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CLIMATE CHANGE & CUMBRIA

What does Climate Change mean for the
Cumbrian Landscape in the 21st Century?

Dr Simon Carr: Institute of Science & Environment,
University of Cumbria
simon.carr@cumbria.ac.uk

OUR STARTING POINT



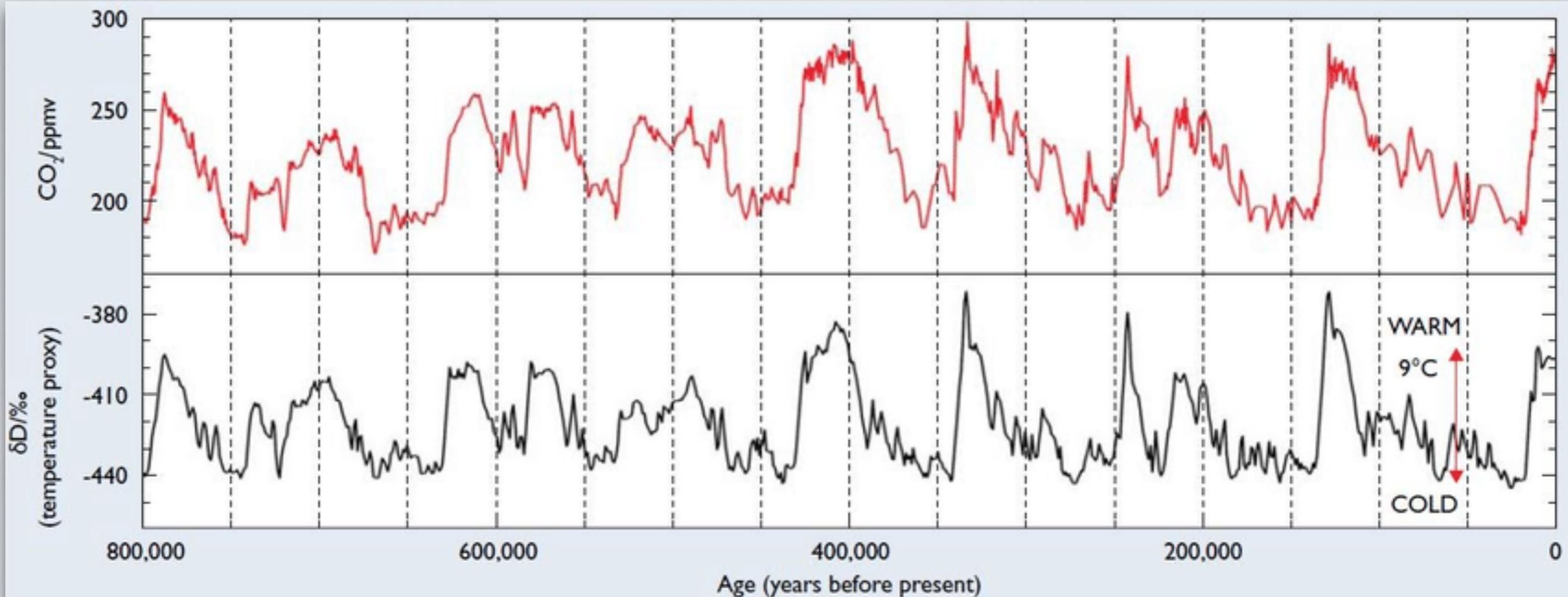


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<https://davemassey.photography/>

LONG TERM CLIMATE CHANGE



Ice Core Data from the EPICA Dome C (Antarctica) Ice Core showing concentrations of Deuterium (D) and CO₂ from air bubbles trapped within the ice core

Jouzel, *et al.*, 2007, *Science*, **317**, 793-797

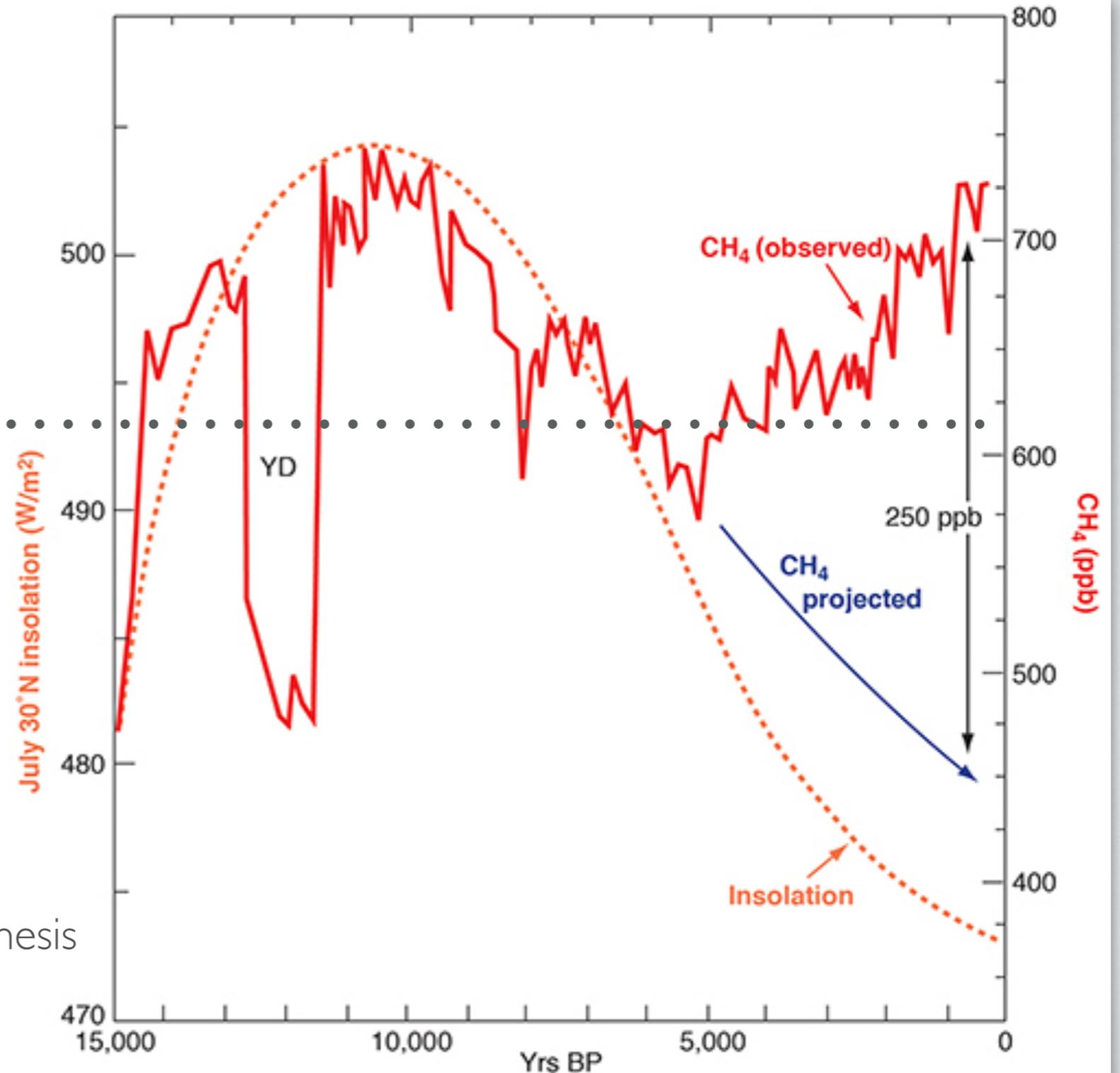
Luthi, *et al.*, 2008, *Nature*, **453**, 379-382

WHY ARE THERE NO GLACIERS IN THE LAKE DISTRICT?



