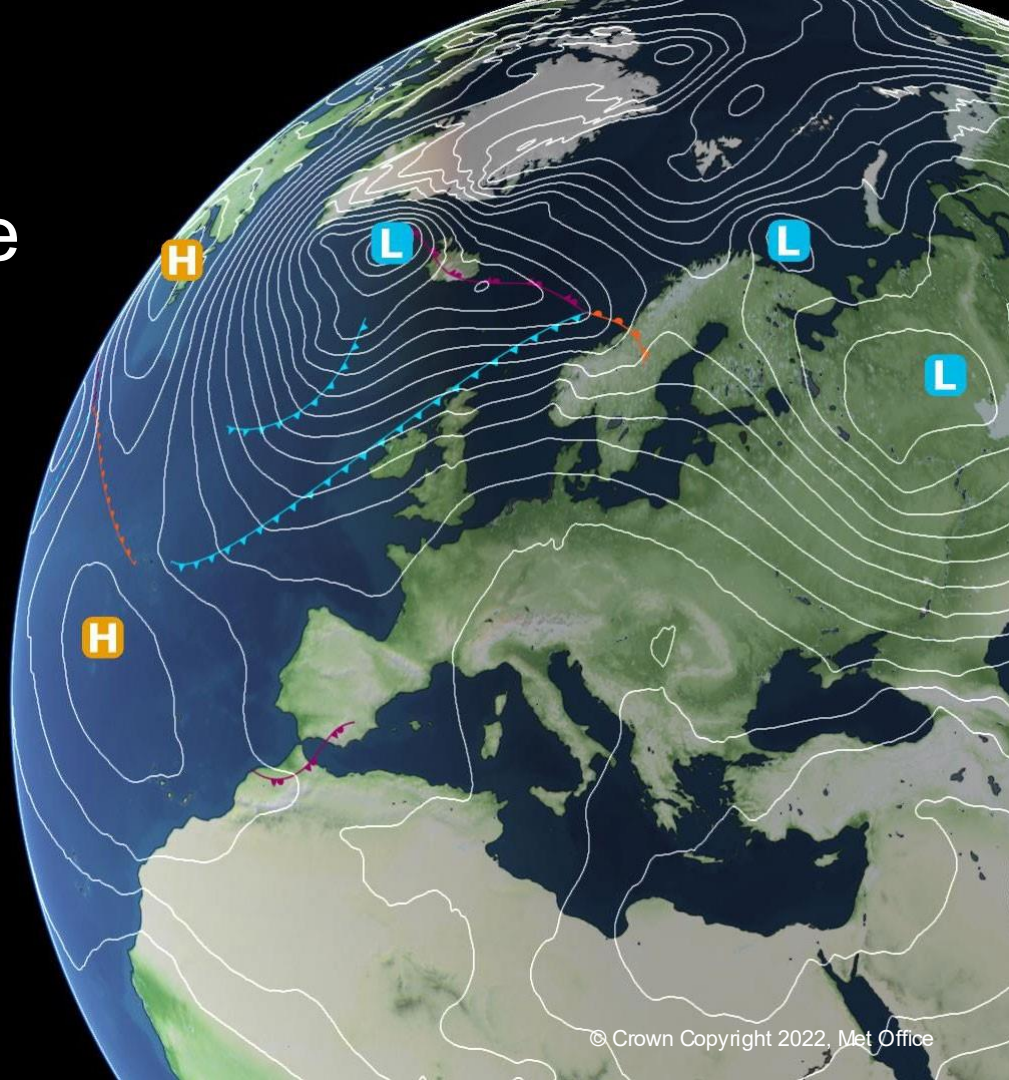
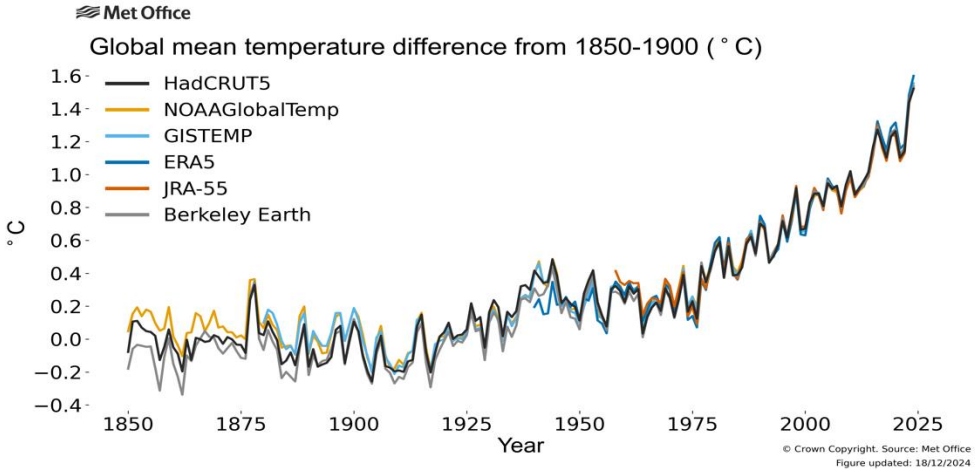
Met Office
Hadley Centre

