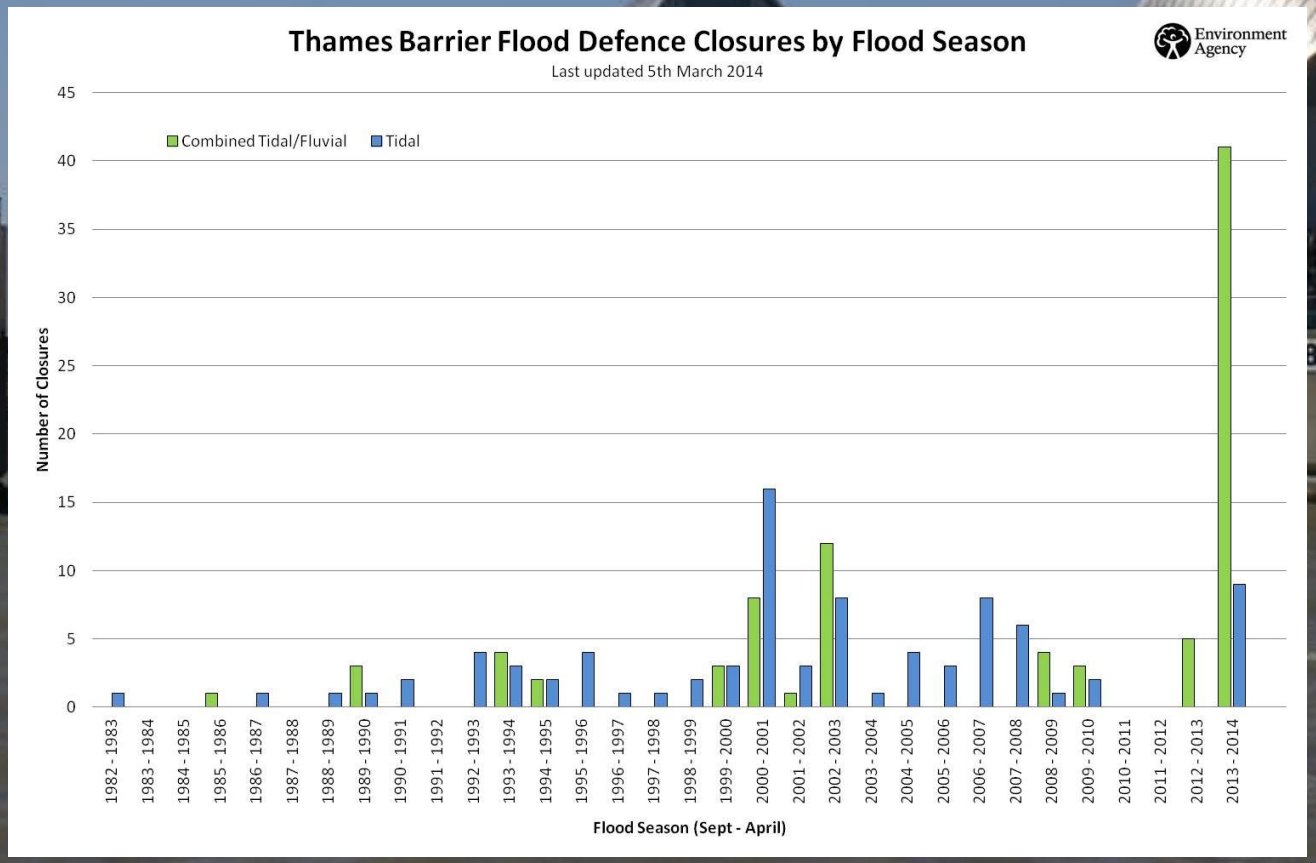
Did Climate Change play a role in last year's severe weather?

"It is not possible, yet, to give a definitive answer on whether climate change has been a contributor or not, but all the evidence suggests there is a link to climate change."