WHY THERE ARE **NO** GLACIERS IN THE LAKE DISTRICT

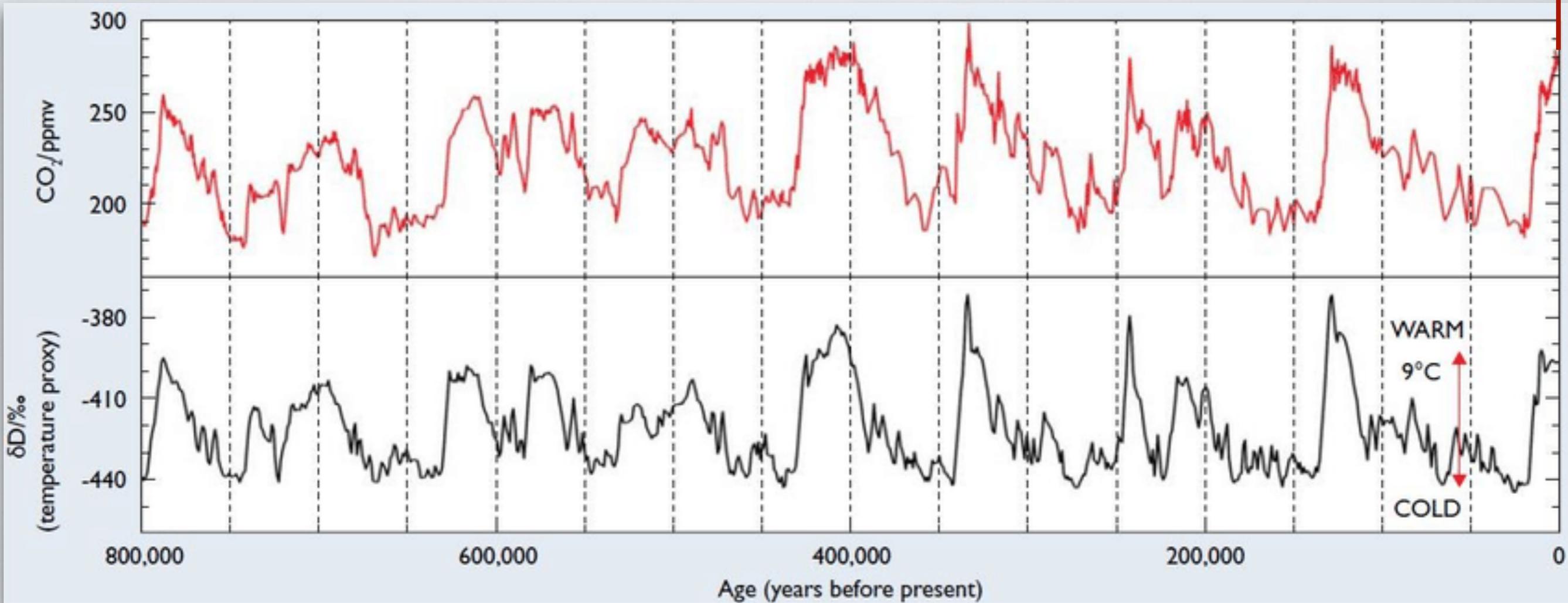
Threshold of
glaciation in UK



Bill Ruddiman:
the Early Anthropocene hypothesis

LONG TERM CLIMATE CHANGE

Today: ~420 ppm

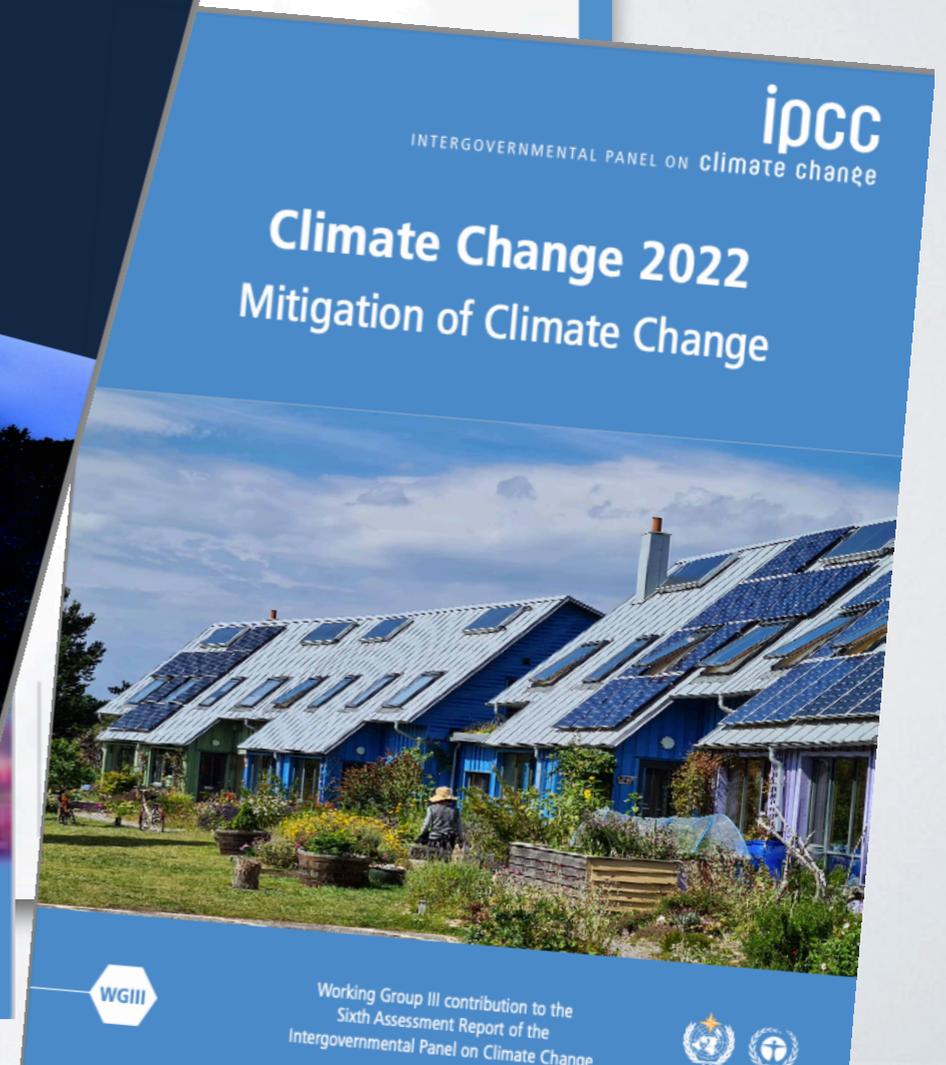
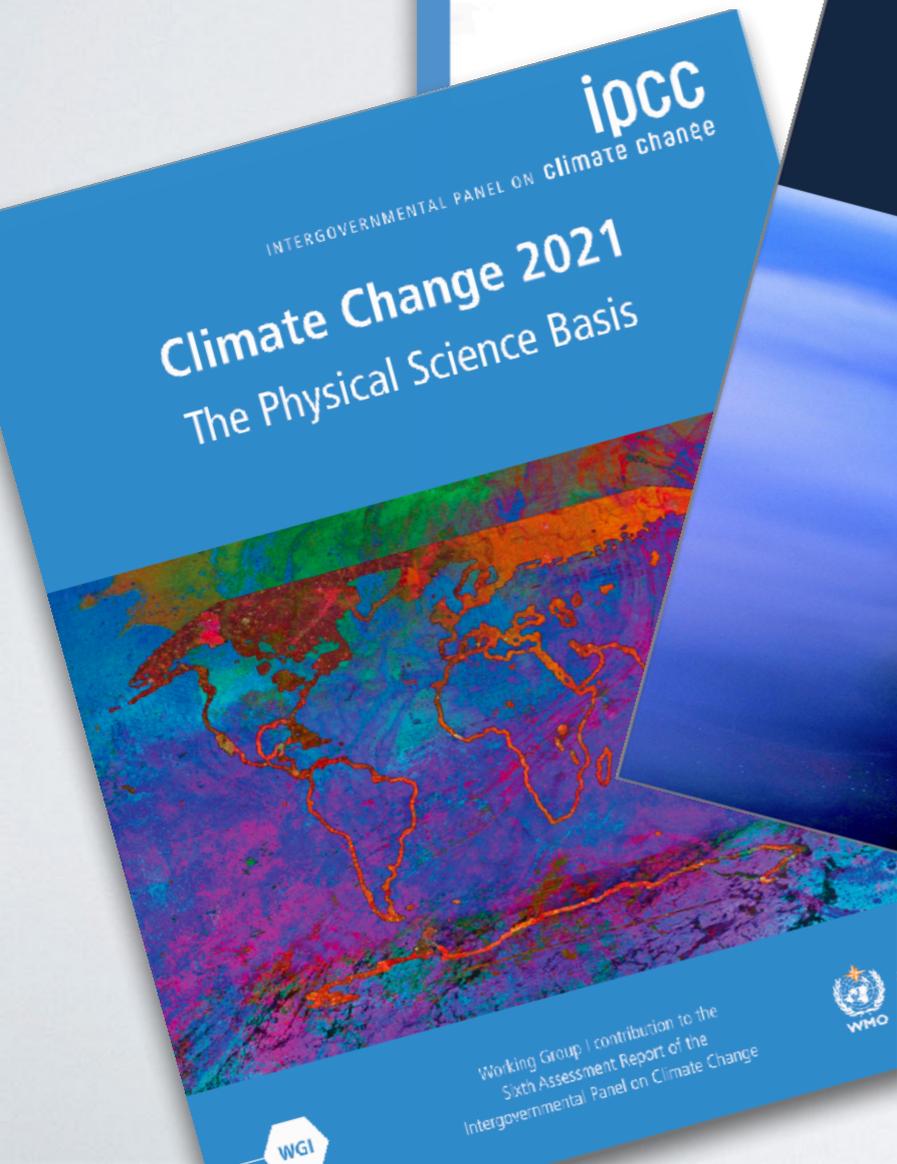
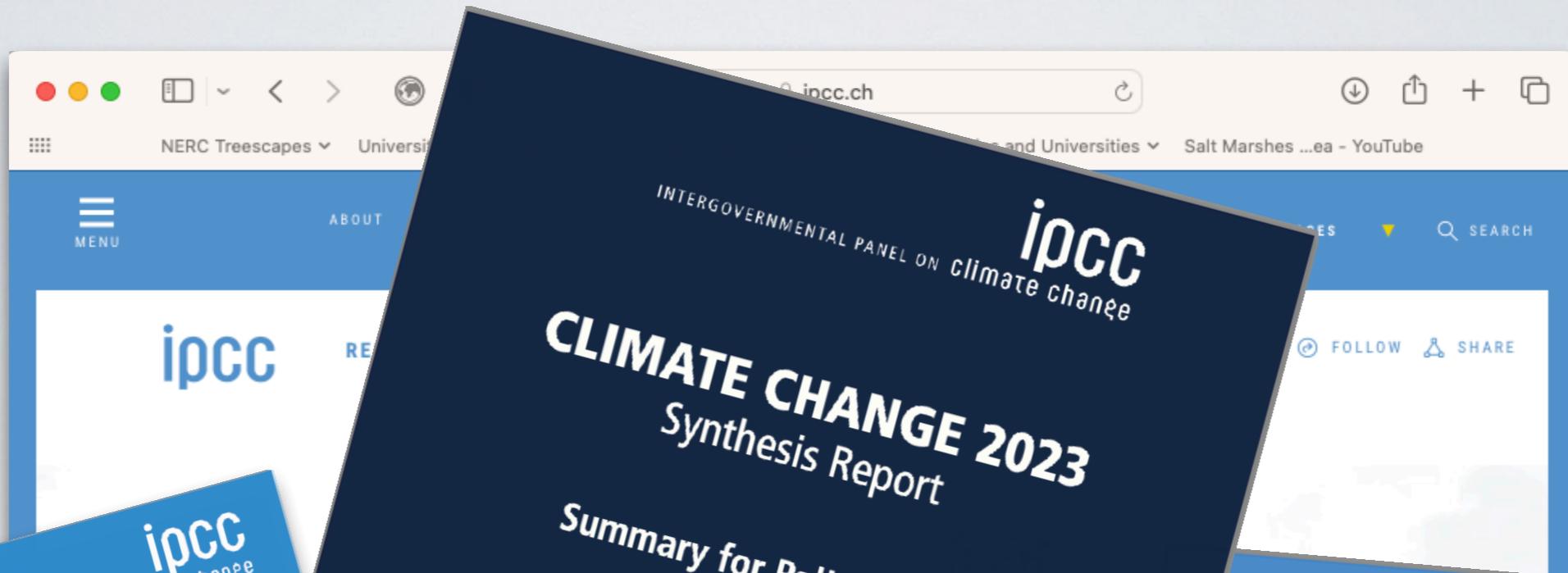


Ice Core Data from the EPICA Dome C (Antarctica) Ice Core showing concentrations of Deuterium (D) and CO₂ from air bubbles trapped within the ice core

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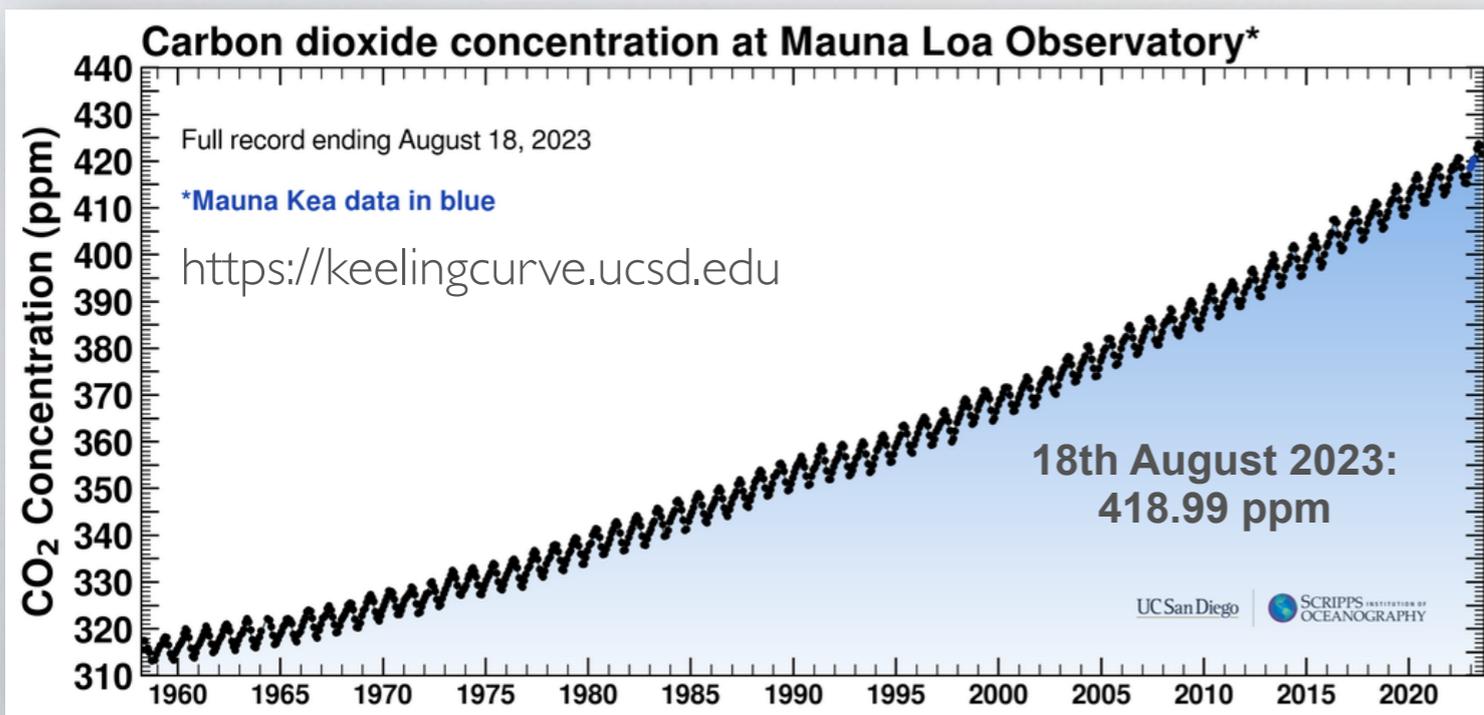
Luthi, *et al.*, 2008, *Nature*, **453**, 379-382

