Effects of model jet trends on seasonal predictions: a case study of European summer 2022 in ECMWF system 5

Matthew Patterson[1], Daniel J Befort[2], Chris O'Reilly[3] and Antje Weisheimer[1,2,4]

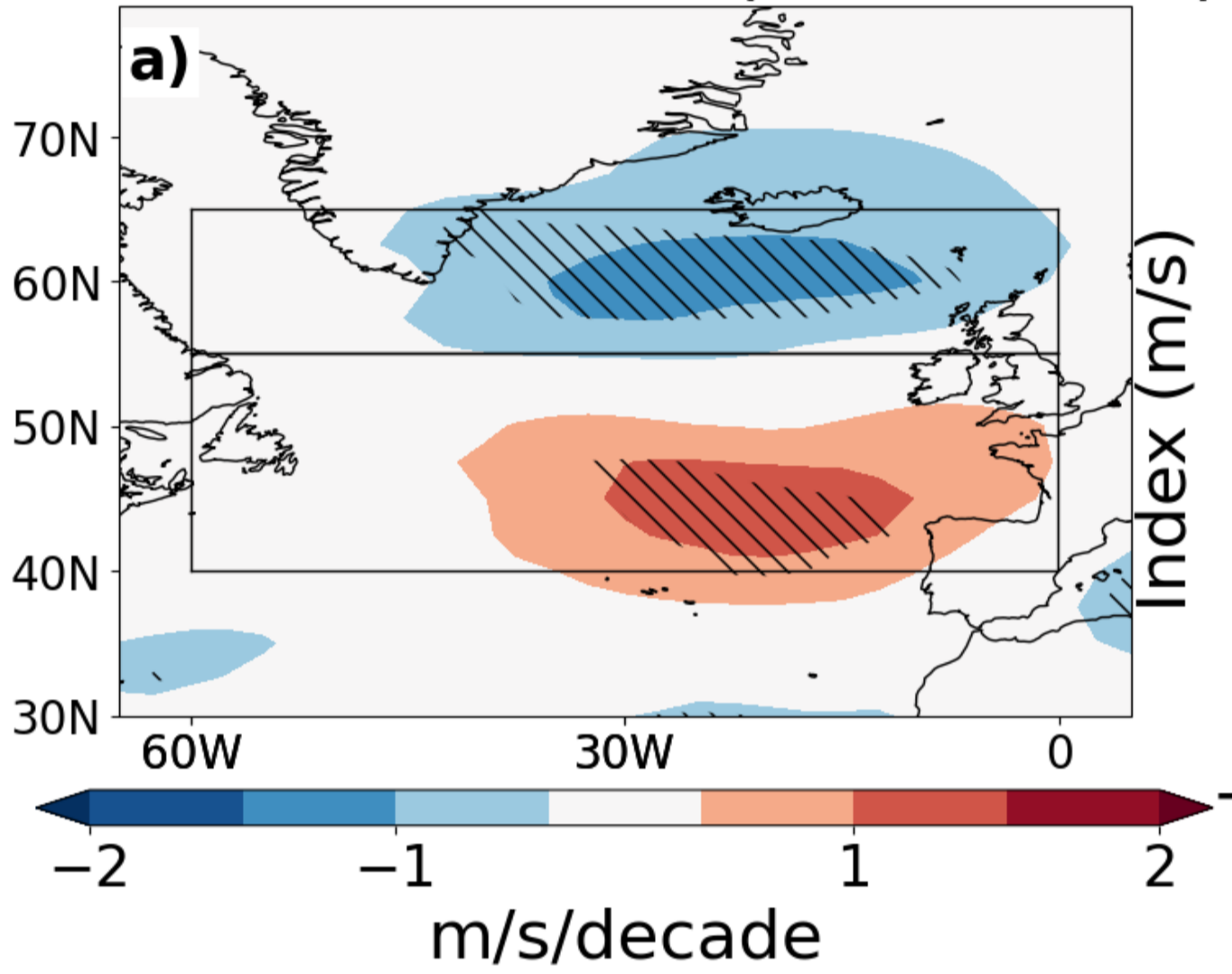*Email - matthew.patterson@physics.ox.ac.uk*

