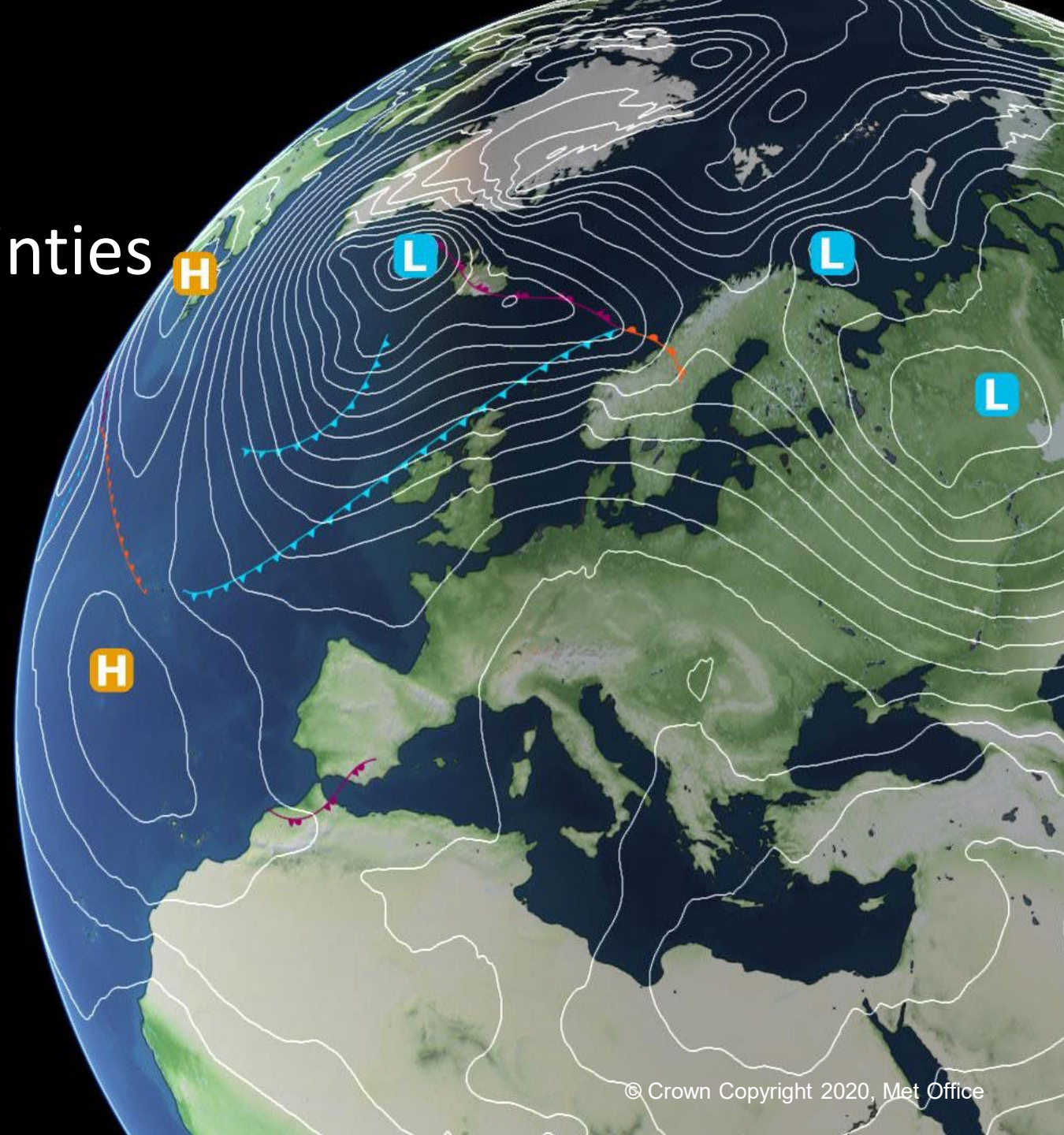


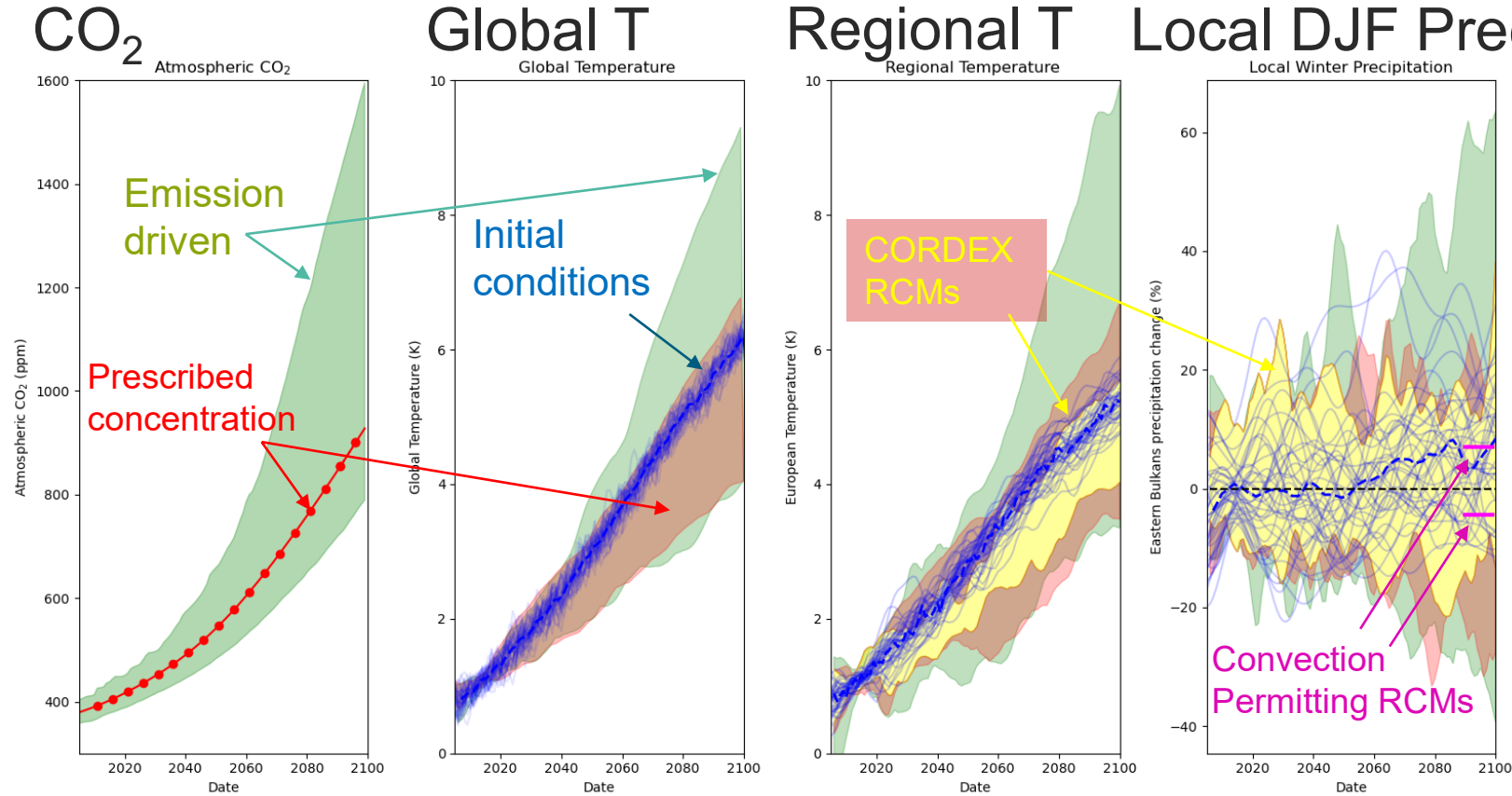
# Exposing wider ESM uncertainties to mitigation and adaptation