

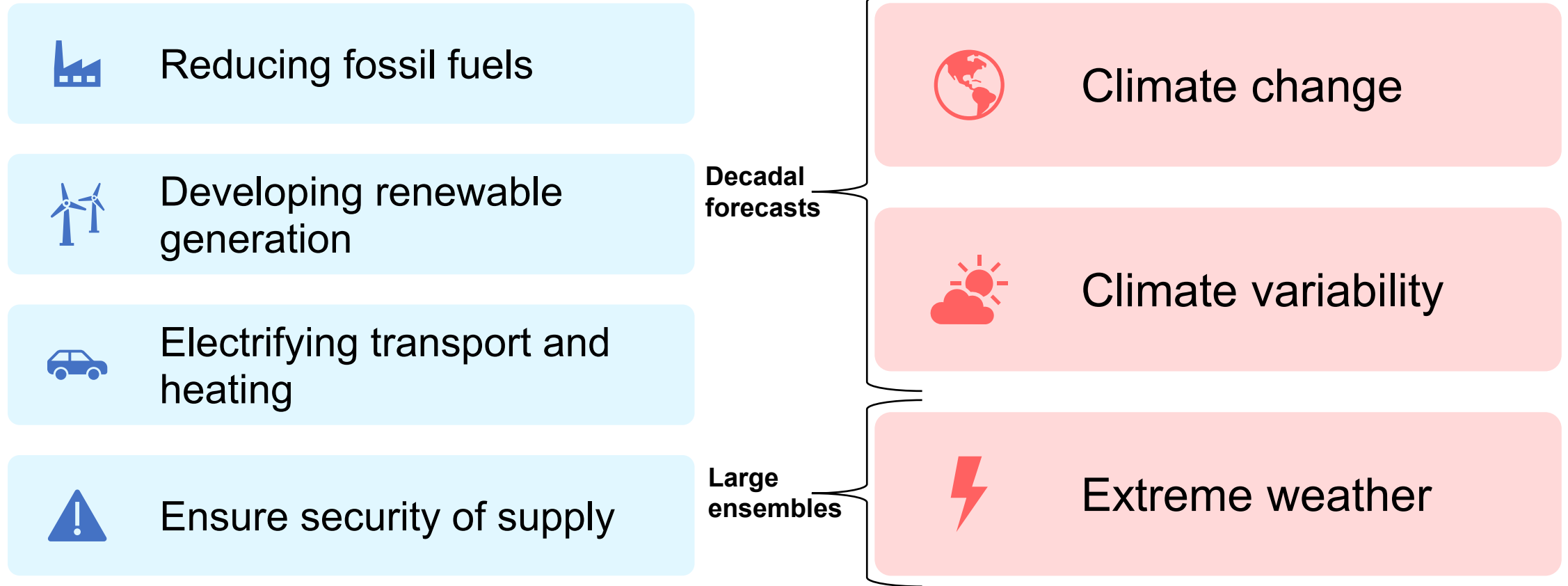
Decadal predictions for the European energy sector

Ben Hutchins – 13th March 2025

Risk and Resilience Day

Supervisors: David Brayshaw (Reading), Len Shaffrey (NOC), Hazel Thornton (UKMO), Doug Smith (UKMO)