THE BIG PICTURE



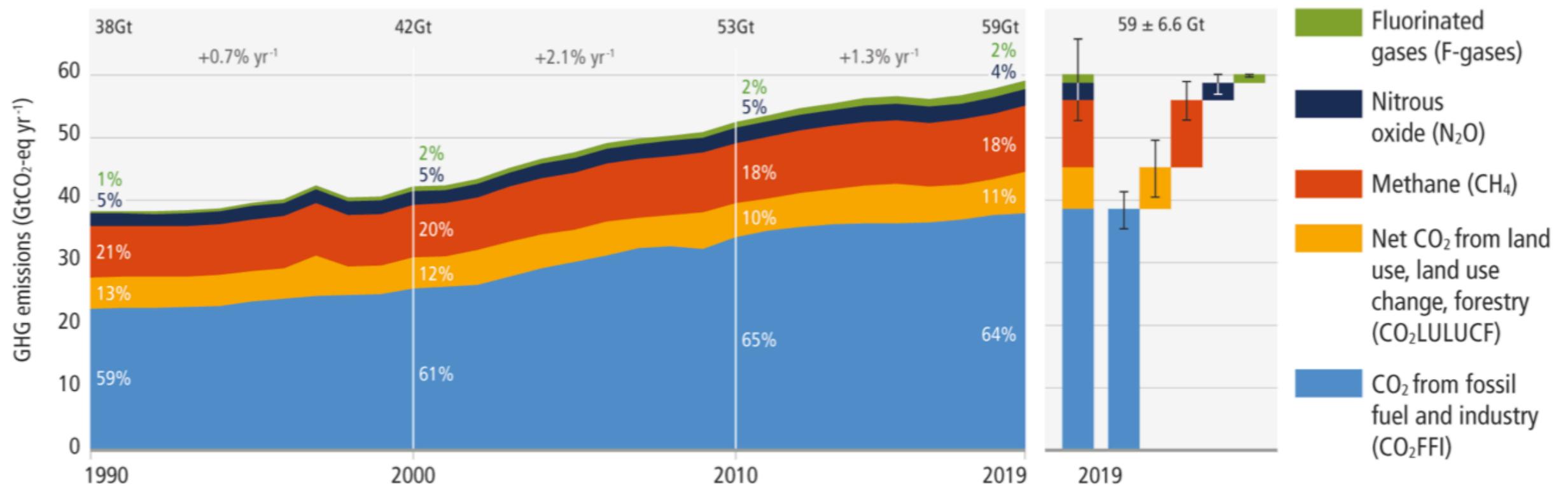
WELCOME TO THE ANTHROPOCENE

- For the past 4.6 billion years Earth history has been determined by the **unconscious** laws of the sciences.
- Now, conscious **thought** and **volition** are equal or perhaps more significant in driving change to the Earth system.
- We have now entered what is known as the **Anthropocene**, where humans have as much influence over our Earth System as geology, physics and the other natural sciences.



Global net anthropogenic emissions have continued to rise across all major groups of greenhouse gases.

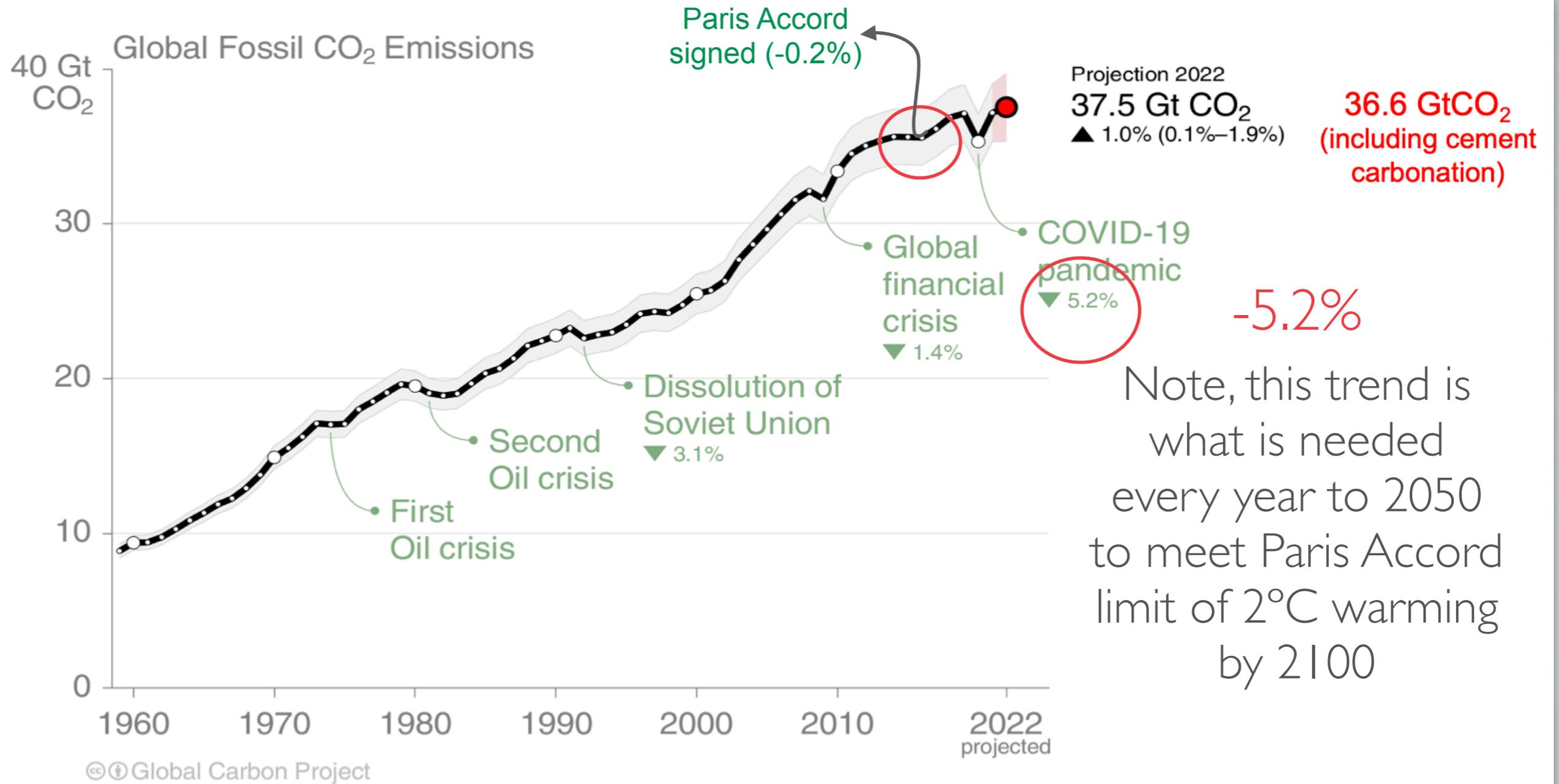
a. Global net anthropogenic GHG emissions 1990–2019 ⁽⁶⁾



IPCC Working Group 3 report, 2022

- Global development fuelled by burning of fossil fuels;
- The pace of GHG emissions continues to increase.

WHERE ARE WE NOW





#ShowYourStripes

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<https://showyourstripes.info/c/europe/unitedkingdom/england>

WOODHOUSE COLLIERY

- The UK's first new deep coal mine in 50 years;
- Coking coal 'essential' for steel production;
- Europe's largest steel-maker (Sweden) shifting to 'green-steel' (no coking coal) from 2025;
- Does a new coal-mine fit with the UK and global need to decouple from carbon?

Willis, R. (2023, in review) Use of evidence and expertise in UK climate governance :The case of the Cumbrian Coal Mine. *UCL Open Environment*.