1. Atmospheric, Oceanic and Planetary Physics, University of Oxford; 2. European Centre for Medium-range Weather Forecasts; 3. Dept. of Meteorology, University of Reading 4. National Centre for Atmospheric Science.
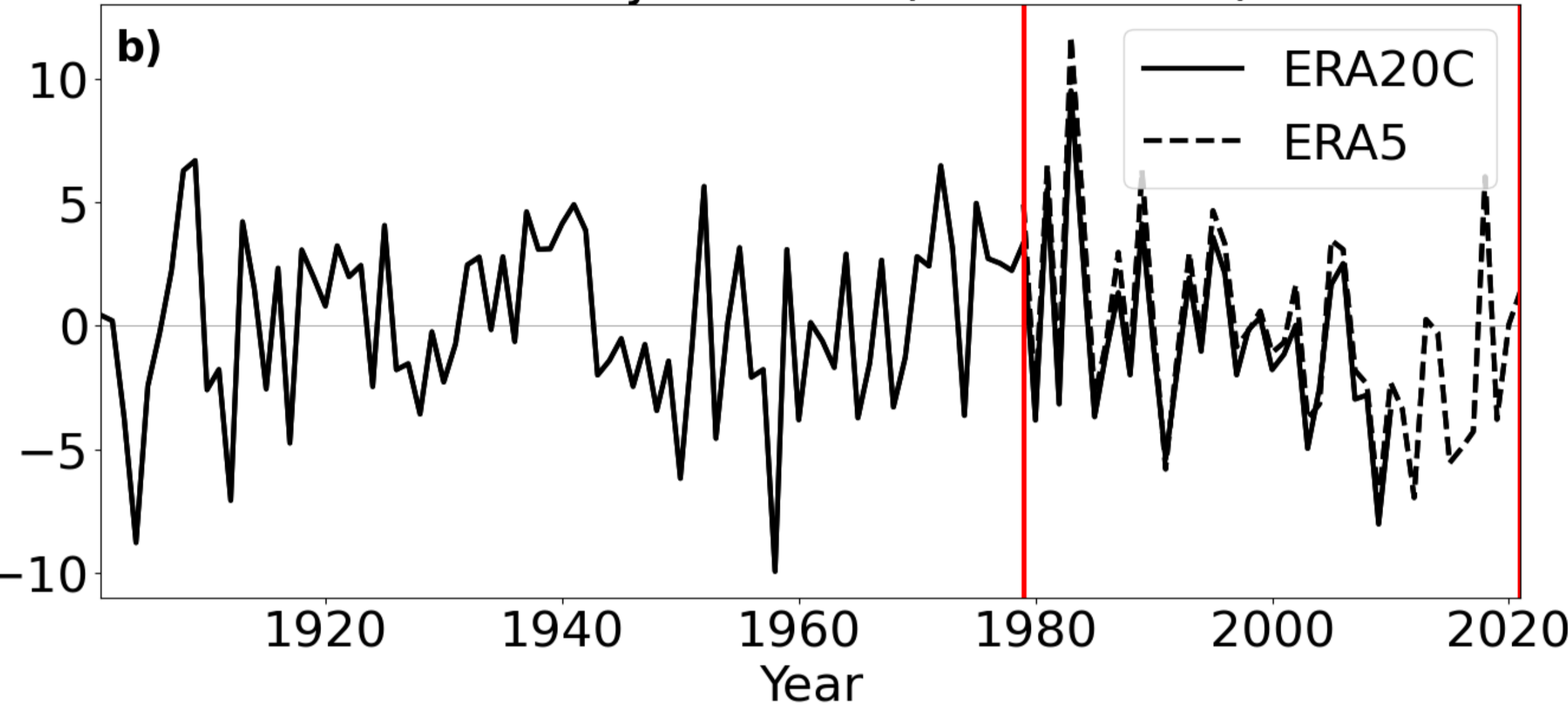
Key points

- North Atlantic atmospheric circulation for the high impact 2022 summer season was well predicted at 2-4 month lead-time by ECMWF system 5 but this likely occurred for the wrong reasons.