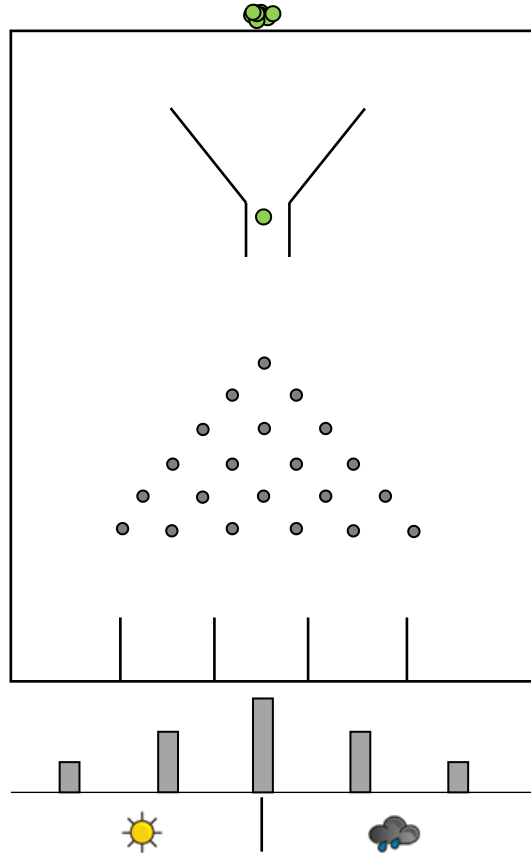
A rapidly transitioning power system



How do decadal forecasts work?

You cannot predict 1 ball...

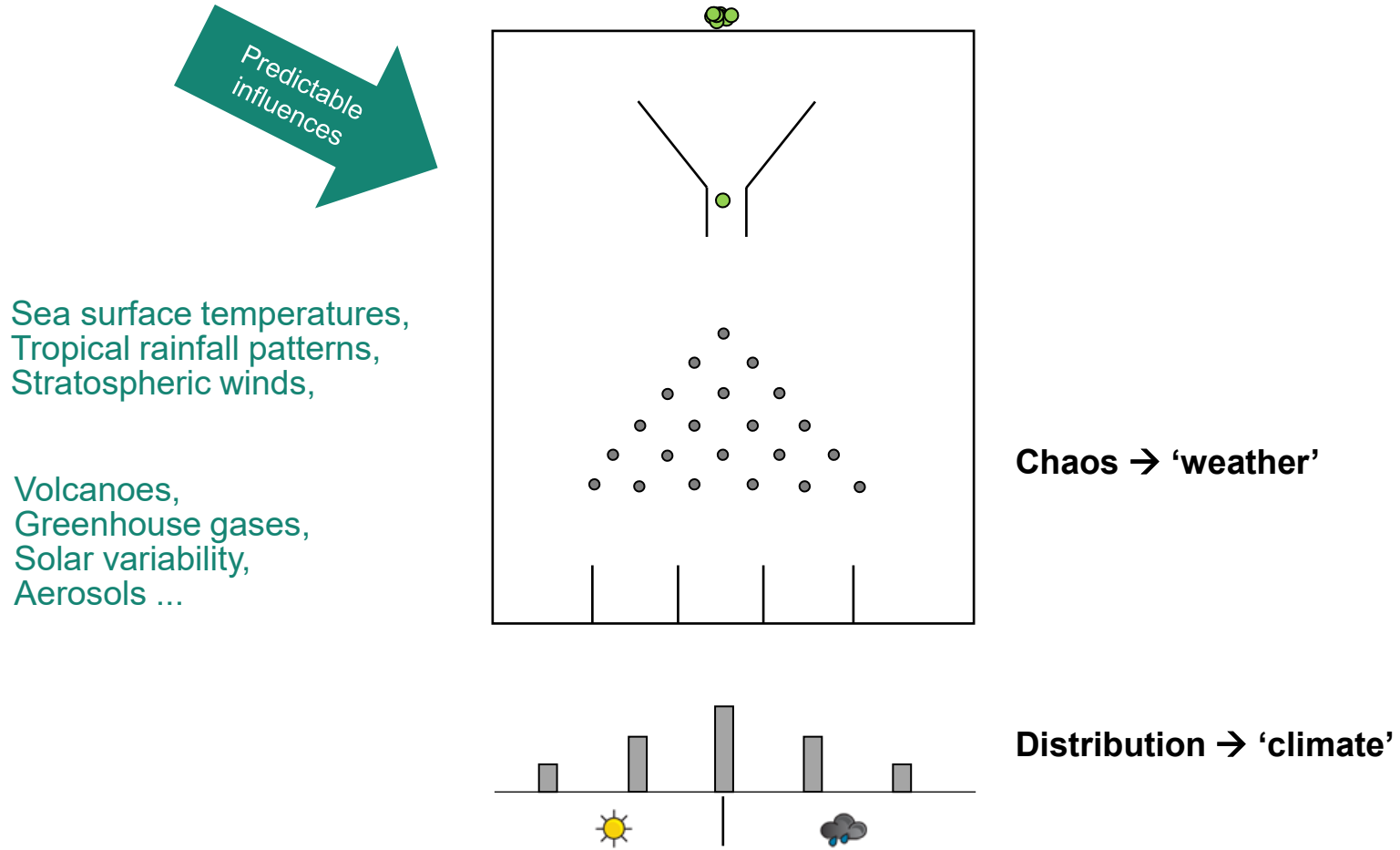
But you can predict the distribution!