decisions

Ben Booth

Doug McNeill, Andy Wiltshire



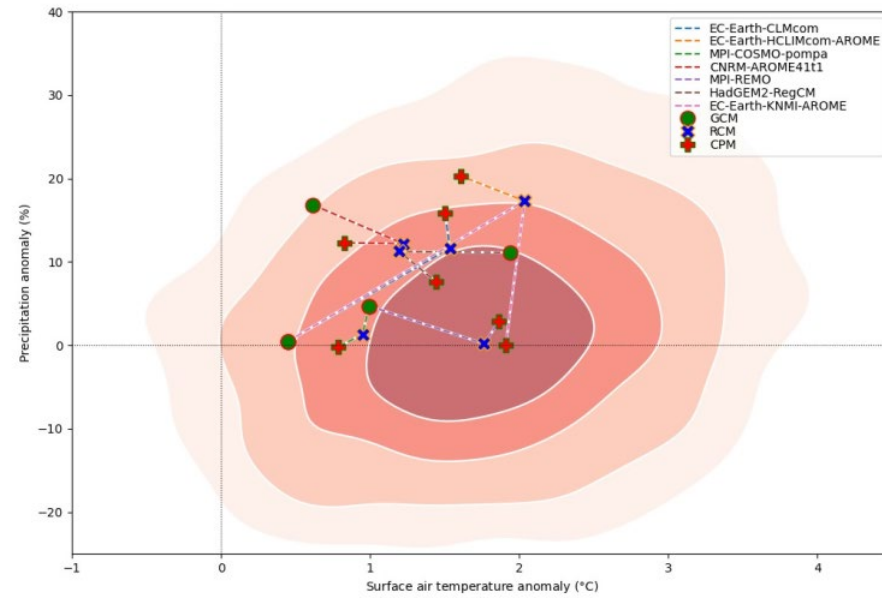
# Current CMIP not exposing TCRE to impact