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BOLTON FELL MOSS

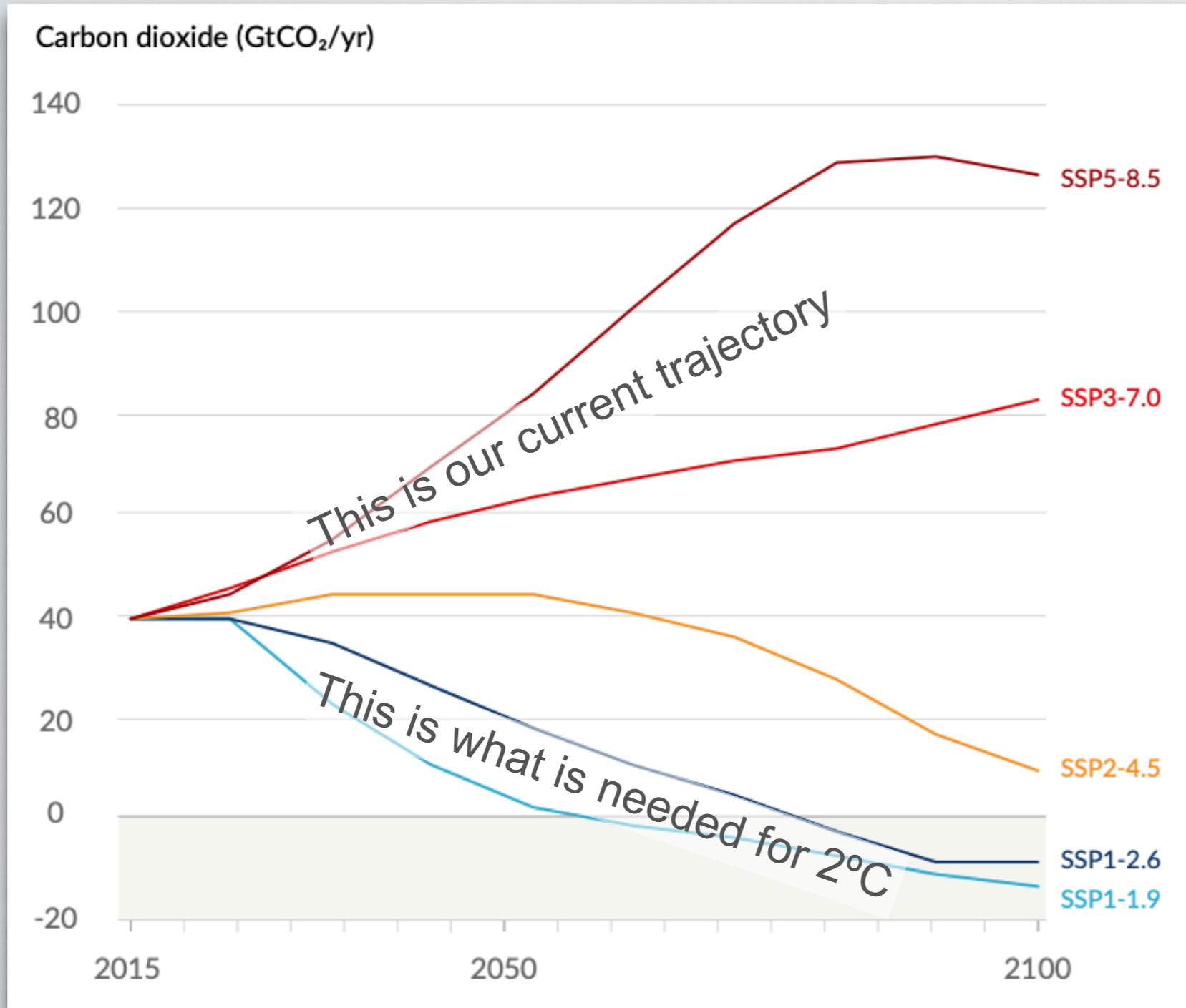


2016 Restoration



2023 onwards: Cumbria's
single largest carbon sink

THE IPCC SCENARIOS TO 2100



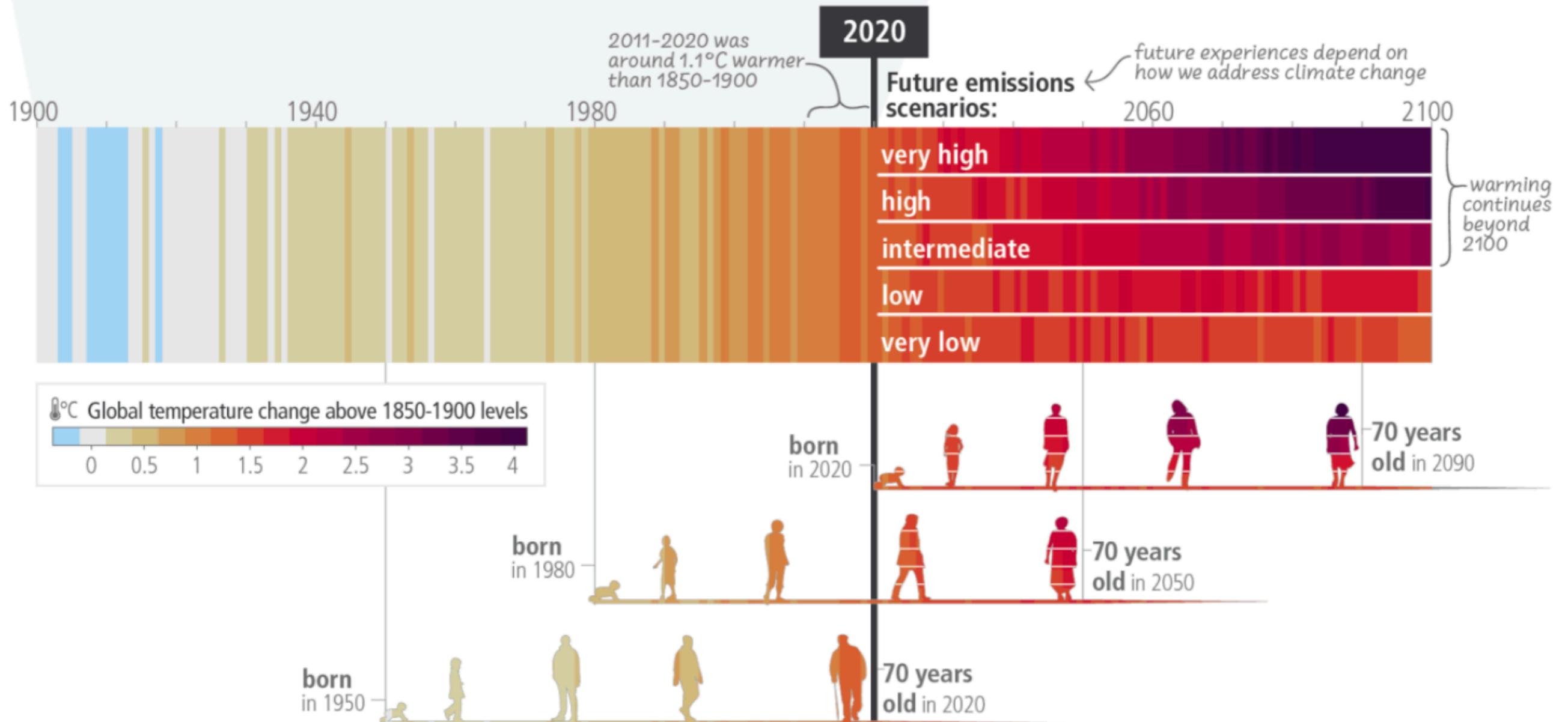
IPCC Working Group I report, 2021



Think of the Sun as providing 230W of energy for every m² on the planet: then add the number for each scenario as the **additional** energy driving climate change; this is **radiative forcing**