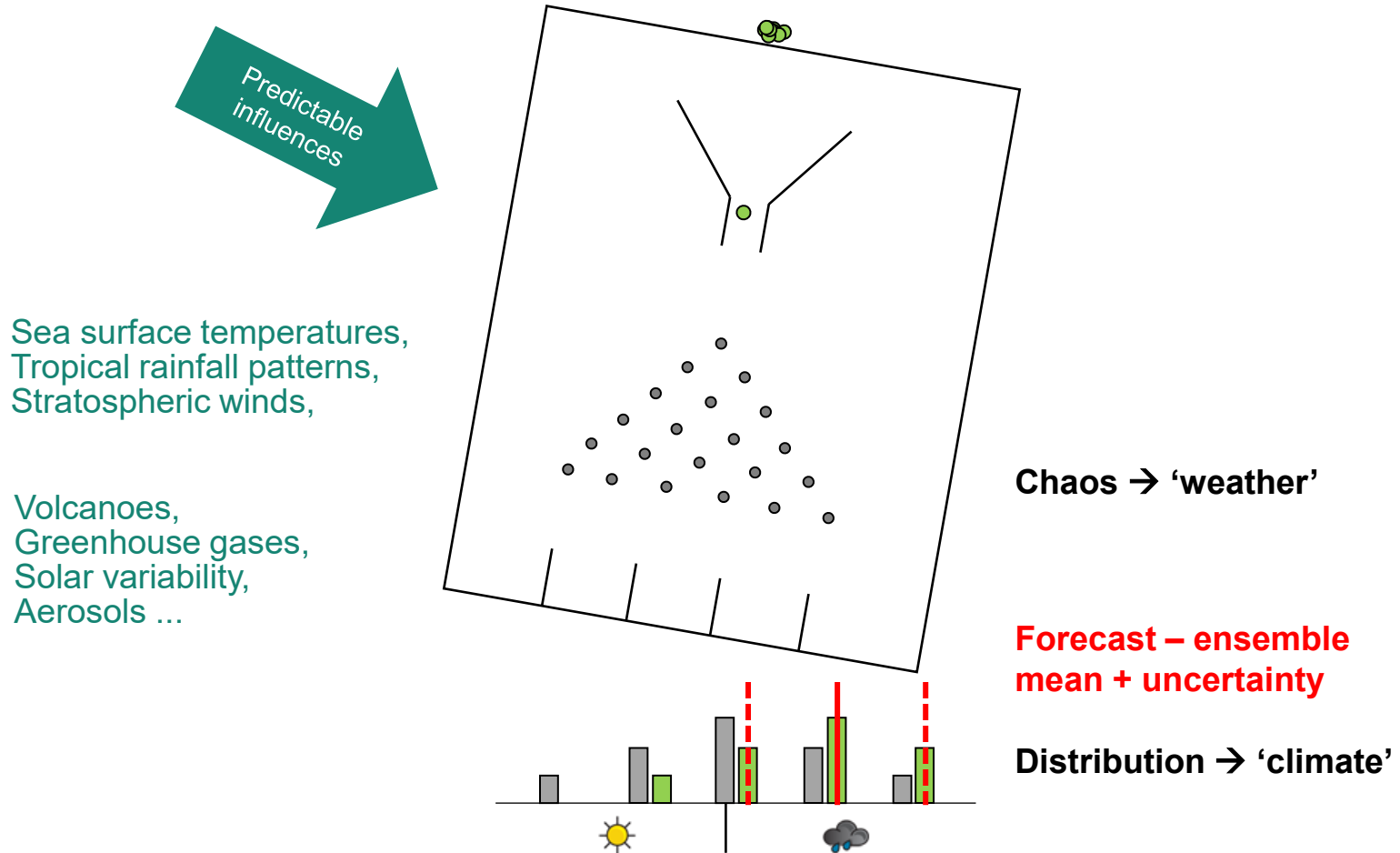
Chaos → 'weather'