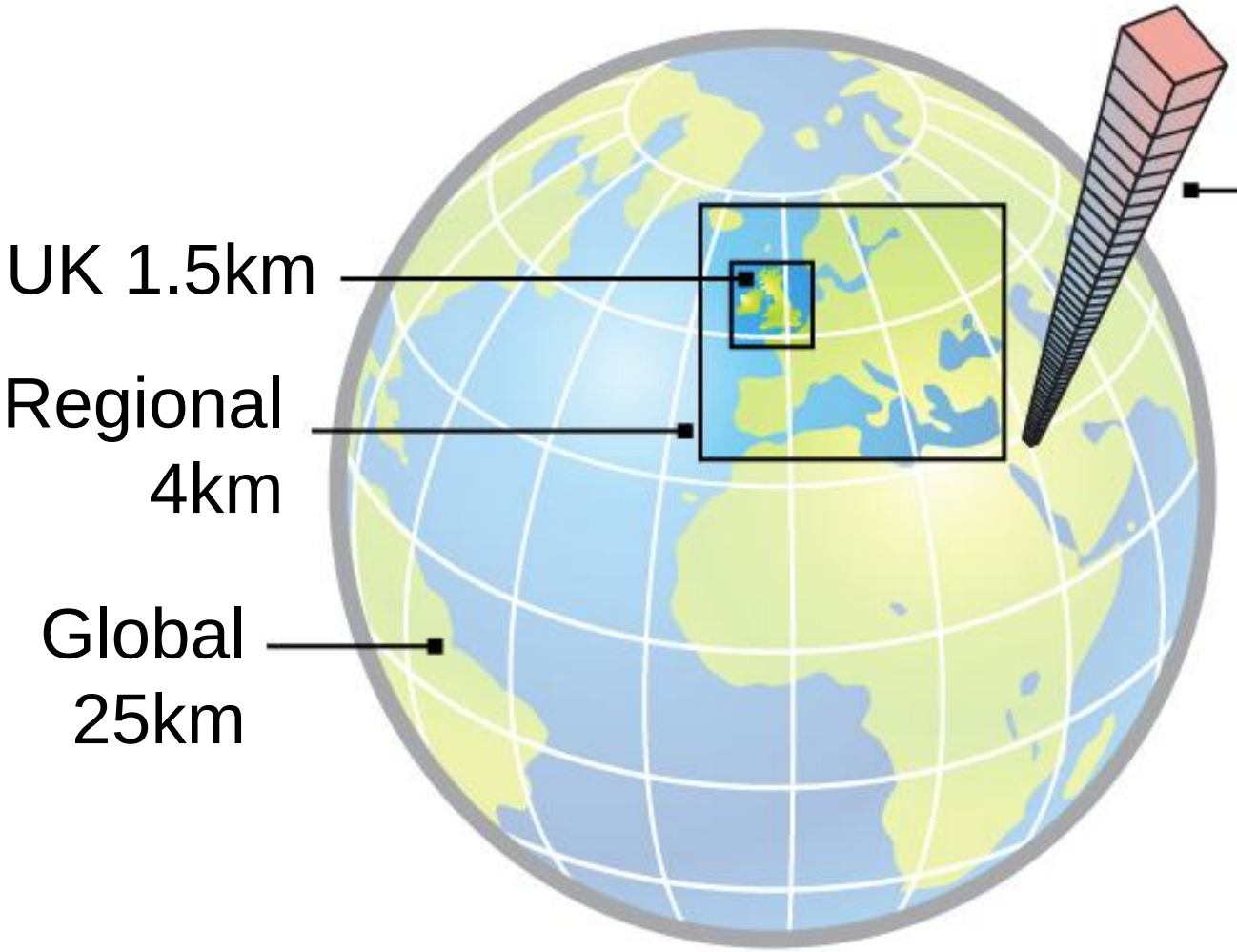
"There is no evidence to counter the basic premise that a warmer world will lead to more intense daily and hourly rain events."

Julia Slingo

- Estimated £200bn value of property in Thames floodplain, 1.1 million employees, 55000 properties
- Thames Barrier was closed 4 times in the 1980s, 35 times in the 1990s, and 135 times since 2000.