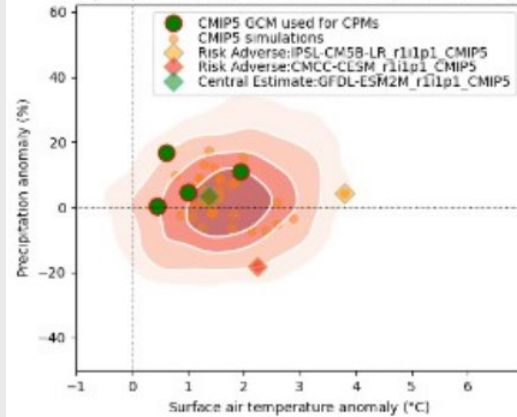
- Subset of adaptation decisions need information **on less likely but still plausible high/low end projections**
- Current impact relevant climate projection data does not capture the ESM projection range

# Uncertainties not cascaded to CORDEX

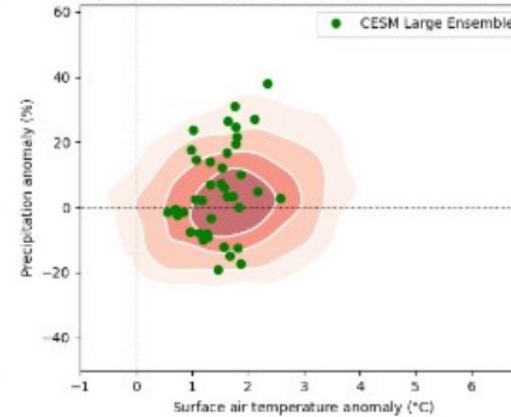
Alpine winter climate response (2040-2049 relative to 1996-2005)



DJF Alpine RCP85 (2040-2049 relative to 1996-2005)

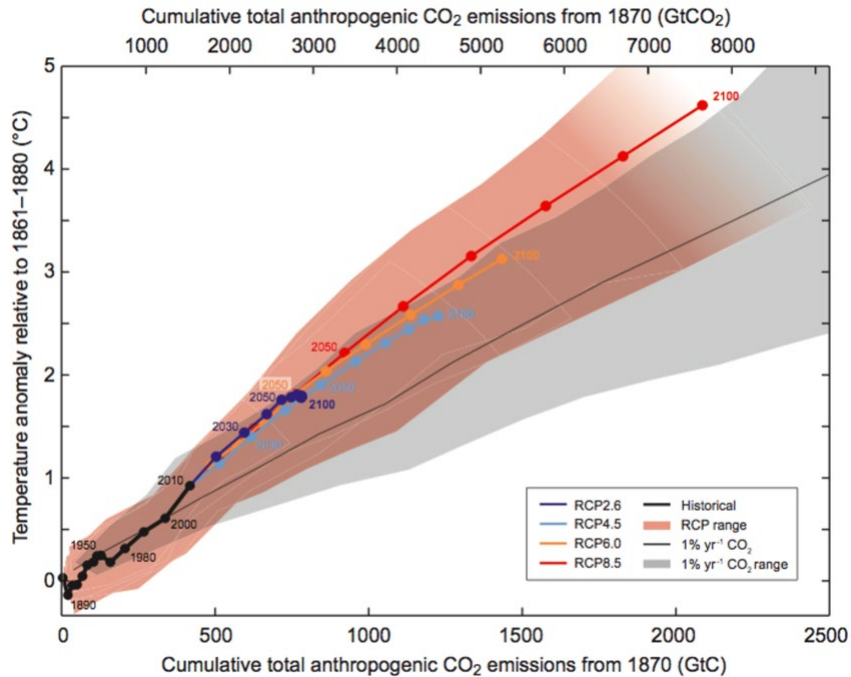


DJF Alpine RCP85 (2040-2049 relative to 1996-2005)



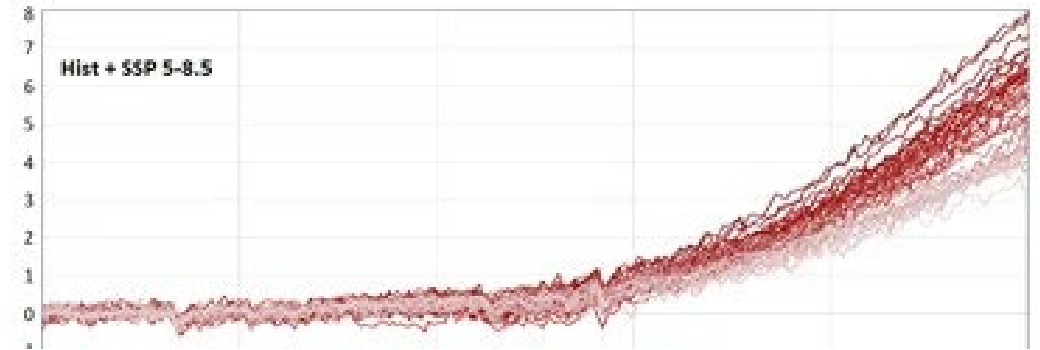
# What do we need to shift adaptation to a more robust basis?