Distribution → 'climate'

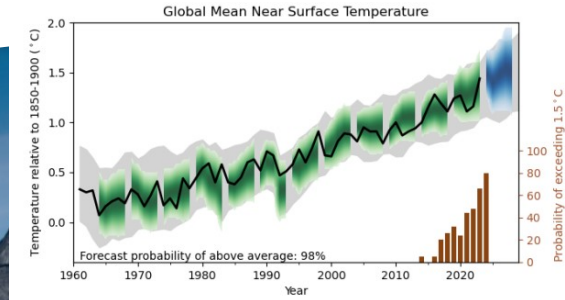
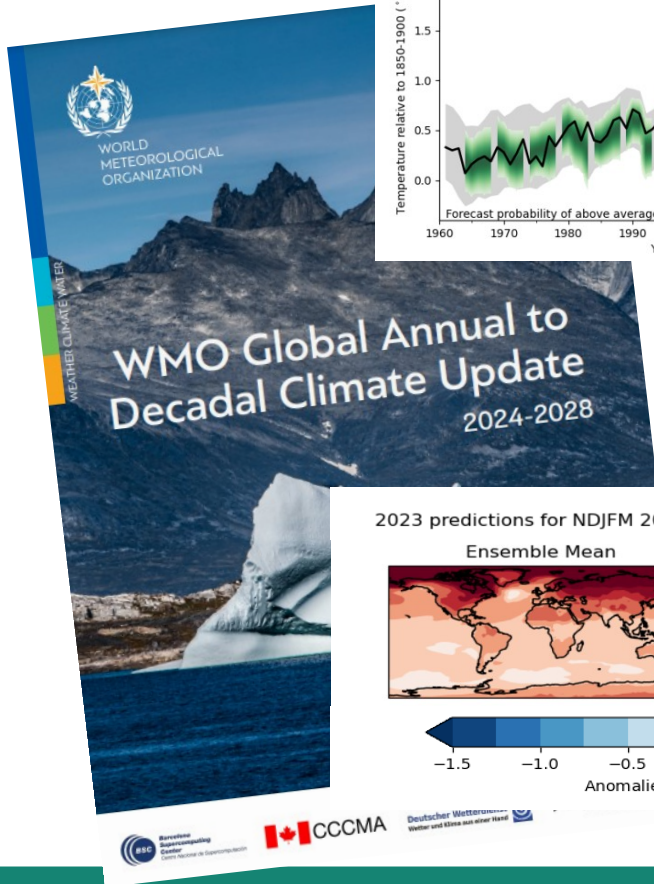
How do decadal forecasts work?