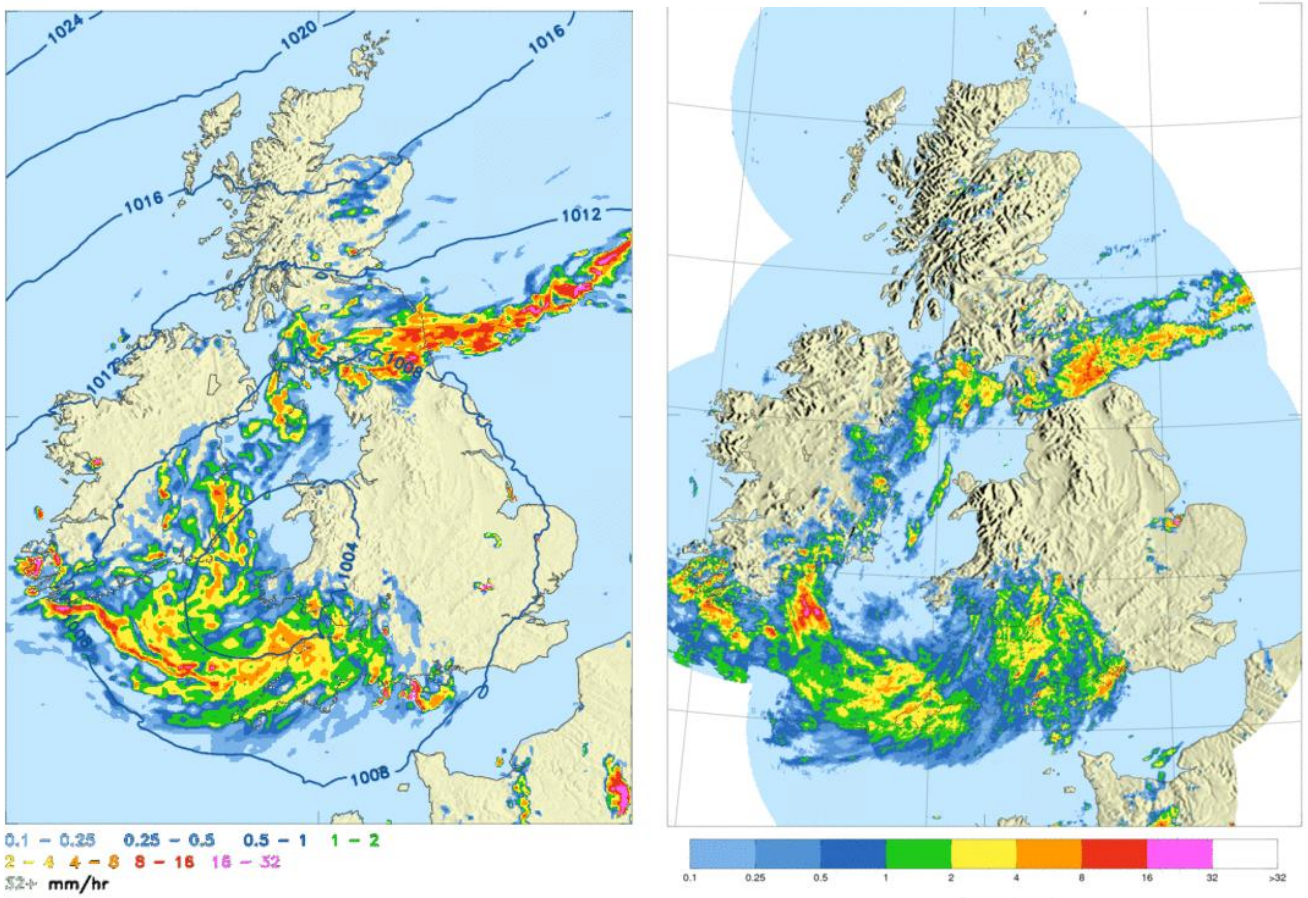
From Global to Local:
Bridging the Scales



Met Office Weather Forecasting Models

Science and technology of weather forecasting today can be used to assess climate risks of tomorrow