- The prediction of a northward jet was largely driven by a greenhouse gas-forced trend in the model, in contrast to the observed southward trend over recent decades.

- This suggests that erroneous model jet trends can have an impact on seasonal predictions.

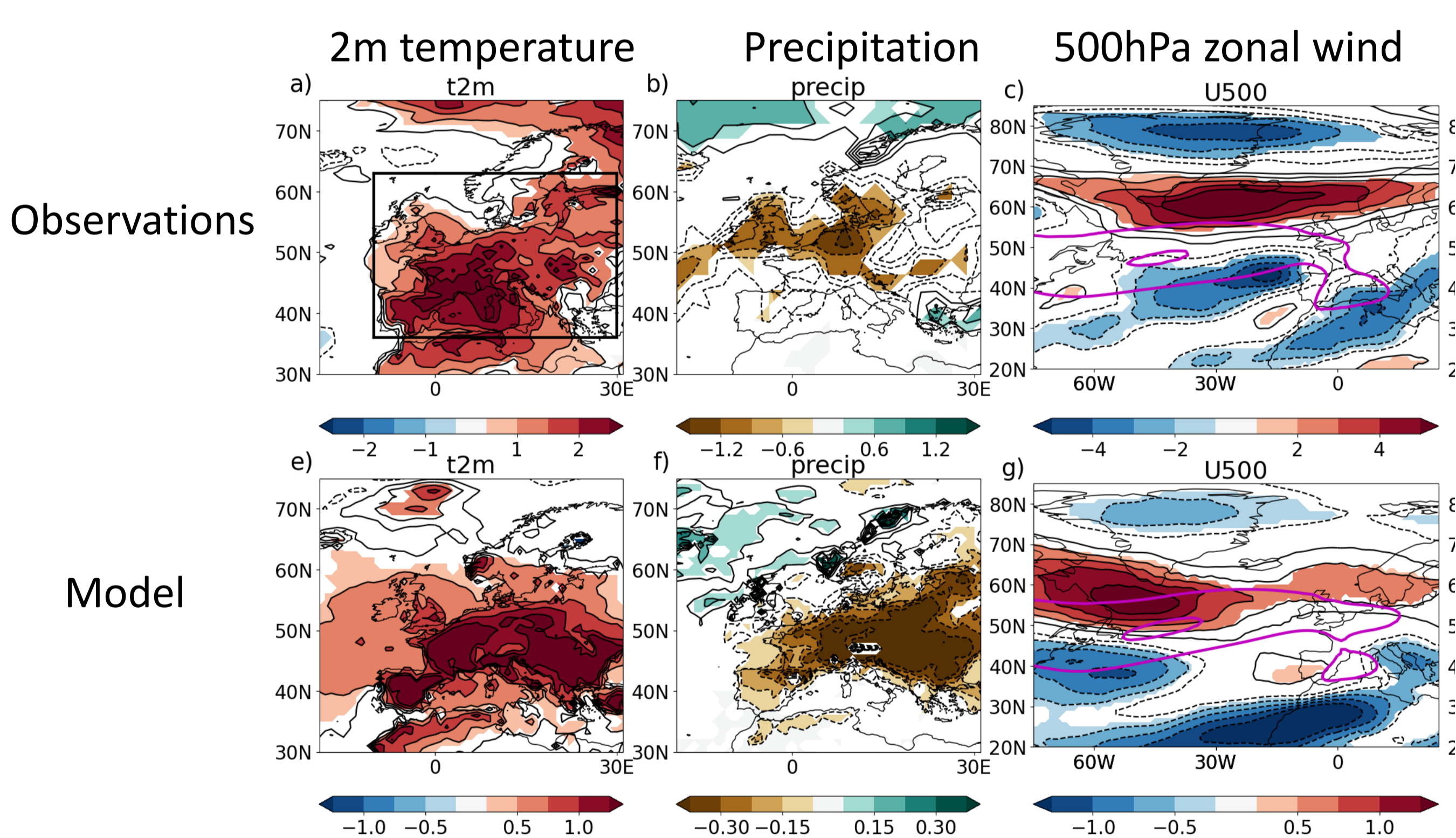## Observed summer jet trend

a) Trends in JJA 250hPa zonal wind in ERA5 (1979-2021) b) variation in a jet latitude index (northern box minus southern box). Positive values indicate a northward jet.