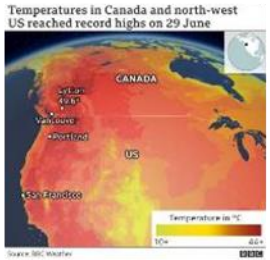
Trends, scenarios, and the emerging impacts of most relevance for informing strategic adaptation and resilience

Professor Jason A. Lowe OBE
Met Office and University of Leeds
7th May 2025



Global temperatures have risen by ~1.3°C

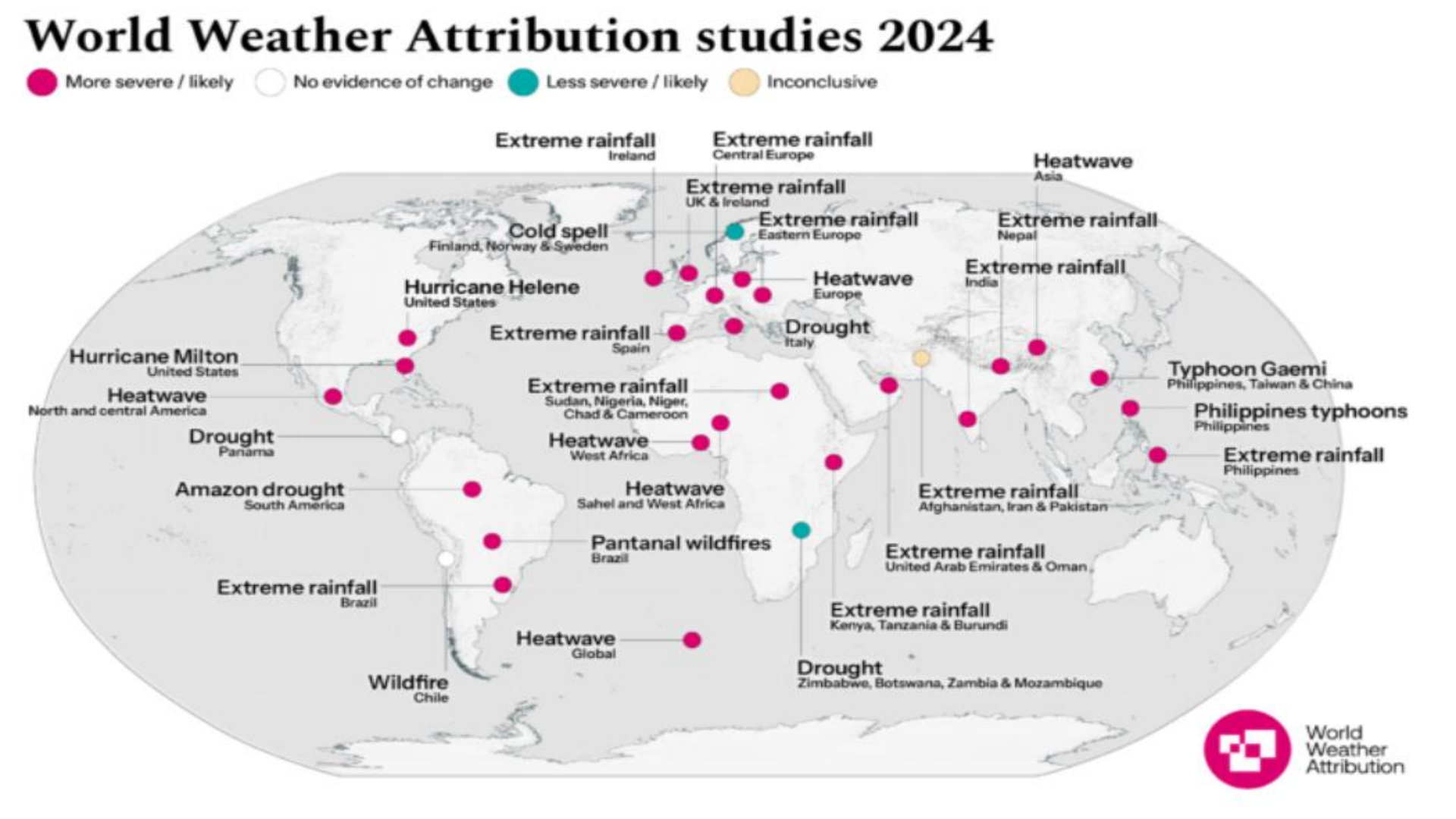