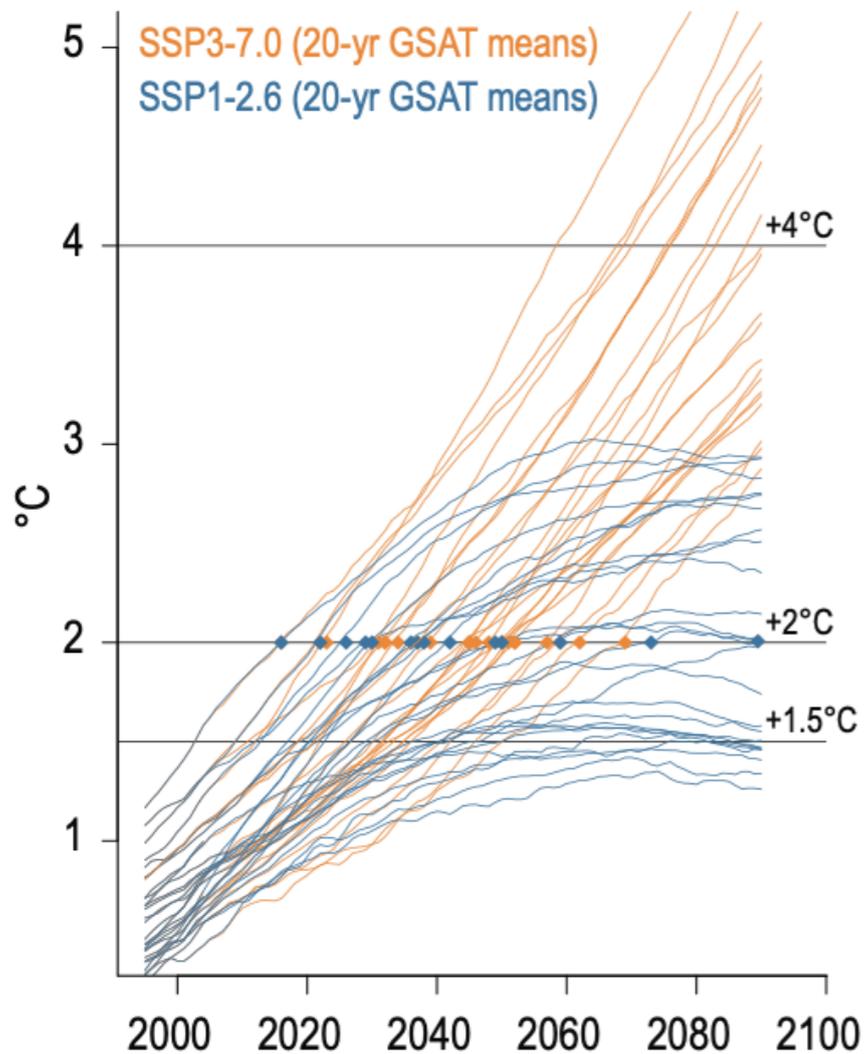
FEARFUL FUTURES

c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term

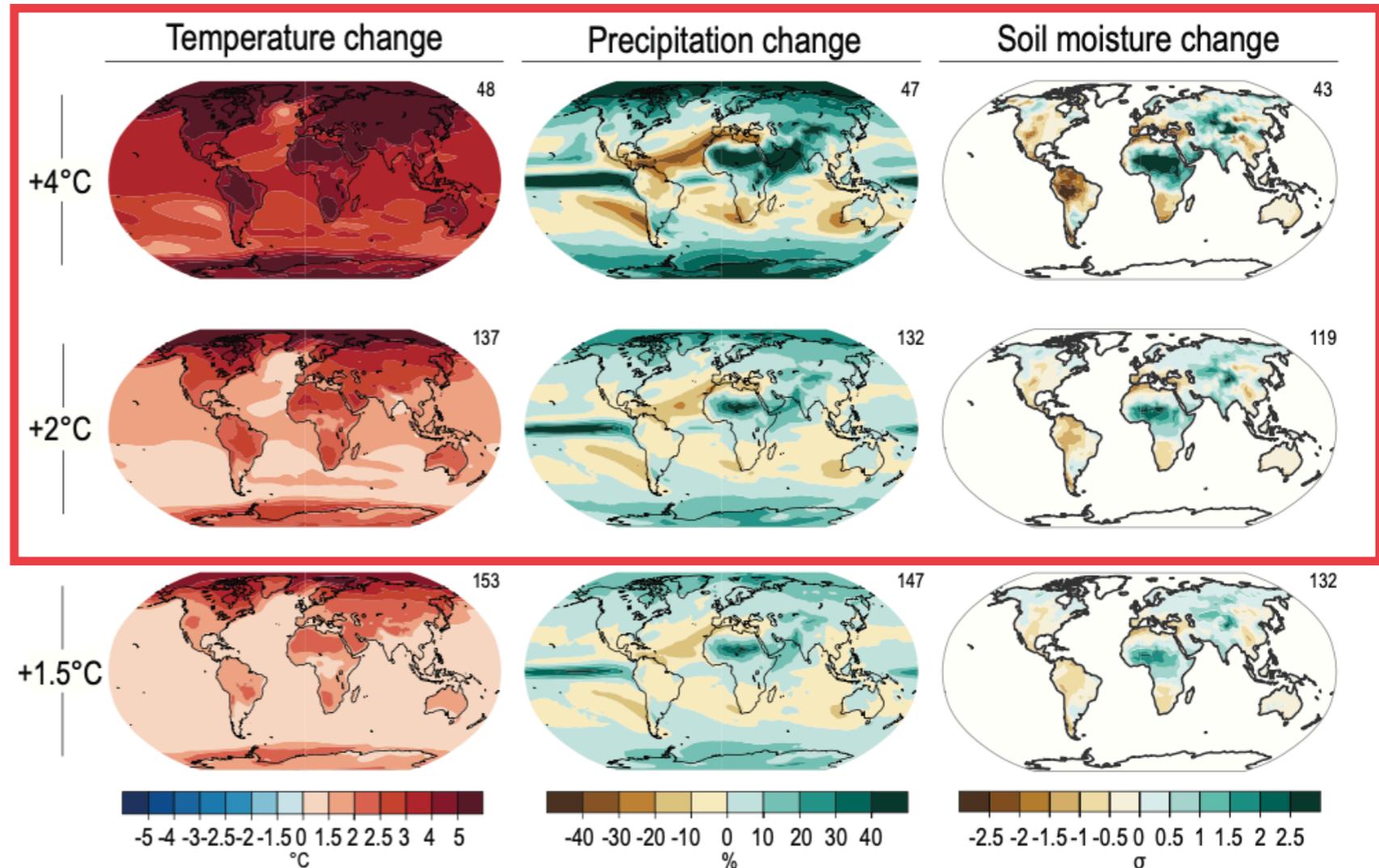


FUTURE CLIMATE CHANGE

(a) Global mean temperature in CMIP6

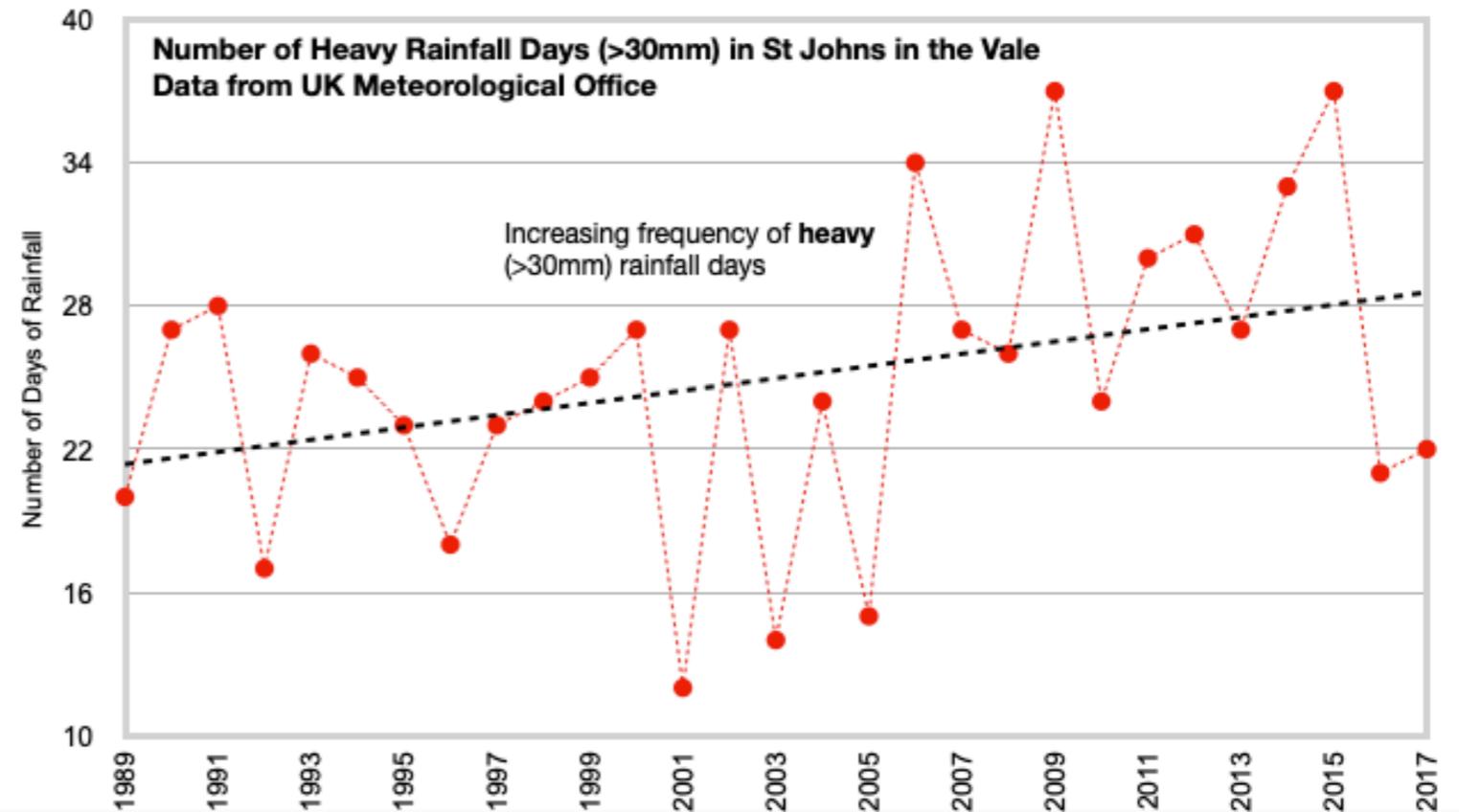
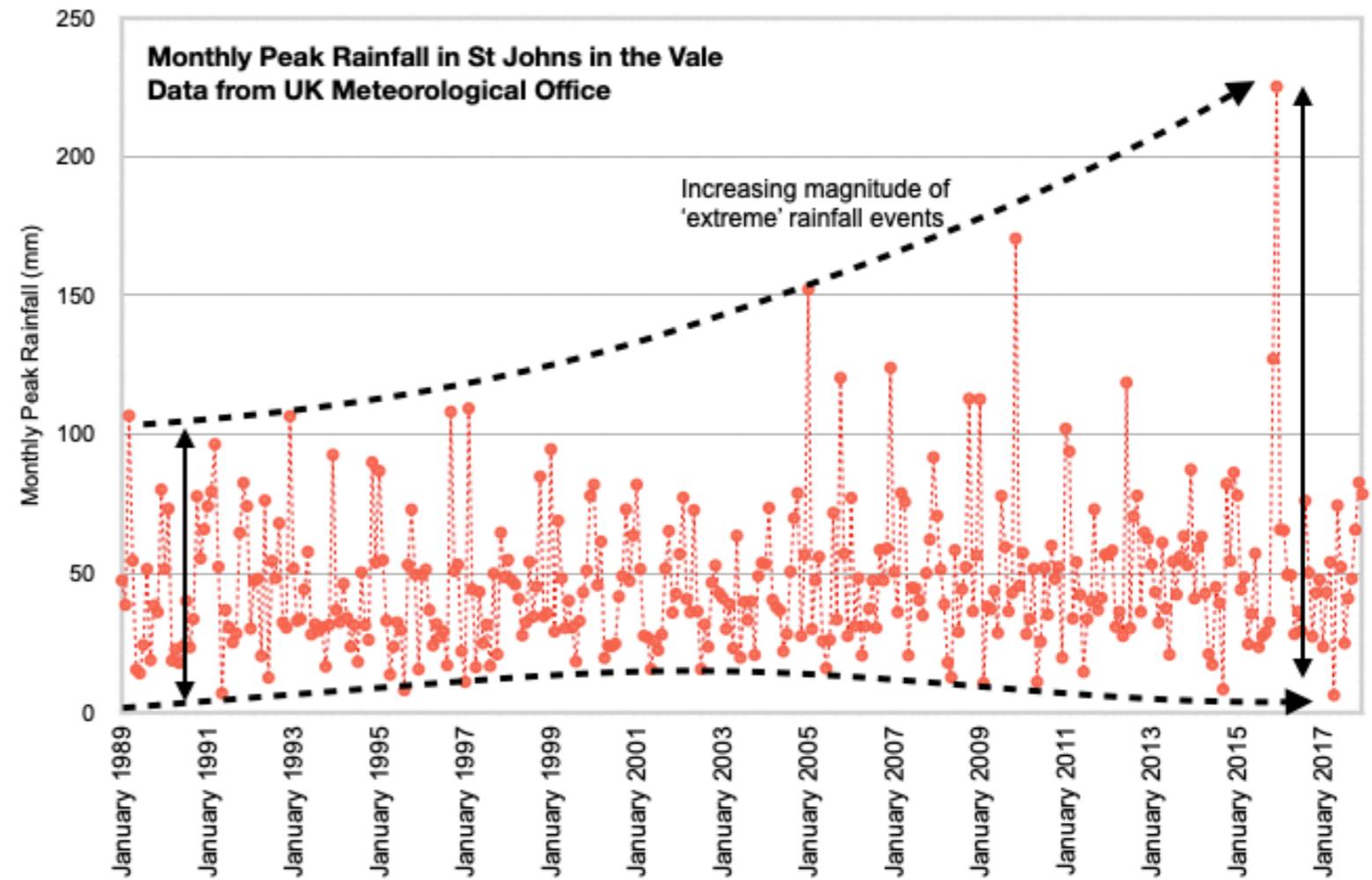


(b) Patterns of change in near-surface air temperature, precipitation and soil moisture