## IPCC WGI



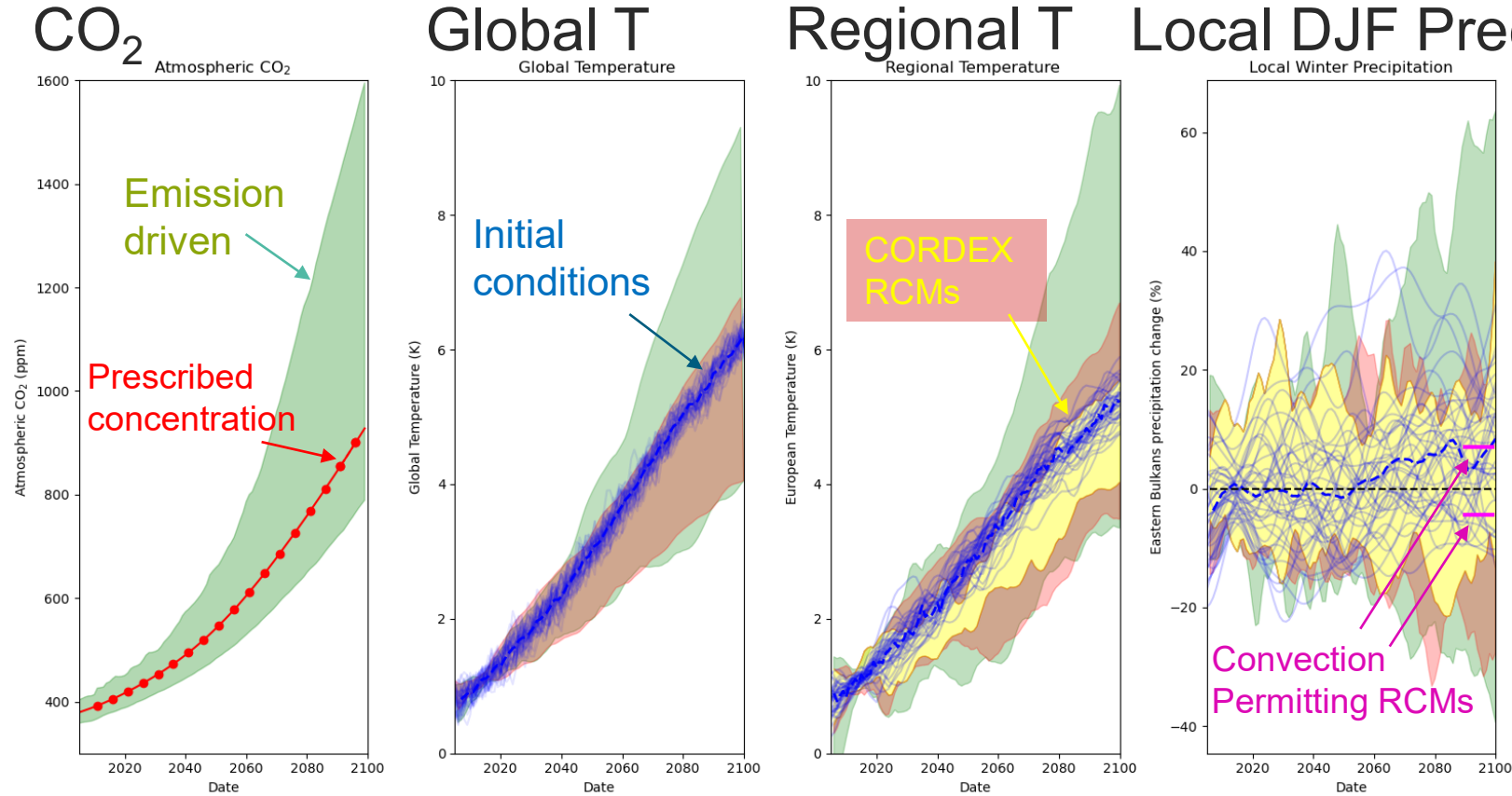
WGI does well at synthesizing multiple strands of evidence

## IPCC WGII & WGIII



If uncertainties are not accounted for in ScenarioMIP then they effectively do not exist