Extreme rainfall forecast 6–7 July 2012



Forecast

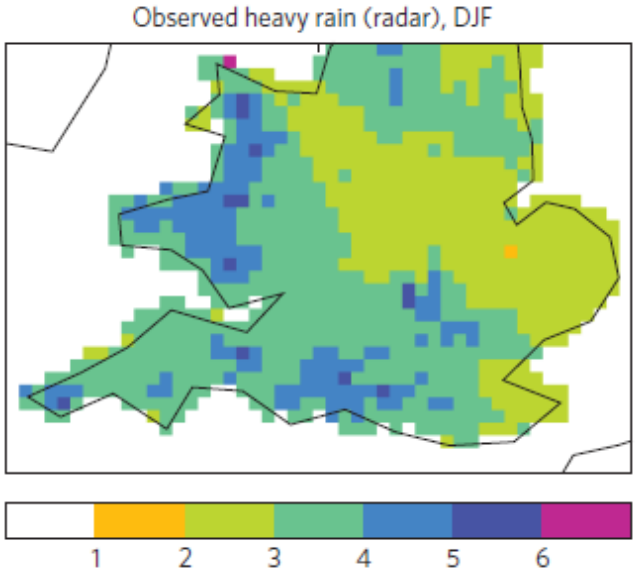
Observations

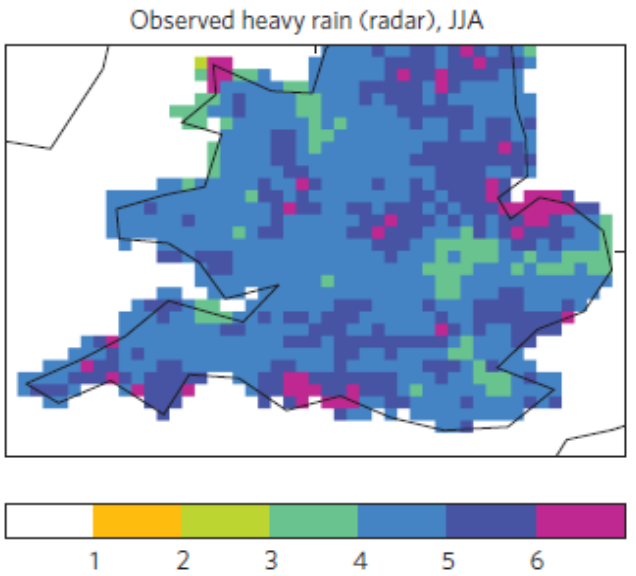
Next generation UK Climate Projections

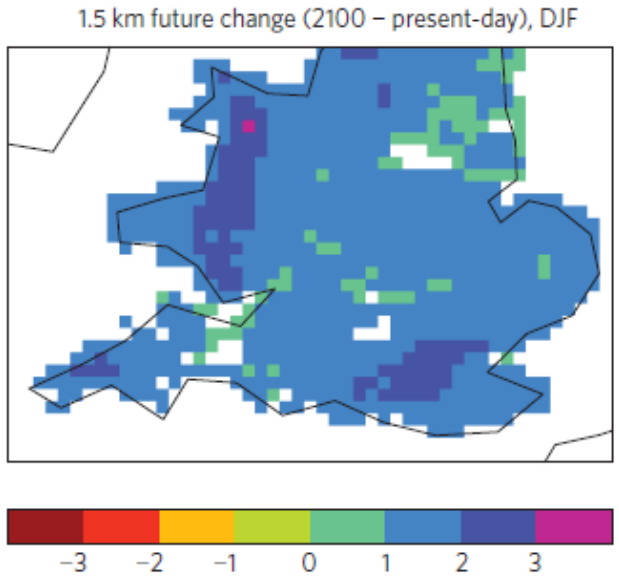
Future change in heavy hourly rainfall (upper 5%)

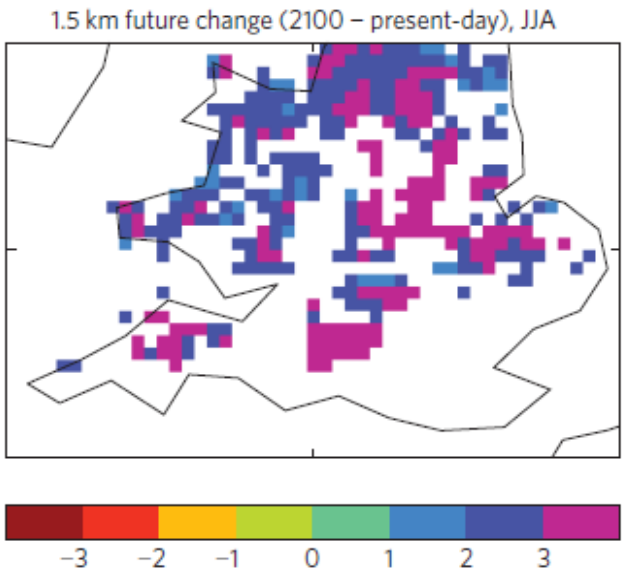
‘Future intensification of short-duration rain in summer, with significantly more events exceeding the high thresholds indicative of serious flash flooding’