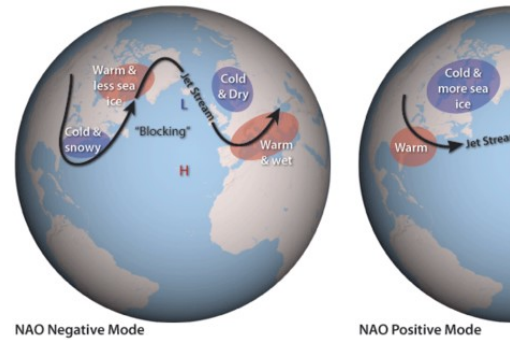
How do decadal forecasts work?



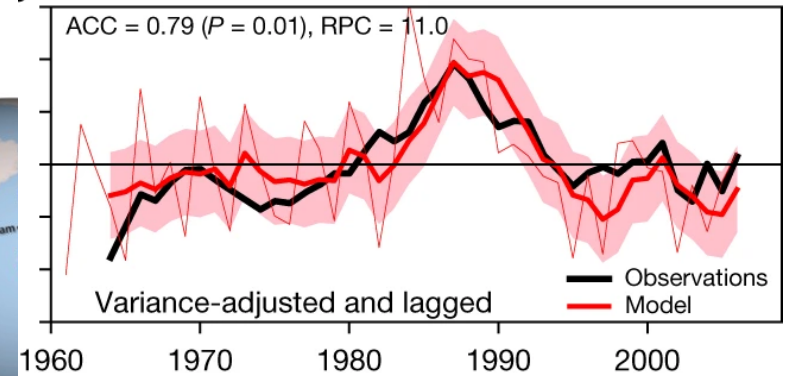
How do we use decadal forecasts?



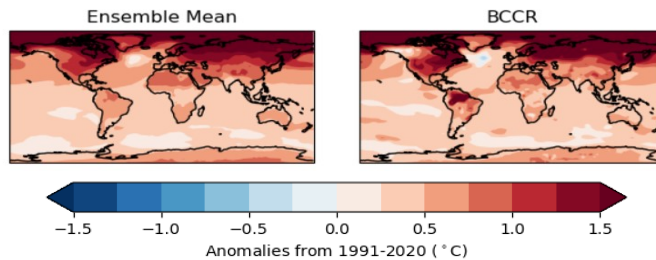
NAO phases



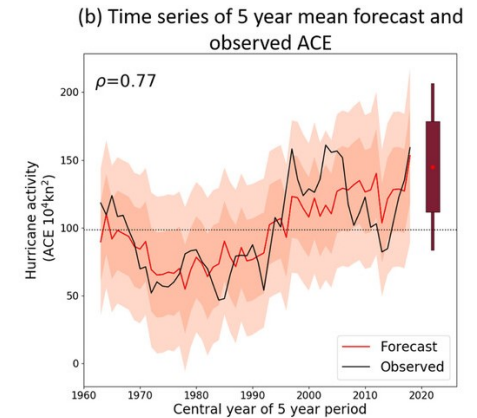
Decadal NAO forecasts



2023 predictions for NDJFM 2024/25-2028/29 near-surface temperature



Decadal hurricane forecasts



How can we use decadal predictions for energy?

Chapter 1: Decadal forecasts for the European energy sector

- What skill is there in decadal forecasts over Europe?
- Can we forecast modelled energy variables?

Chapter 2: Quantifying extreme winters for the UK energy sector

- In terms of electricity supply security:
- What is the most challenging *winter*?
- What is the most challenging *winter day*?

Chapter 3: Quantifying long duration storage for the UK energy sector

- What size of long duration store does the UK need to cope with the most challenging winters?