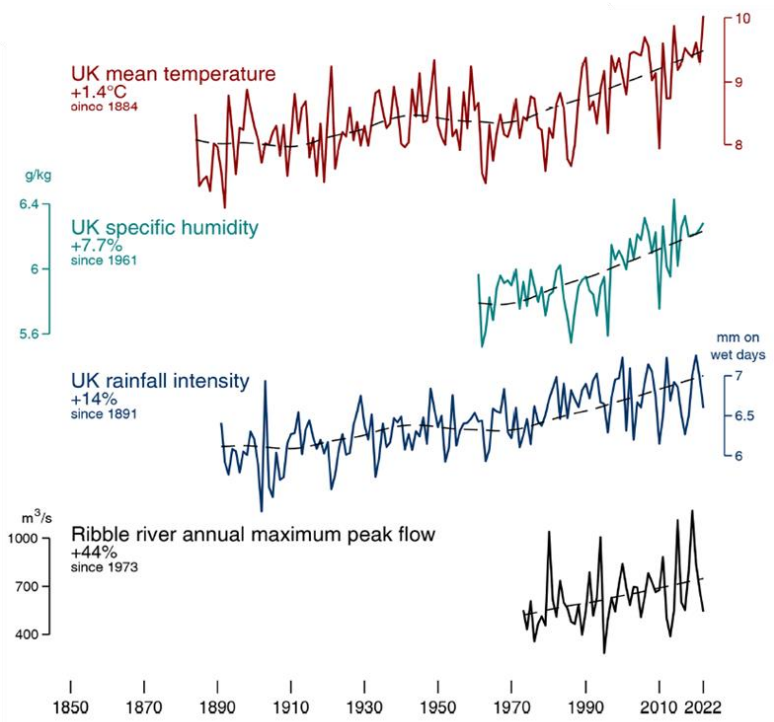
2024 was 1.53°C above the 1850-1900 global average, according to the HadCRUT5 dataset, and is therefore the warmest year on record. 2023's value of 1.46°C

Also changes in rate of climate change. E.g. the chance of a summer day in UK warmer than 40°C became 4x more likely between 1990 and 2020.