# CMIP7 will be emission driven



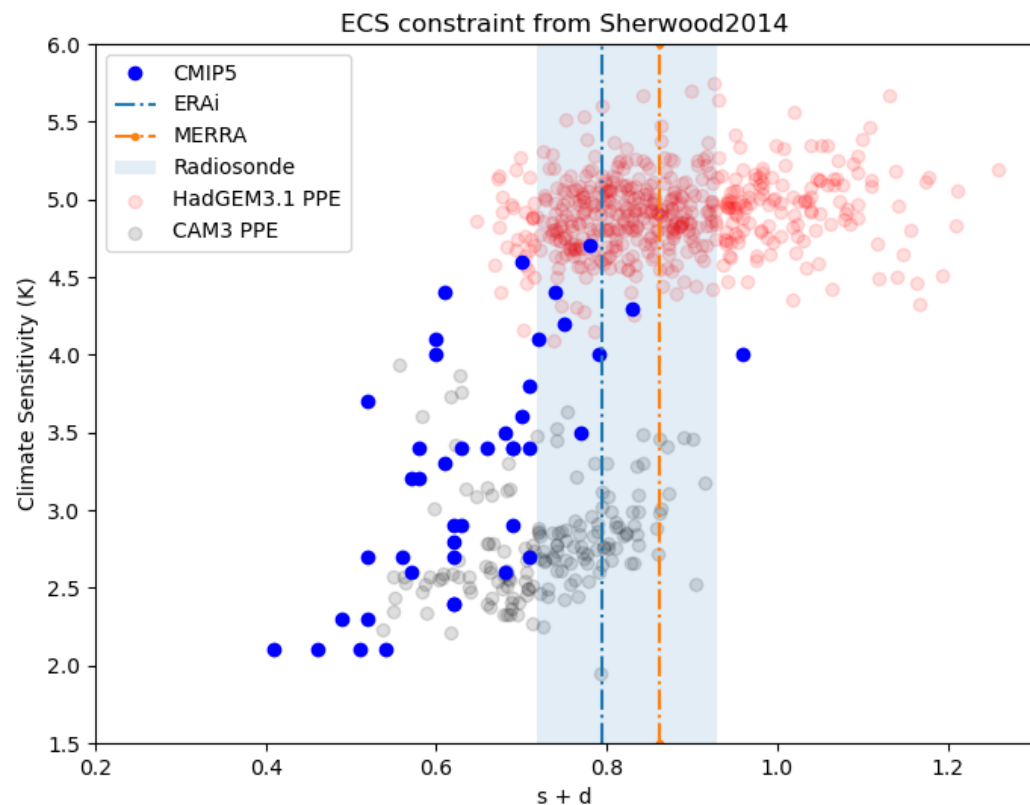
- Subset of adaptation decisions need information **on less likely but still plausible high/low end projections**
- Plans for CMIP7 ScenarioMIP are for emission driven scenarios.

CMIP7 improving the information cascade

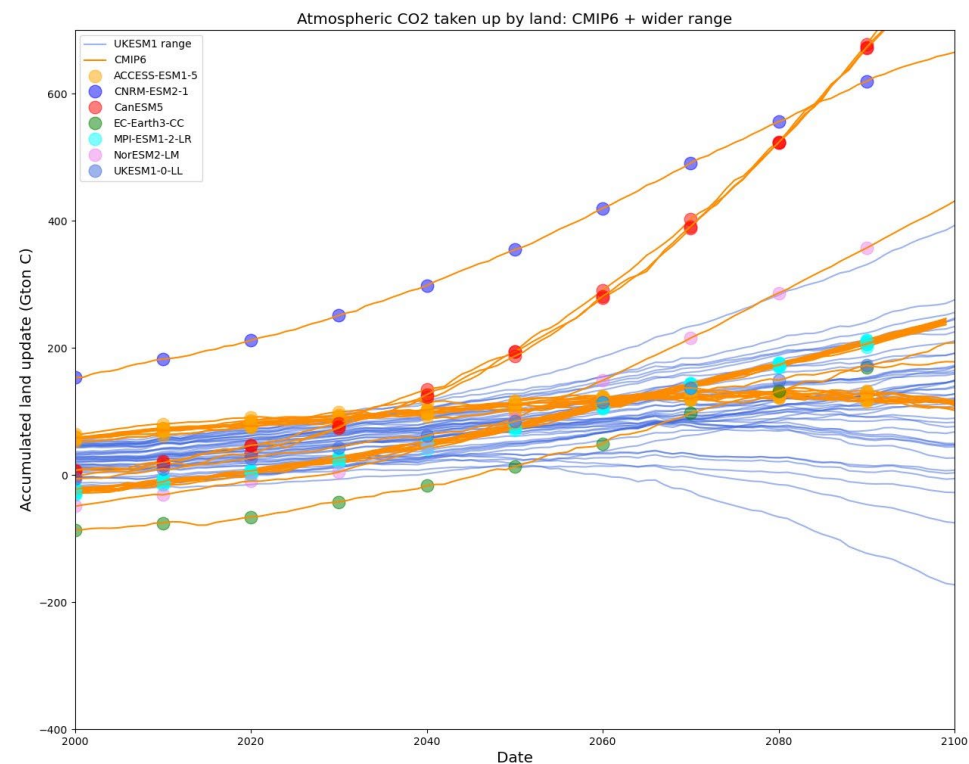
# Aligning global modelling to inform adaptation

- Emission driven (to capture socio-economic to impact cascade)
  - Current ScenarioMIP proposals addresses this
- Internal variability
  - Initial conditions ensembles should enable CORDEX/impacts modellers to capture this
- **How can we shift CMIP to better capture model diversity?**

# Flagship CMIP simulations are just a snapshot



Physical feedbacks



Land Carbon Uptake

# Perturbed Parameter Ensembles

## **AIM**

- Explore the wider range of potential climate change, consistent with a current model's parameterisation

## **Methodology**

- Identify important process parameters and their plausible ranges
- Run multiple ensemble members, with each exploring a different set of parameter values within these plausible ranges



# PPE of CMIP6-era model

**Doug McNeall** and **Andy Wiltshire** have led a land surface PPE (offline)

- This samples very broad range of carbon cycle responses.
- By excluding responses that are inconsistent with real world estimates, we can identify spread of model responses consistent with current parameterisation.