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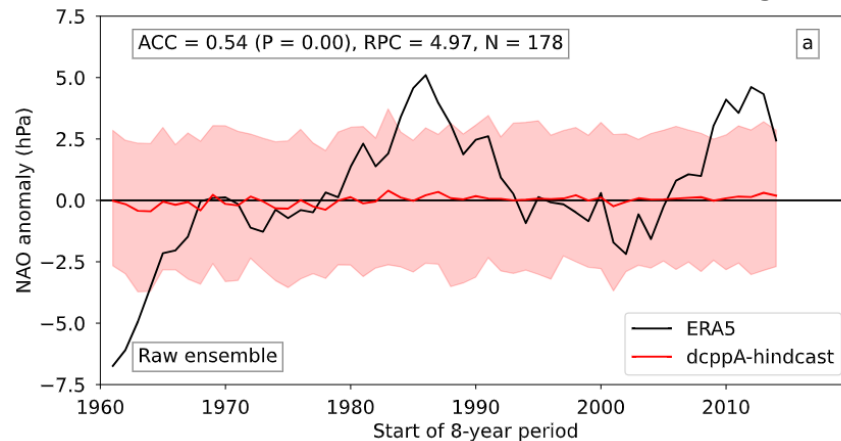
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How much skill is there in decadal predictions?

NAO: forecast years 2-9, ONDJFM

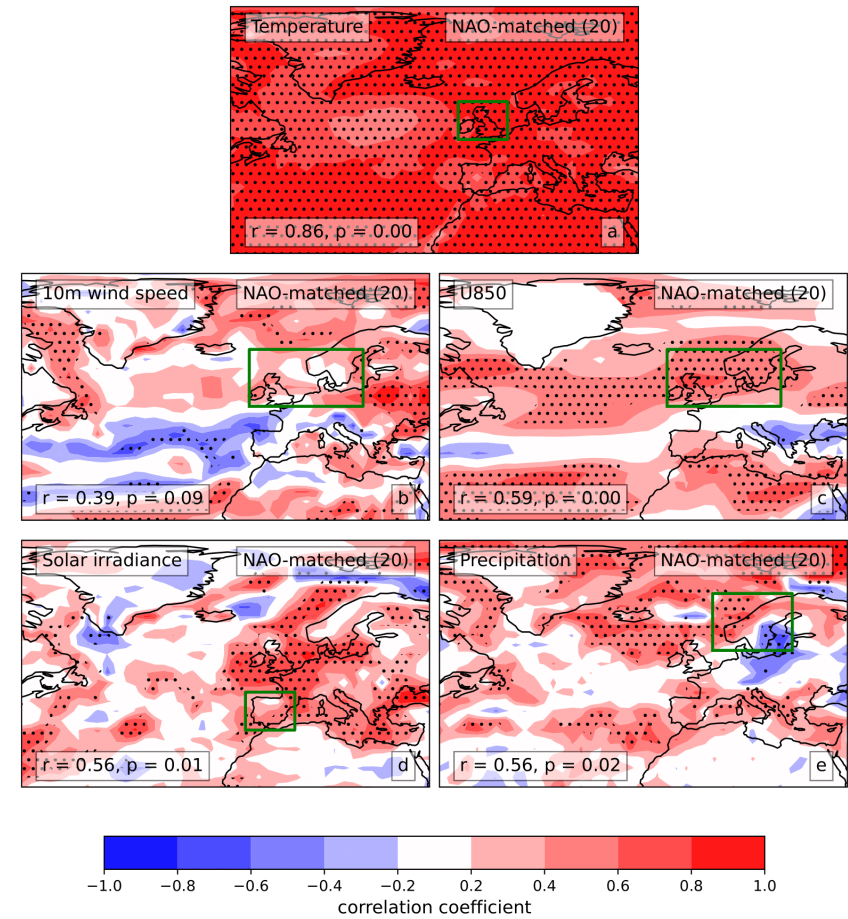
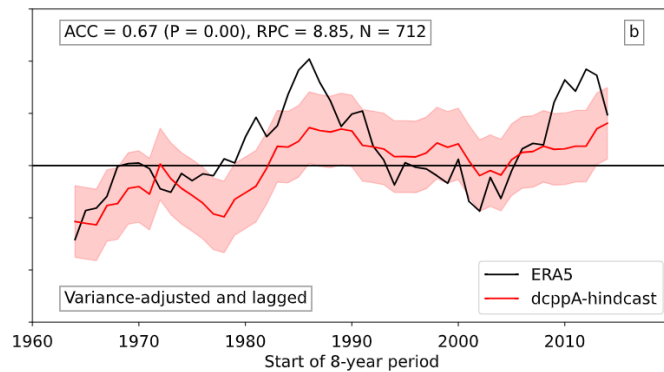