World Weather Attribution studies 2024



UK climate has also changed significantly



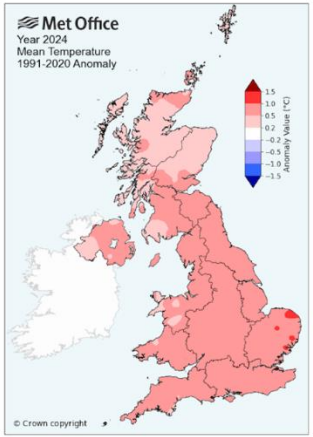
GC Insights: Communicating long-term changes in local climate risk using a physically plausible causal chain

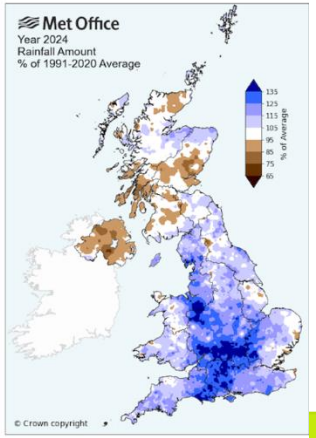
Ed Hawkins[1], Nigel Arnell[2], Jamie Hannaford[3], and Rowan Sutton[1]

[1]National Centre for Atmospheric Science, Department of Meteorology, University of Reading, Reading, UK
[2]Department of Meteorology, University of Reading, Reading, UK
[3]Centre for Ecology and Hydrology, Wallingford, UK

Met Office view of 2024 in context