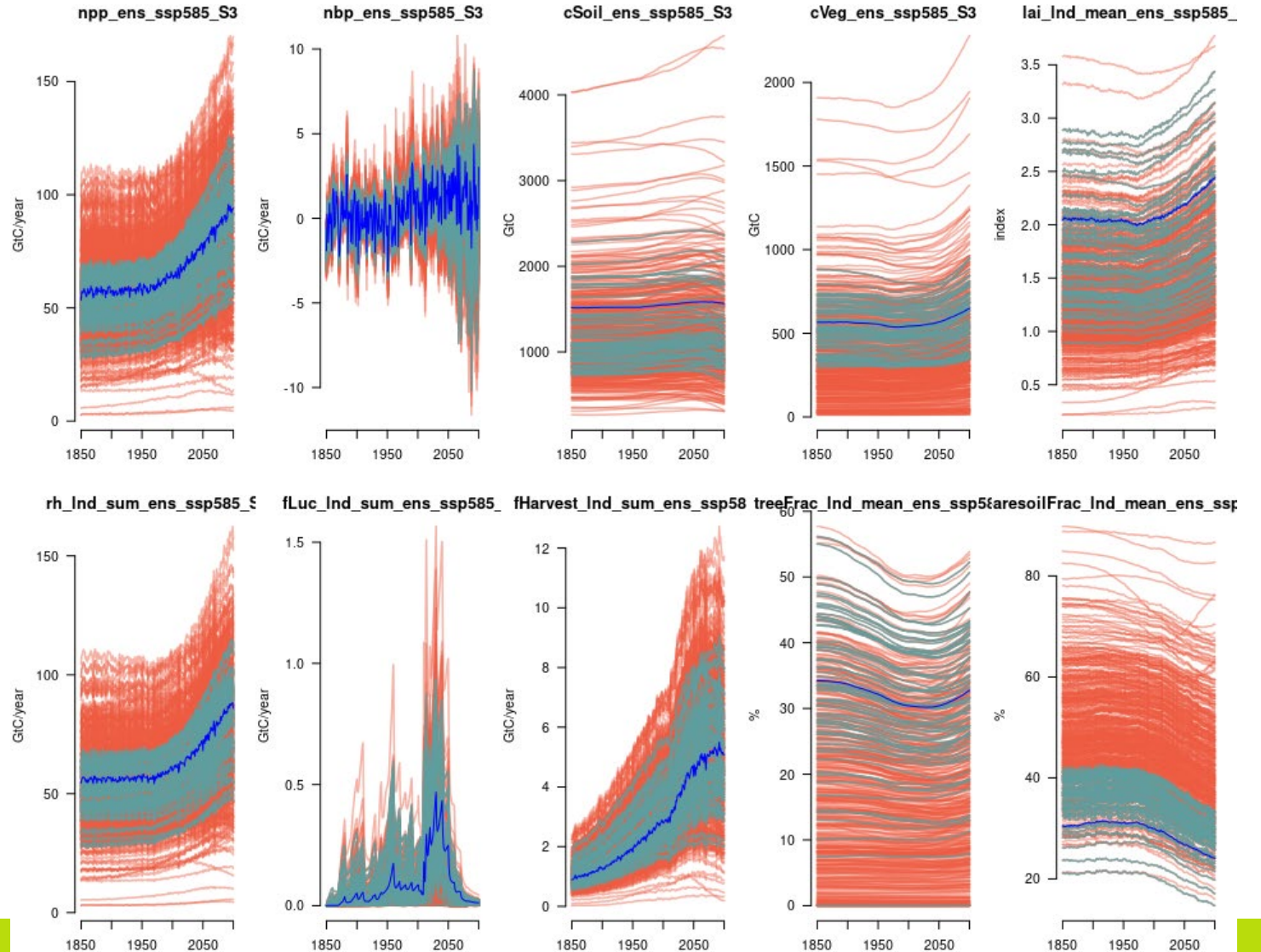
*<https://doi.org/10.5194/gmd-2022-280>*

# PPE of a CMIP6-era model

Simulations were screened using modern day estimates of:

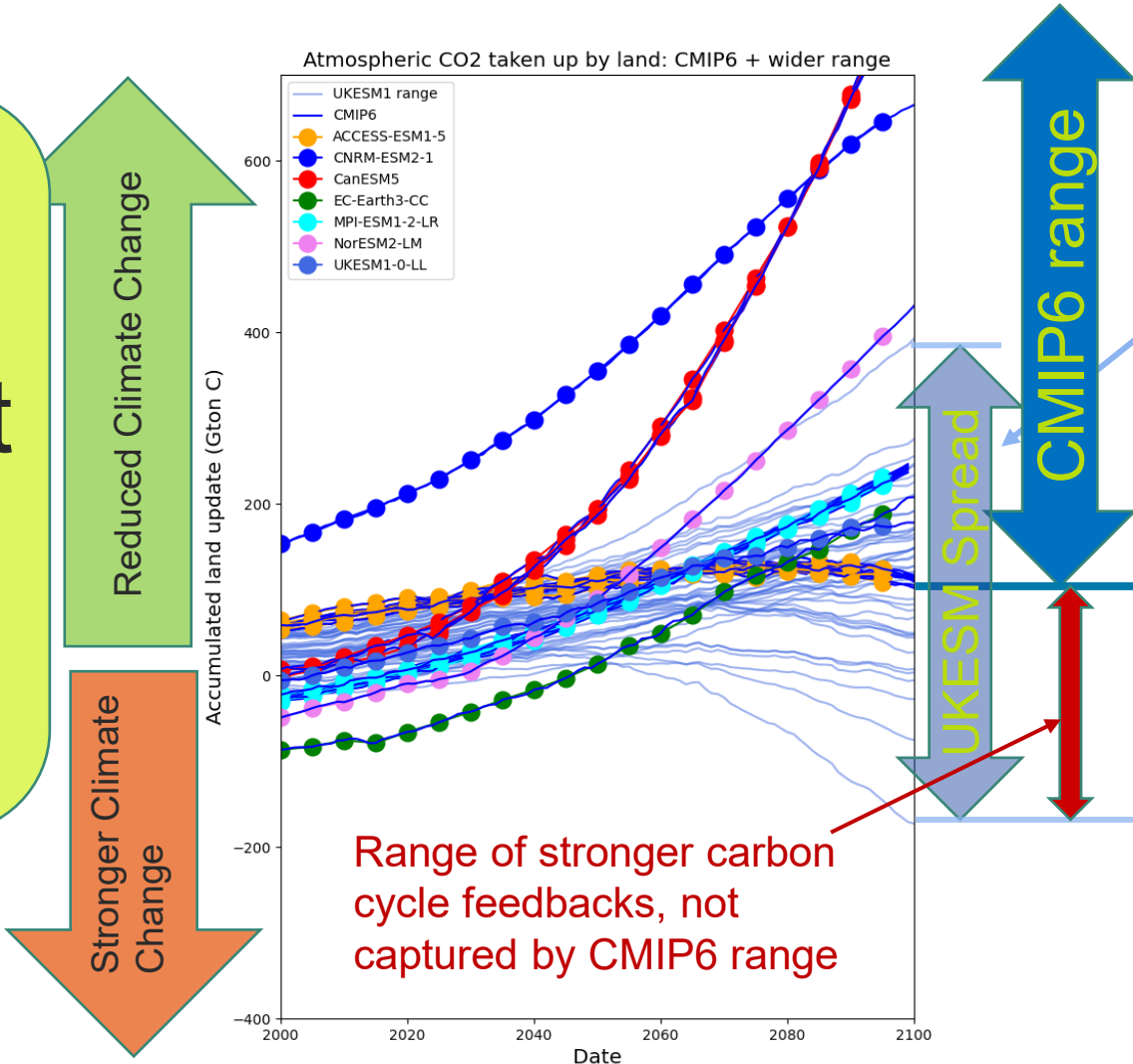
- **NBP, NPP, cSoil** and **cVeg**
- **Cumulative NBP** (land uptake)
- **Bare Soil** (as a proxy for plausible vegetation distributions)

Variants (both historically plausible and exploring a wide range of future change) selected for UKESM runs.



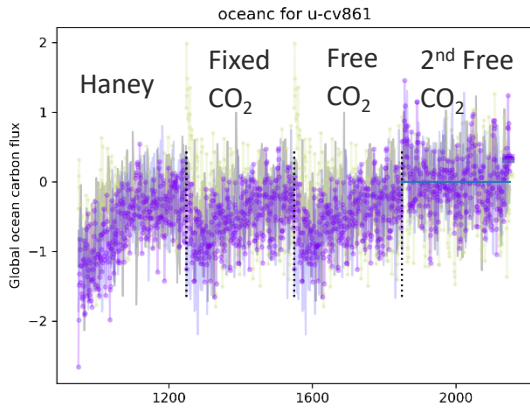
# PPEs broadening TCRE response?

We have plausible variants that suggest net land carbon source?



Plausible variants selected from a Perturbed Parameter Ensemble of UKESM's land surface

- 29 member UKESM-fast ensemble is already spun-up.
- Historical + Scenario runs to be started soon.