The summer North Atlantic jet has shifted southwards since around 1980.

The drivers are not fully understood and may include greenhouse gases, aerosols and internal variability.

No CMIP6 models capture this trend and most show a northward trend over this period (not shown)
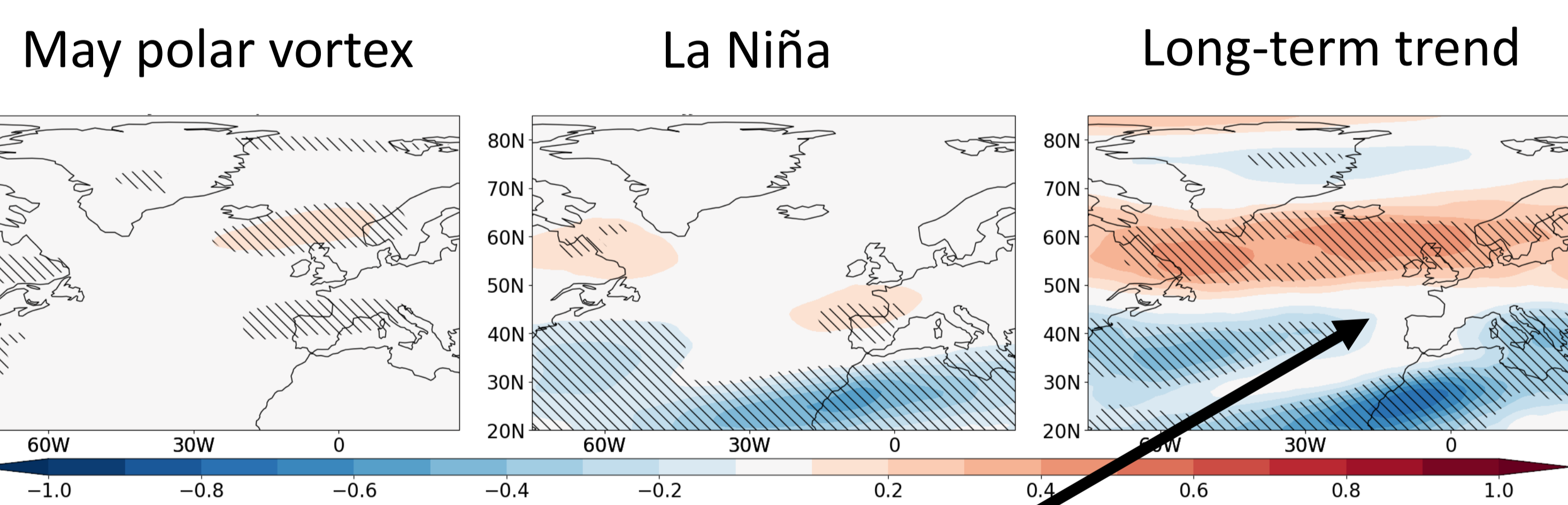
2022 summer was well predicted …

European summer 2022 was characterised by a northward shifted jet, record heat and low rainfall.

… but prediction driven by erroneous trend

Multiple regression analysis of seasonal hindcasts (1981-2021) used to infer the role of different drivers in the 2022 forecast of U500.

Trend dominates the prediction over other drivers like La Niña

Discussion

- The signal of interannual variability from the tropical Pacific and other regions is sufficiently weak for European summer circulation that low-frequency variability and **trends can dominate seasonal predictions**.
- ECMWF system 5, like many CMIP6 models, exhibits a northward jet trend over the historical period, at odds with the observed trend. In system 5, this drives a northward jet prediction for 2022. Consequently, erroneous jet trends are potentially a large source of error in seasonal predictions.
- It is imperative that we **understand the drivers of the observed trend** more fully and examine what processes may be missing from the model in order to improve seasonal predictions for this region.