- 4th warmest year on record. Spring was the warmest on record for the UK.
- The year was relatively wet, with 7% more rainfall than average.
- An attribution study found that rainfall in the winter season of 2023-24 was 20% more intense and 10 times more likely due to human-causes





The 10 warmest years have all occurred this century

5 of the 10 wettest years have occurred this century

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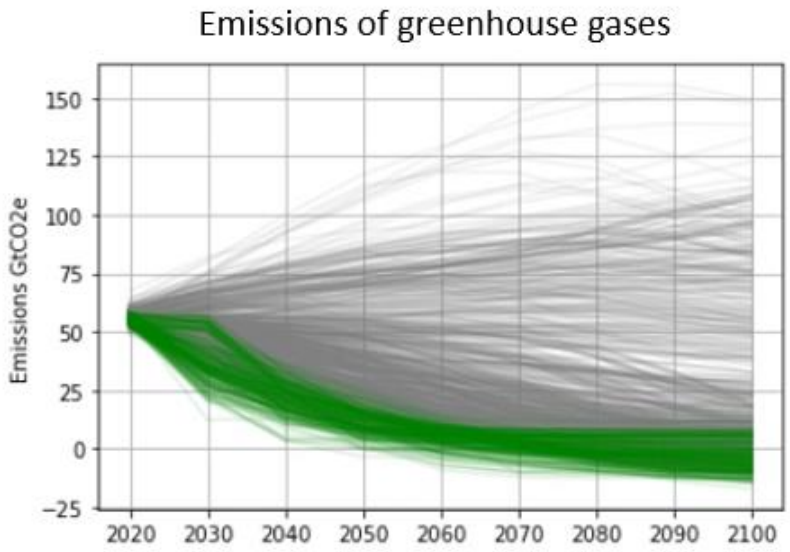
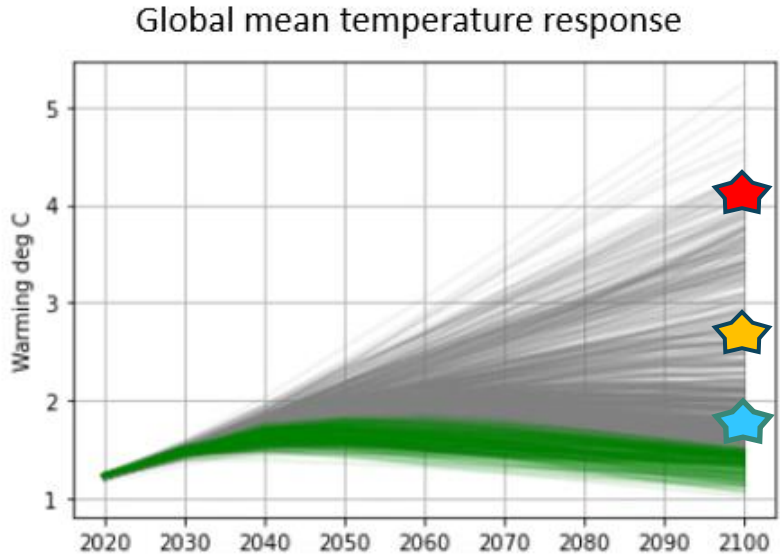
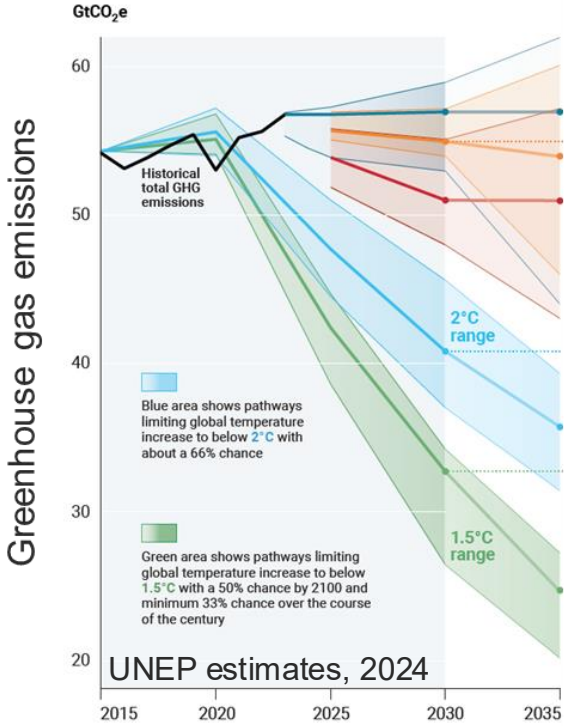
Climate change in the future: is it still possible to limit warming to 1.5°C?