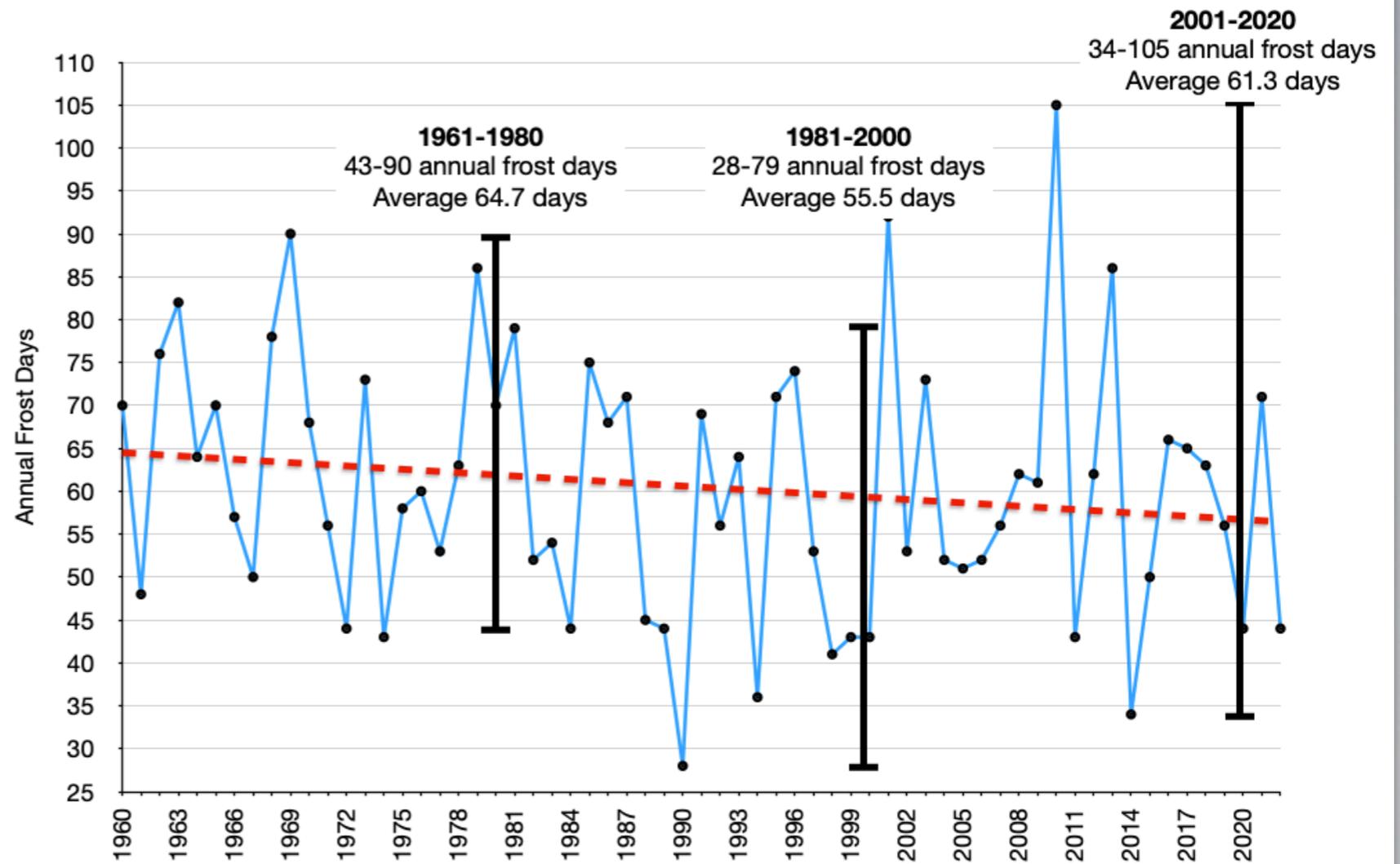


EXTREME PRECIPITATION EVENTS

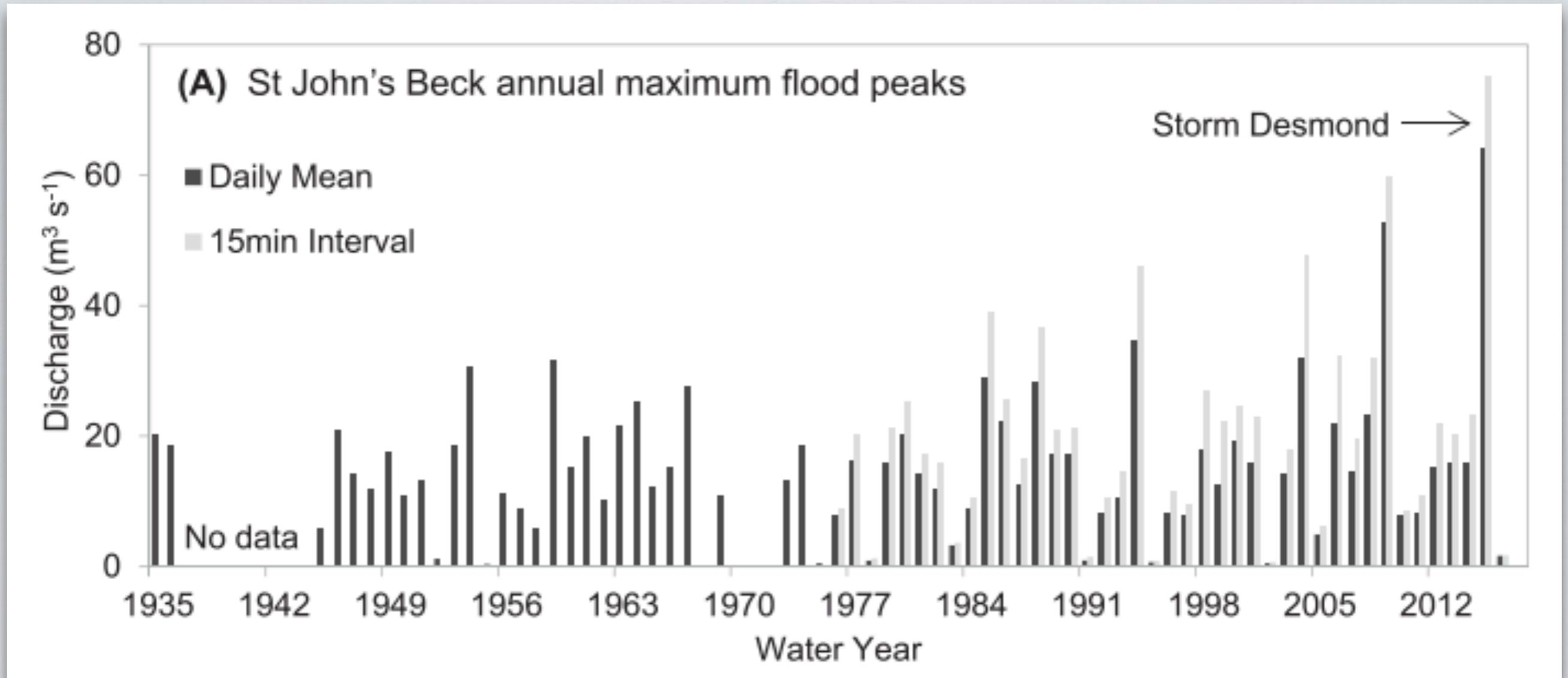


AS CLIMATE
WARMES, MORE
PRECIPITATION
FALLS AS RAIN,
RATHER THAN
SNOW

Annual Frost Days at Newton Rigg Weather Station, 1960-2022



A LONG HISTORY OF FLOODING



Joyce, H. M., *et al.* (2018). Sediment continuity through the upland sediment cascade: geomorphic response of an upland river to an extreme flood event. *Geomorphology*, 317, 45–61



Press Association

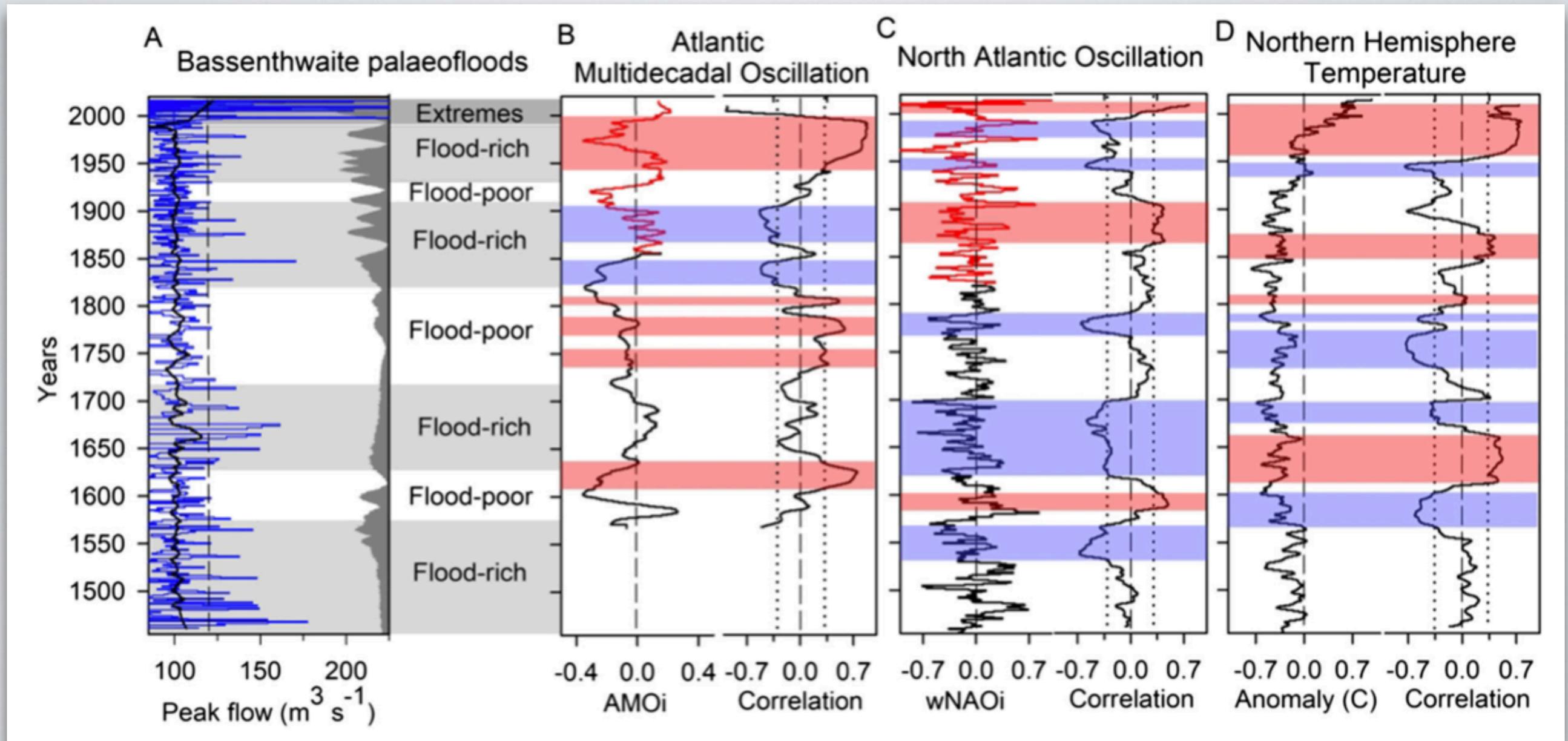


Ullswater Catchment CIC



Paul Ellis/ AFP

A LONG HISTORY OF FLOODING



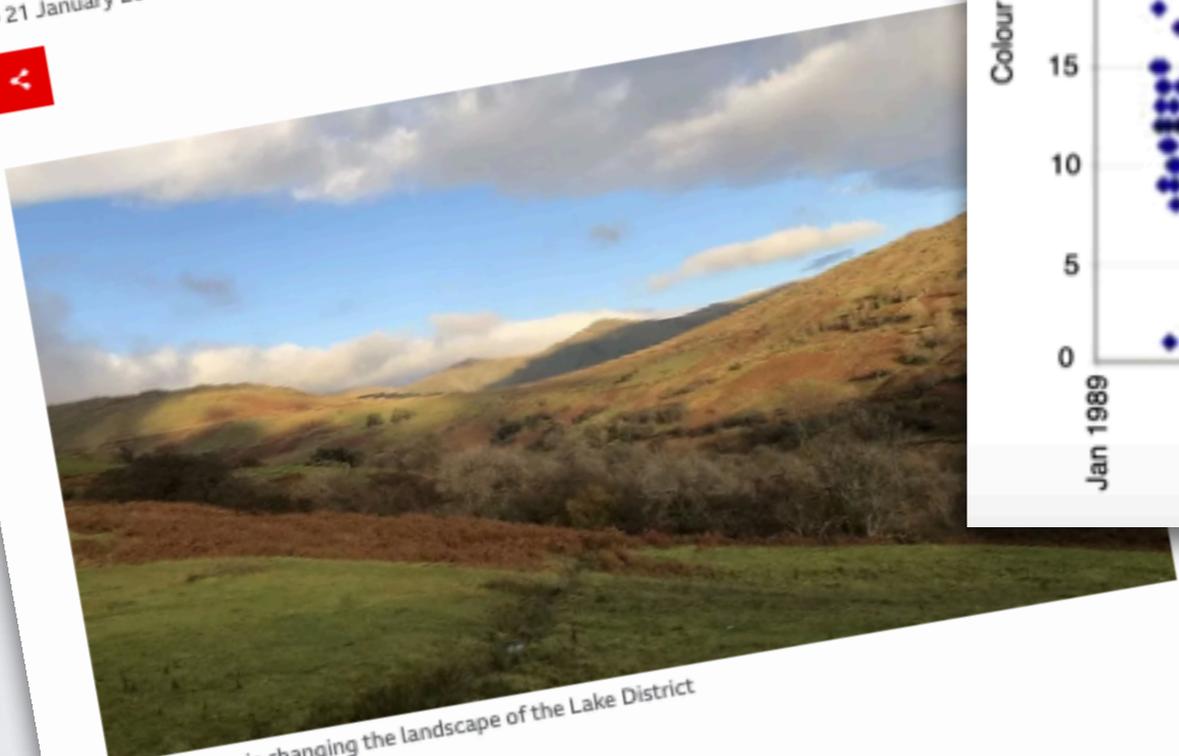
Chiverrell, R.C *et al.* (2019) Using lake sediment archives to improve understanding of flood magnitude and frequency: Recent extreme flooding in northwest UK. *Earth Surface Processes & Landforms* 44, 2366-2376