Kendon et al., 2014: Nature Climate Change







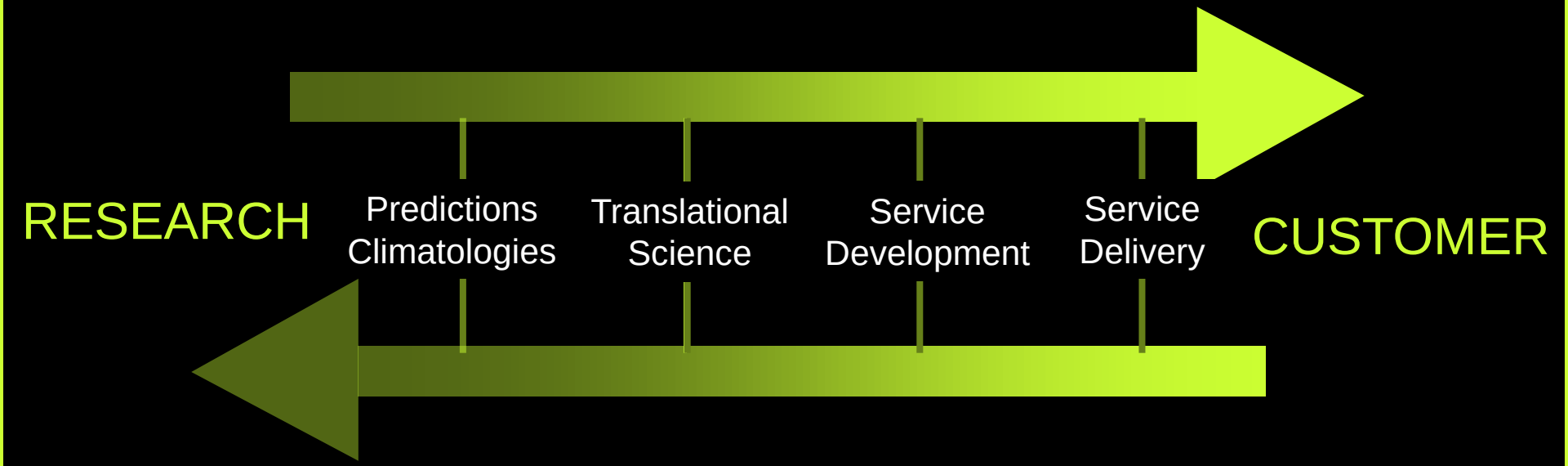


Climate Services:
A revolution in the application of climate science

- From mitigation to **mitigation** and **adaptation**
- Climate change to **climate change and climate variability**
- Global, century-scale scenarios to **regional predictions, days to decades ahead**
- Global climate to **characteristics of hazardous weather and climate extremes**
- From **few** to **many** customers – public, governments, business and industry
- **Operational delivery** – from IPCC Assessment Reports to regularly updated monitoring, forecasts, products and services

Climate Services: Setting the Right Structures

From Science to Service: The end-to-end delivery chain



Continuous Dialogue *Beginning* with the Customer

Listening to the Customer

Experiencing a changing climate…

"When I was a young man in this village, the rains used to start in March. Now the rains do not come until … May, and farmers will have to prepare their lands and wait …"
Village leader in Ghana

Putting Climate Risk in Context

'Circle of Securities'

Sir John Beddington – 'The Perfect Storm'

- Can 9 billion people be fed equitably, healthily and sustainably?
- Can we cope with the future demands on water?
- Can we provide enough energy to supply the growing population coming out of poverty?
- Can we do all this whilst mitigating and adapting to climate change?

Making Climate Science Work for Society

- **Saving lives and livelihoods**
- **Delivering resilience and preparedness**
- **Making wise choices for future adaptation**
- **Avoiding dangerous climate change**
- **Supporting growth and the green economy**

Living with Climate Risk

"In order to protect the environment, the precautionary principle approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

Principle 15, United Nations Conference on Environment and Development (Rio de Janeiro, 1992).