Current policies Net zero announcements Backtracking

Is it still possible to limit warming to below 1.5°C?

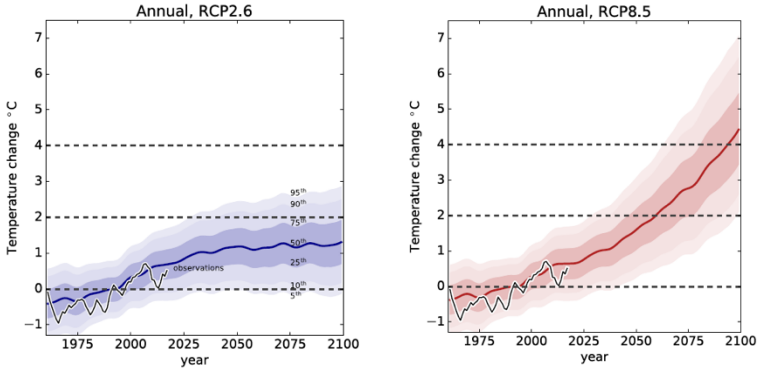


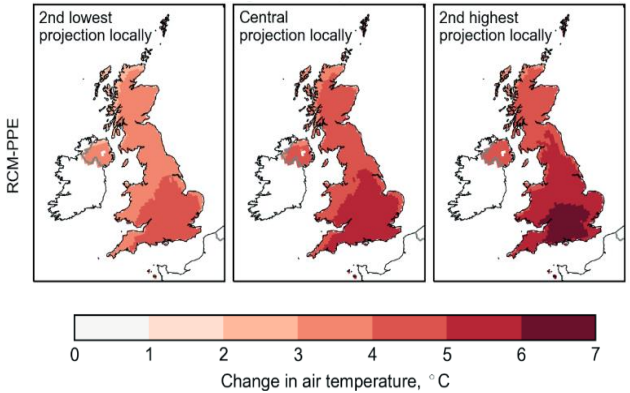
Current policies and NDCs

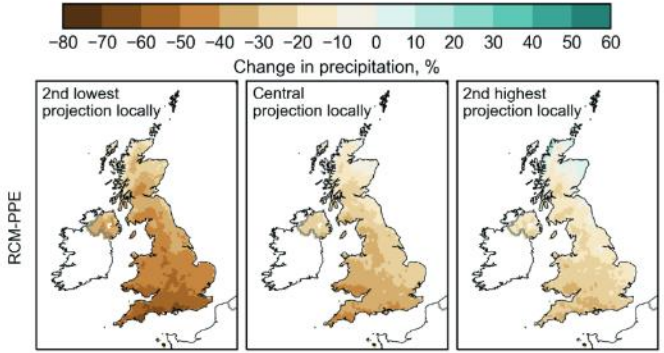
"Technically feasible" 2°C and 1.5°C pathways

- Climate will only be stabilised by achieving net-zero greenhouse gas emissions
- There are (just about) technically feasible pathways compatible with 1.5°C
- But the chance of now limiting warming to below the guardrail is "vanishingly small"

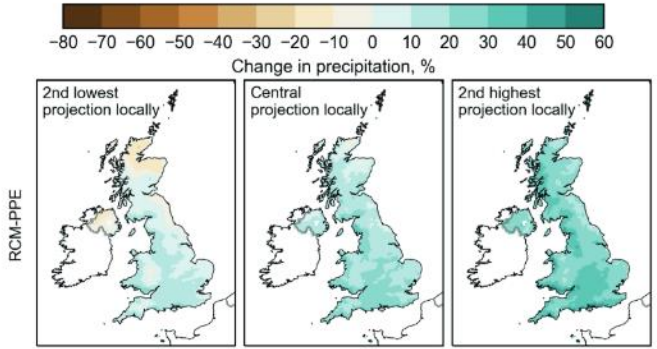
Future UK – “a greater chance of warmer wetter winters and hotter drier summers”