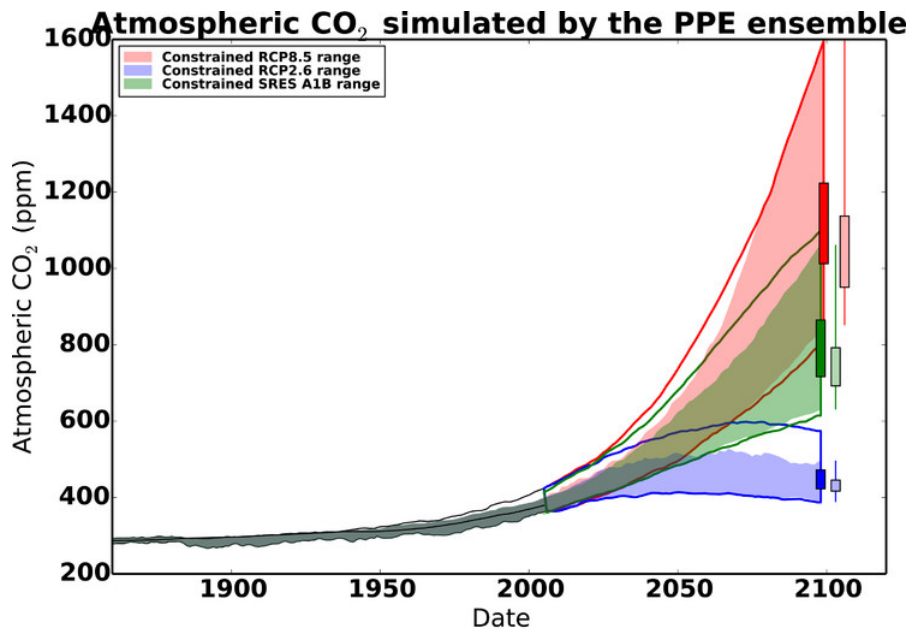


# But we need for Multi-model PPEs ..

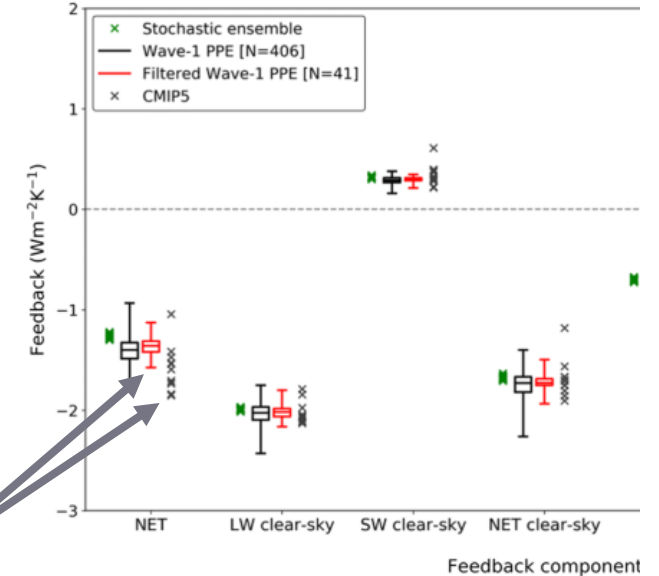
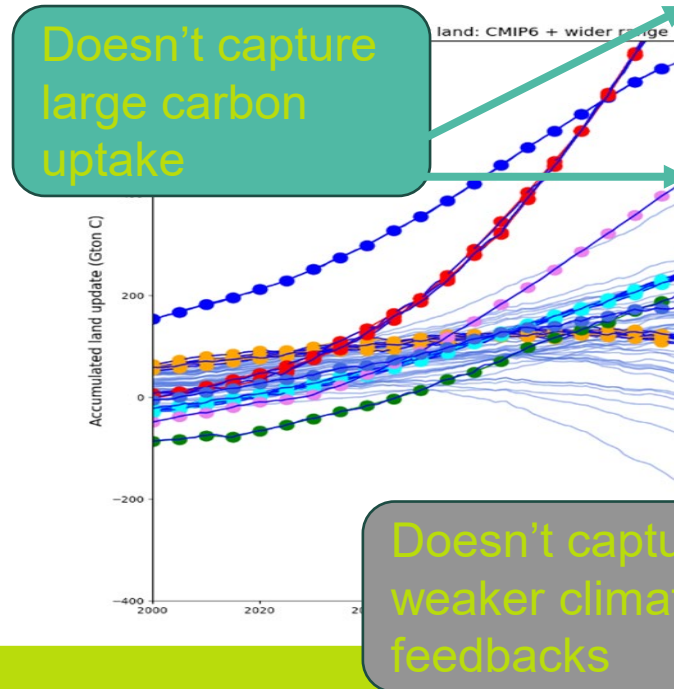
29 member UKESM-fast emission PPE spun-up

.... but will only be able to explore wider responses at the high end

Hadley CMIP5-era PPEs span range



Hadley CMIP6-era PPEs no longer able to span full range



# Aligning global modelling to inform adaptation?

- How can we shift CMIP to better capture model diversity?
  - PPEMIP – Important. Can we capture model uncertainty? Can we scale to ScenarioMIP?
- Could CMIP modelling centres consider submitting alternative variants to ScenarioMIP?
  - E.g. high/low sensitivity variants.