- Multi-model ensemble
 - 12 models, 178 members
- Predicting atmospheric circulation (e.g. NAO)
 - Small predictable signal
 - Lag and adjust via RPS (signal-to-noise)

How much skill is there in decadal predictions?

Forecast years 2-9, ONDJFM, total skill

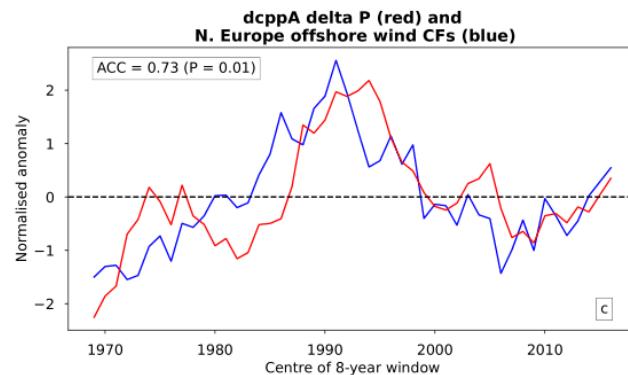
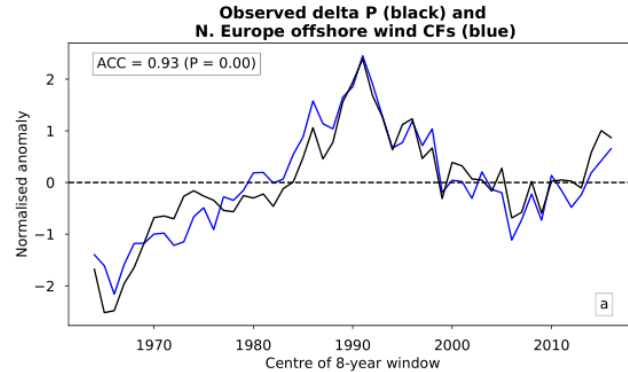
- Surface variables
 - Post-processed by NAO-matching
- Skill for temp., solar, and precip.
- Less skill for 10m wind speed



Can we use decadal forecasts for energy?

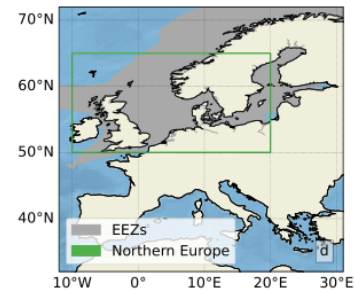
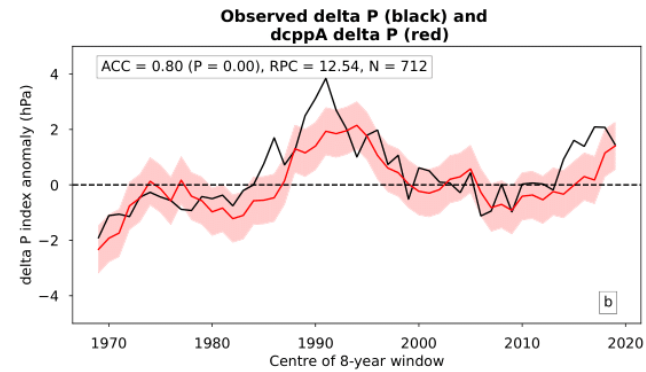
Northern Europe offshore wind capacity factors