Summer 2061-2070

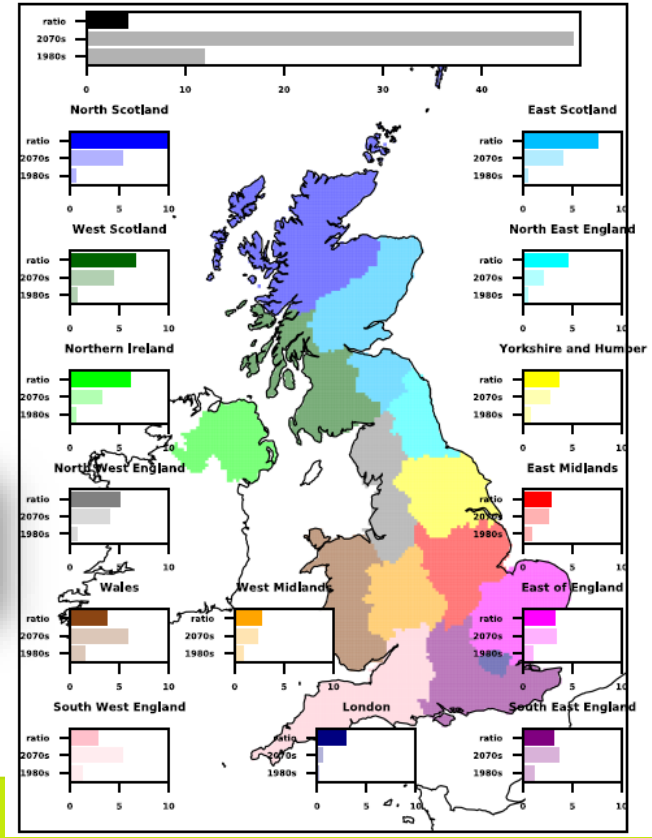


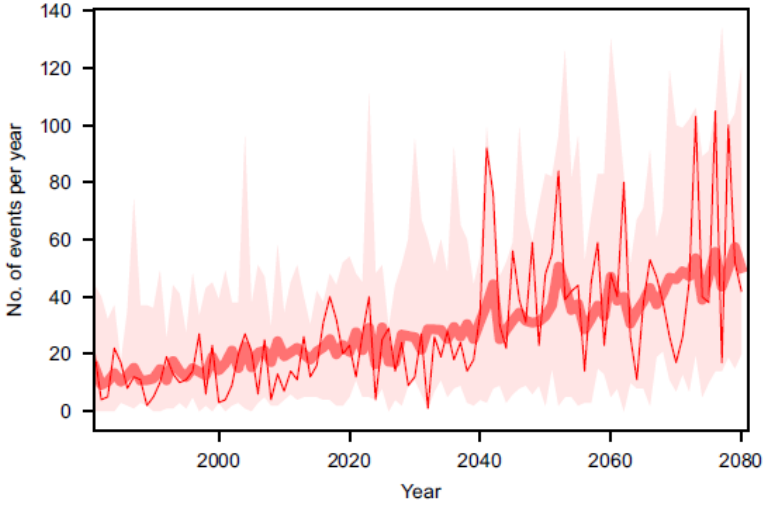
Winter 2061-2070

Maps for high emission scenario

Extremes are projected to change, but this won't happen smoothly over time

Average number of events per year exceeding 20mm/h in the 1980s and 2070s, and their ratio





- Thin line shows one model
- Is there a regime shift in this model?
- Some models (shading) show large extremes even in present day


nature > nature communications > articles > article

Article | Open access | Published: 07 March 2023

Variability conceals emerging trend in 100yr projections of UK local hourly rainfall extremes

Elizabeth J. Kendon, Erich M. Fischer & Chris J. Short

Nature Communications 14, Article number: 1133 (2023) | Cite this article

What about changes in other metrics for the UK?

Wildfire

- For 2°C warming, frequency of days with “very high” fire danger is projected to double
- The frequency increases by a factor of 5 at 4°C of warming.

Lightening

- Projected increases in spring and summer months for the UK
- Reductions in autumn
- Little change in winter

Hail

- Large uncertainty – even in sign of change
- Some evidence that larger hail might make up greater fraction of total

What about amplifiers and surprises? Part 1: Earth system tipping points

Melting
Circulation Change
Biome Loss

The [IPCC Sixth Assessment Report] defines a tipping point as a "critical threshold beyond which a system reorganizes, often abruptly and/or irreversibly"

There are major remaining **gaps in our ability to quantify the likelihood of tipping elements** in the real-world

This gap includes **temporary resilience** in temperature overshoot scenarios

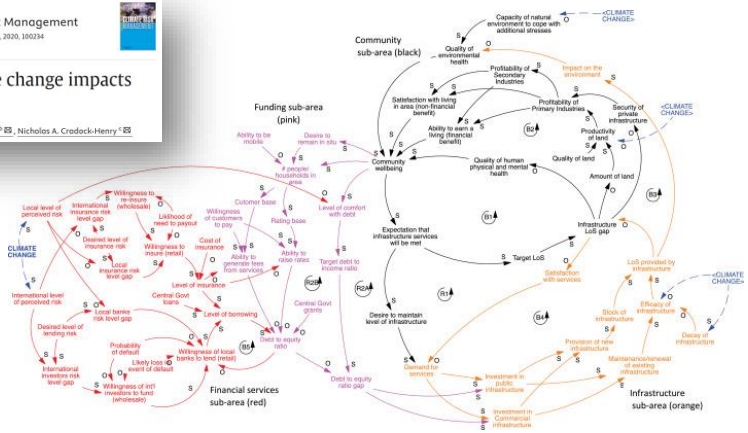
BUT improved understanding of physical process, the **impacts of tipping points** and **time-scales to realise the change**