BOOM & BUST = SOIL EROSION



Climate change: Lake District facing 'dramatic' soil erosion

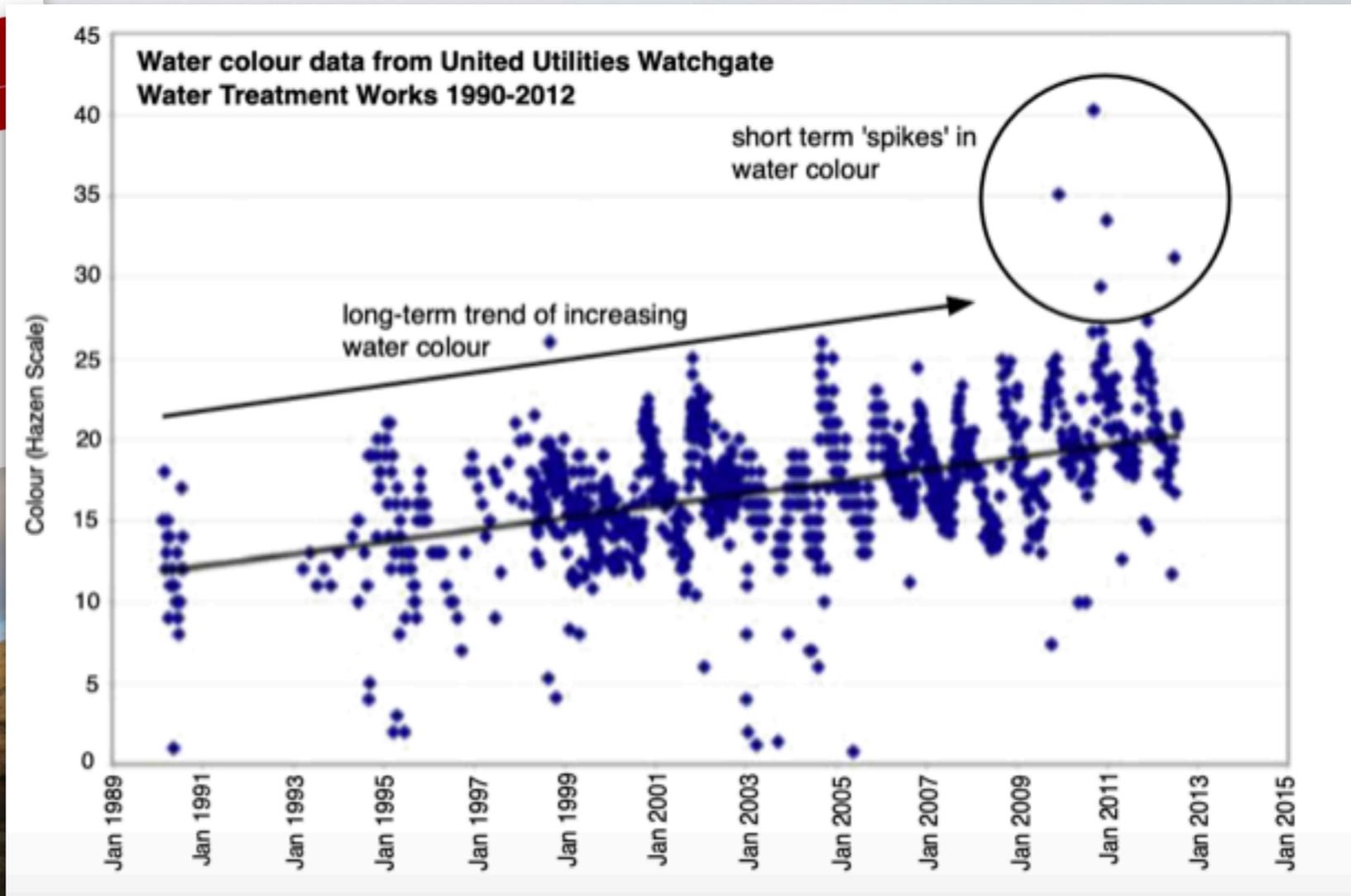
21 January 2020



Soil erosion is changing the landscape of the Lake District

By Alison Freeman
Look North, Newcastle

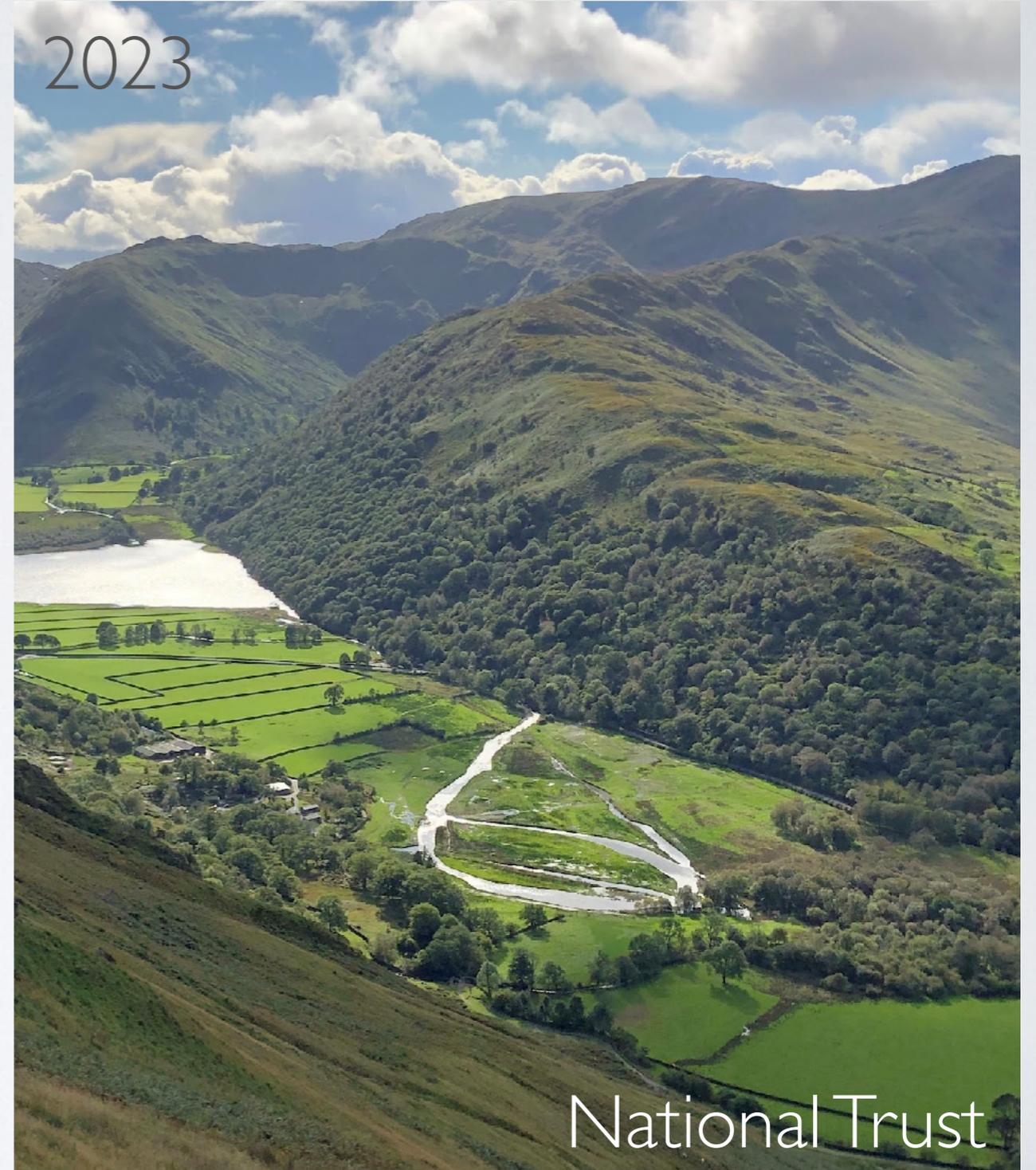
The Lake District is suffering from soil erosion at a "dramatic rate" and could look very different in 50 years' time, an academic has warned.
Dr Simon Carr, programme leader for geography at the University of Cumbria, said extreme weather caused by climate change is stripping the fells.



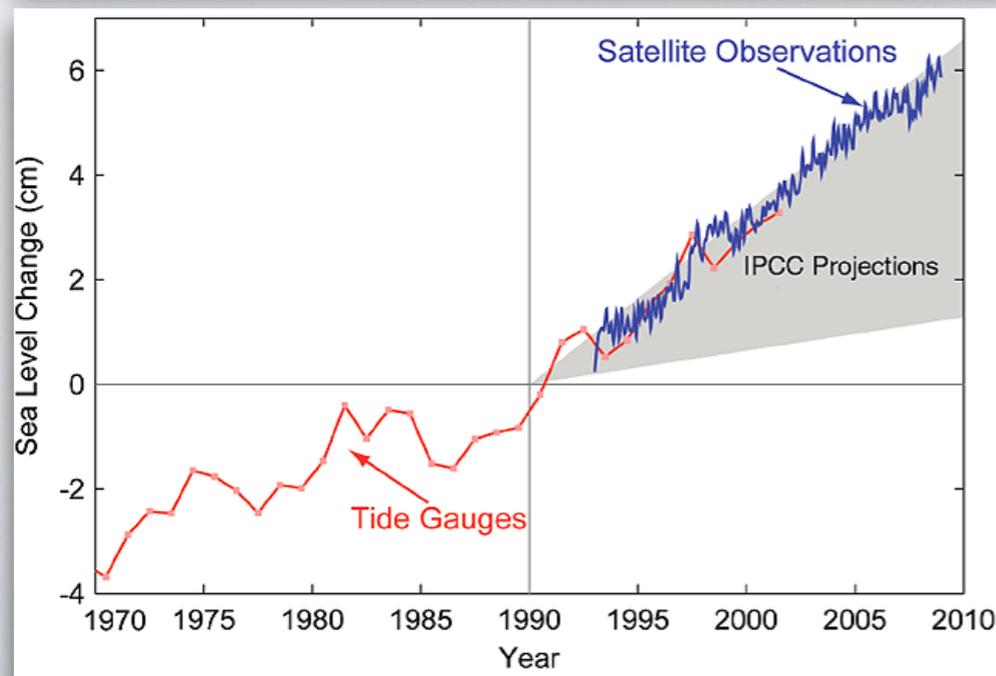
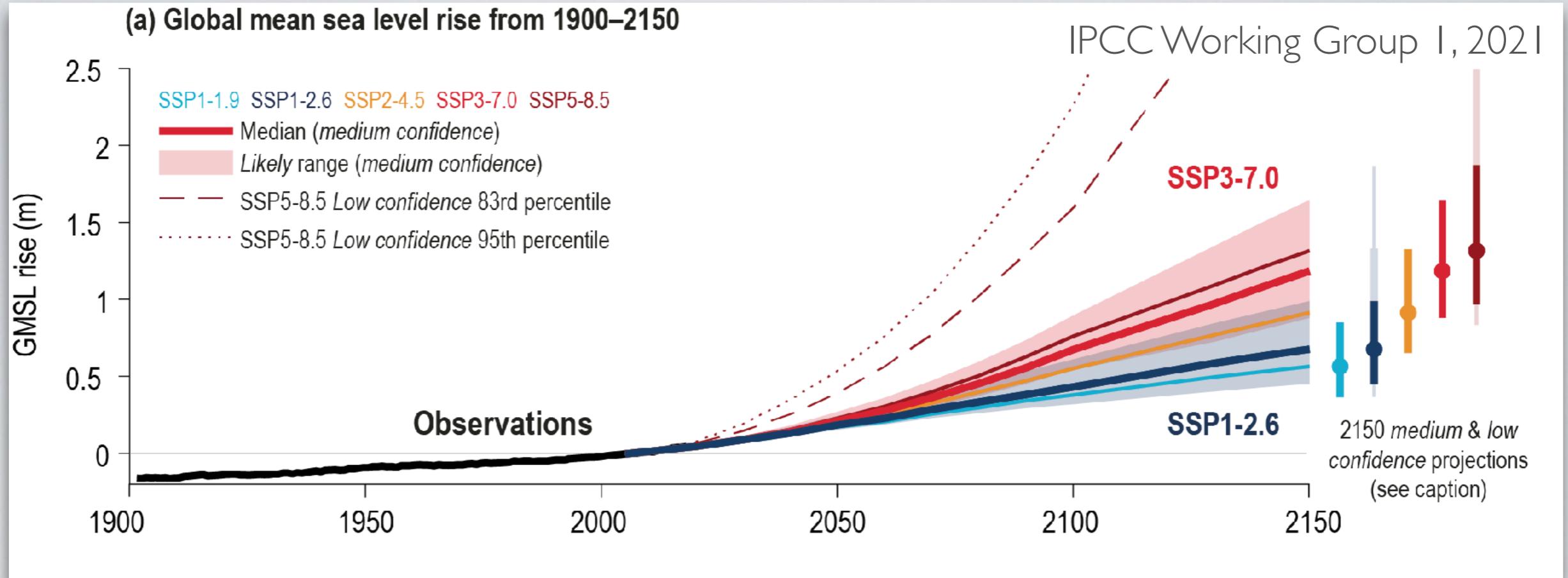
Perhaps 50 years of soil remains on the fells of Lakeland