Obs. relationship

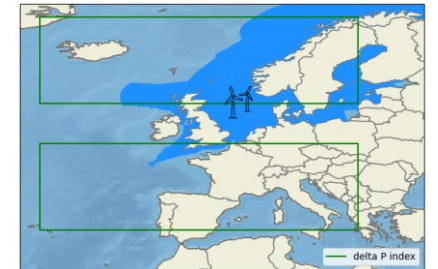


Hindcast as predictor

Hindcast skill



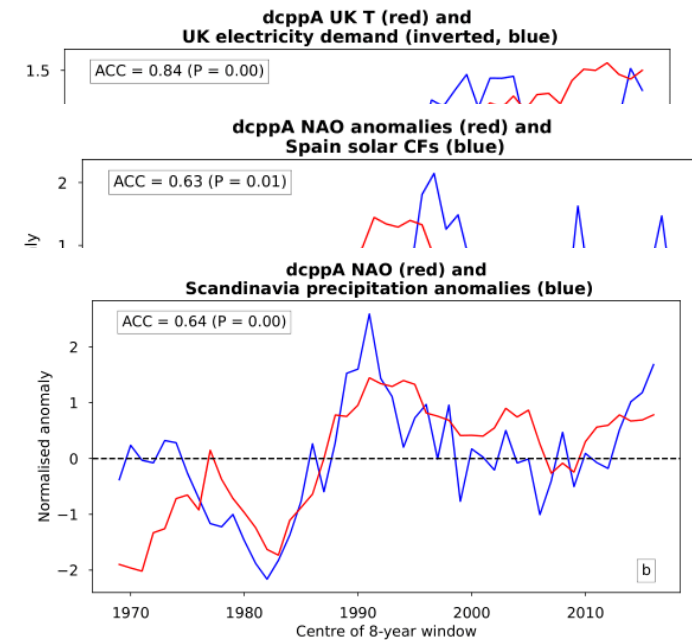
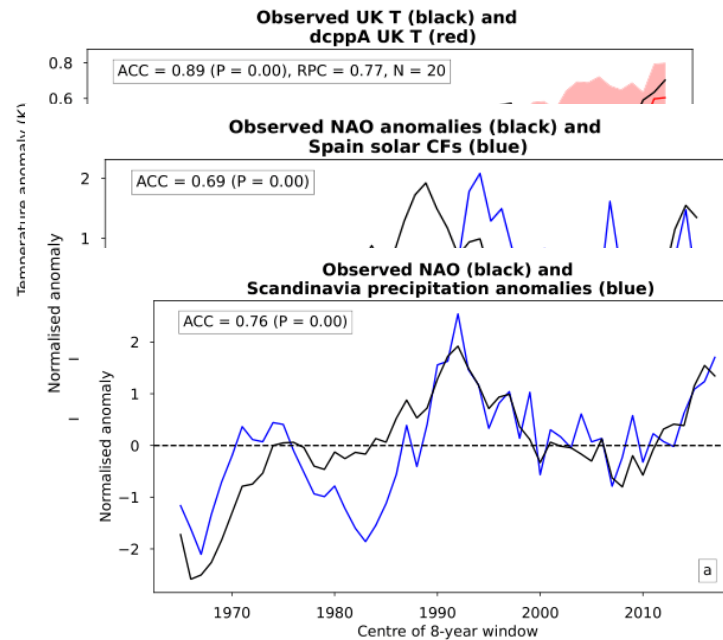
UK North-South pressure difference



Can we use decadal forecasts for energy?

- UK winter electricity demand
- UK mean T as predictor
- Additional case studies:
 - Spain solar capacity factors
 - Scandinavian precipitation

Yes! But challenges in operationalising these forecasts...



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Summary

Decadal predictions can be used to forecast how climate variables (e.g., temperature, NAO) will evolve over the next 10 years.

These predictions can be used for energy variables where they are well correlated with the climate variables (e.g., electricity demand, wind power generation).

As a result, there is potential for skilful decadal forecasts for the energy sector.

Thank you for listening!

Any questions?