What about amplifiers and surprises? Part 2: Compound and cascading risks

Compound hazards

Multiple hazards (e.g. wind and intense rainfall, or drought and high temperatures) often occur together. Treating them as independent can underestimate the total hazard

Cascading risk



An impact on part of the system my cause further downstream impacts. E.g. Flooding can impact a transformer, which impacts a data centre, which impacts people and business

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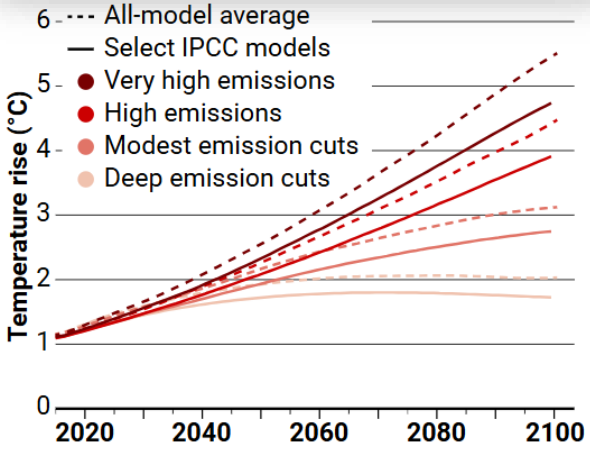
Climate models are an important tool and can simulate many aspects of the observations BUT must be used cautiously

HOME > NEWS > SCIENCEINSIDER > USE OF 'TOO HOT' CLIMATE MODELS EXAGGERATES IMPACTS OF GLOBAL WARMING

SCIENCEINSIDER | CLIMATE

Use of 'too hot' climate models exaggerates impacts of global warming

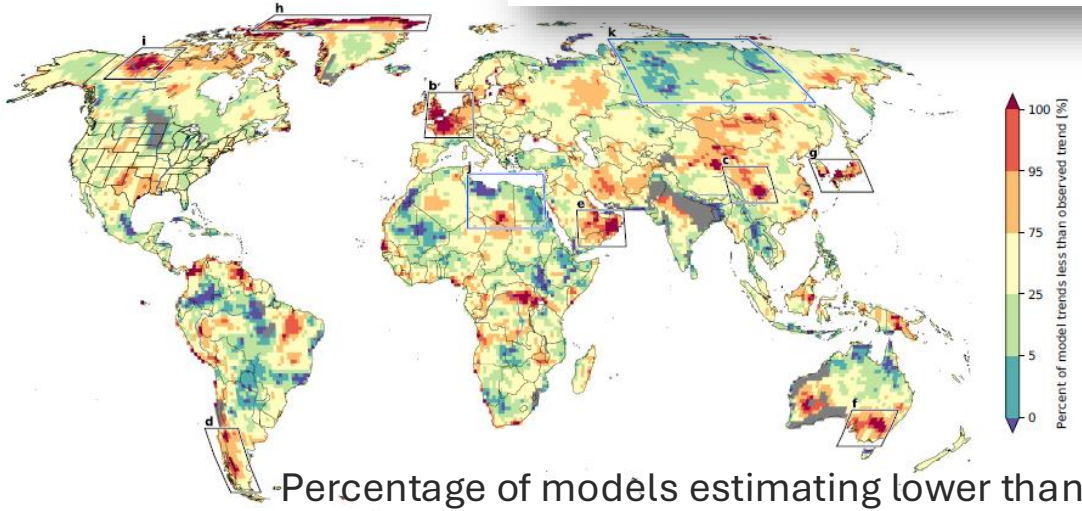
U.N. report authors say researchers should avoid suspect models



PNAS | RESEARCH ARTICLE | EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES | OPEN ACCESS

Global emergence of regional heatwave hotspots outpaces climate model simulations

Kai Kornhuber[a,b,c,1], Samuel Bartusek[b,d], Richard Seager[a], Hans Joachim Schellnhuber[a,1], and Mingfang Ting[b,c]



Percentage of models estimating lower than observed trend in "tail widening" in temperature

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Any Questions?