A 'sheepwrecked' landscape?
(George Monbiot)

GOLDRILL BECK



Landscape level catchment management;



Observed sea level trends since 1990 have been consistently at the top end of IPCC projections



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IMPACT OF SEA LEVEL RISE BY 2050



<https://www.newsandstar.co.uk/news/19187605.areas-cumbria-water-2050/>



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WARTON SALT MARSH



Warton Saltmarsh: coastal retreat in 20 years
(Imagery from Google Earth)



Warton salt-marsh, Lancashire
(Photo: Simon Carr)



Warton salt-marsh, Lancashire
(Photo: Simon Carr)

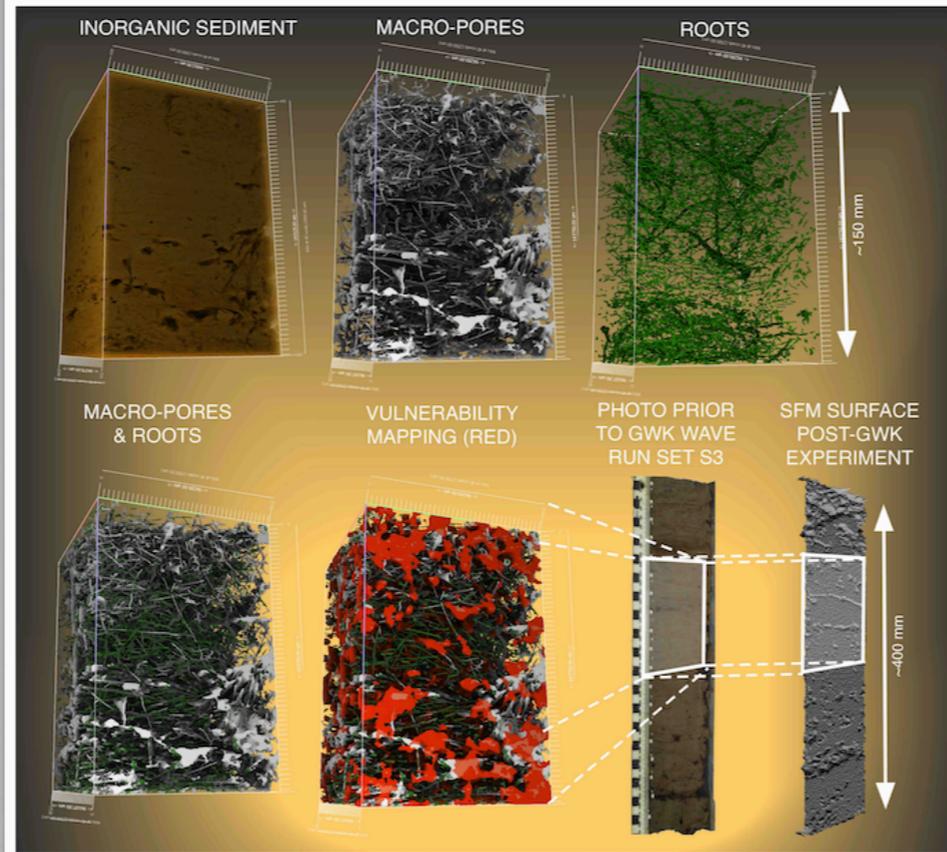
WARTON SALT MARSH

- Are some marshes more resistant to storm-wave erosion than others?
- How do soil type and biology affect the resistance of exposed salt marsh areas to the eroding forces of waves and tides?

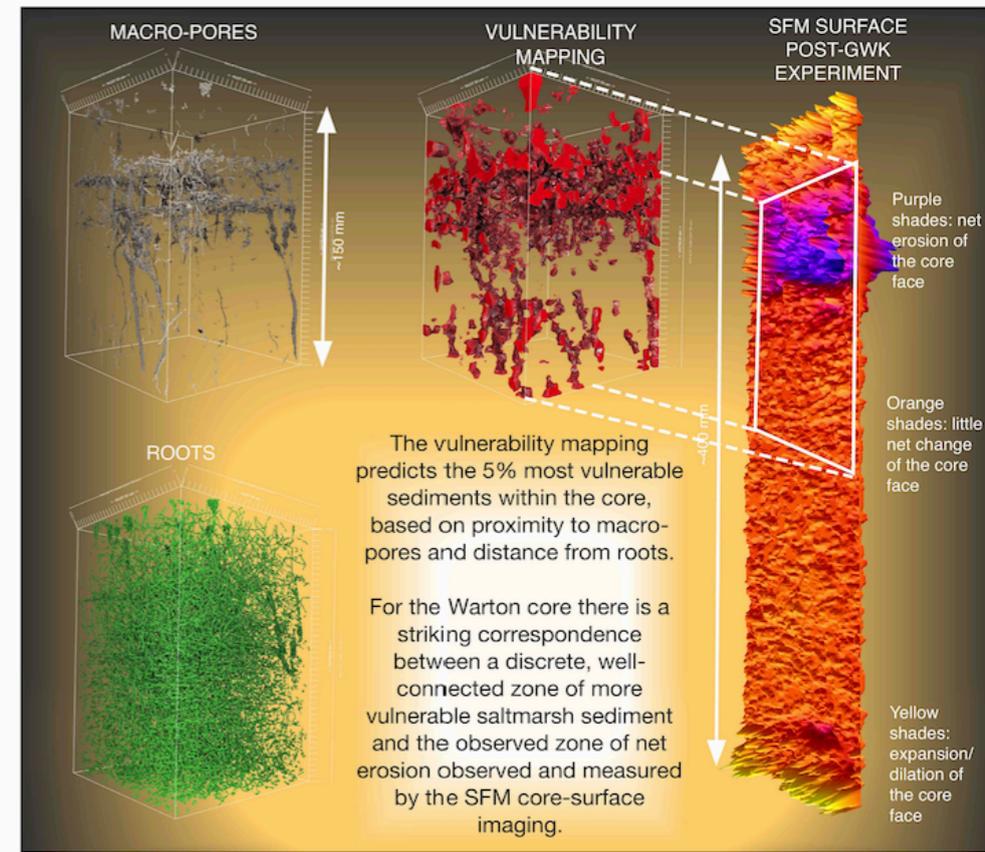




TILLINGHAM: THAMES ESTUARY



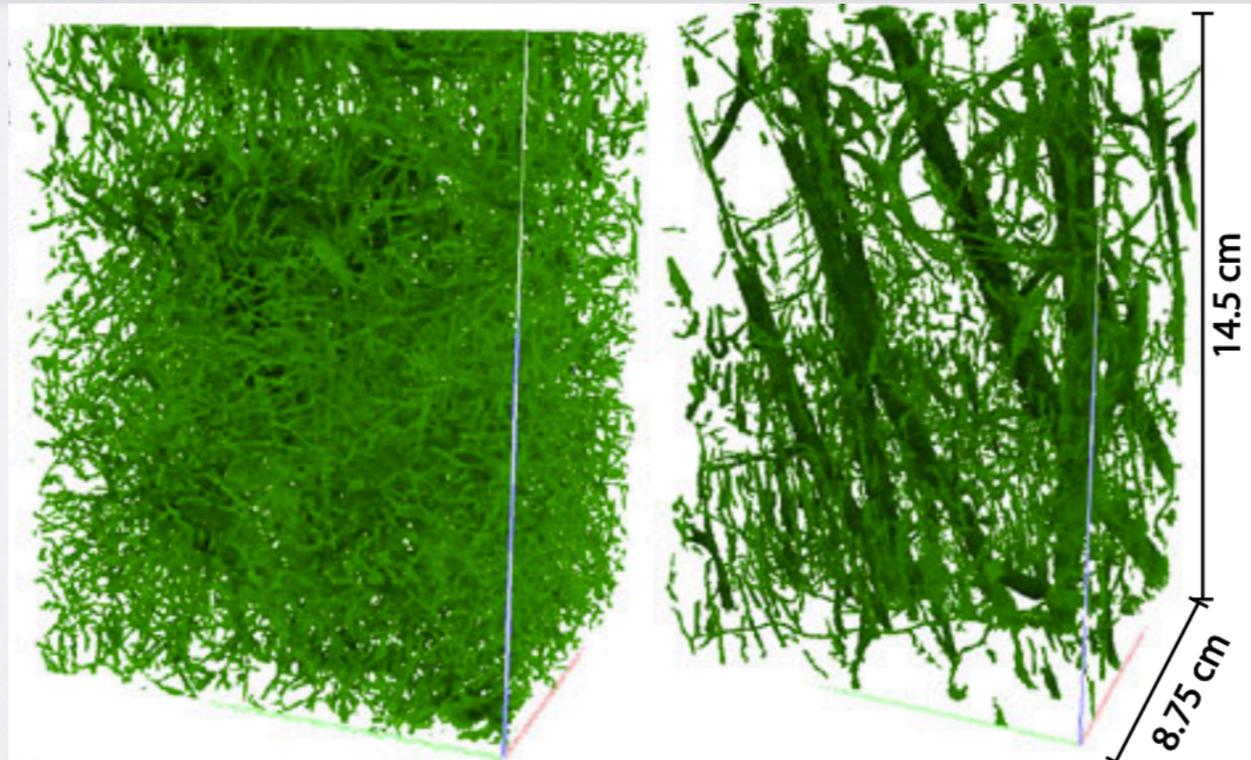
WARTON: MORECAMBE BAY



WARTON SALT MARSH



Too much of this



Not enough of this



A CONCLUSION

- Climate change is the biggest challenge facing Earth and all its occupants;
- It is our **duty** to understand climate change and engage with the challenges it poses;
- It is impacting the landscapes that are familiar to us all;
- But, from each example, there is something that can be done to limit or reverse those impacts;
- It is imperative for the future of our species not to ignore or try to hide from our duty.



THANK-YOU!

