Wind speeds from global reanalyses.
Intercomparison and validation with met mast data

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Jaume Ramon, Llorenç Lledó, Albert Soret, Pierre-Antoine Bretonnière and Margarida Samsó
Barcelona Supercomputing Center – Centro Nacional de Supercomputación.   *Correspondence: jaume.ramon@bsc.es*

Barcelona Supercomputing Center Centro Nacional de Supercomputación

Abstract

Assessing the accuracy of reanalysis datasets is crucial since they are widely used in the wind power industry for WRA. In this work, we perform a comparison of surface and near-surface wind speeds over Europe from five global reanalyses. After describing the main agreements and discrepancies between them, wind speed data from 25 tall towers in the North Sea area have been used to select the reanalysis product that better represents the observed wind speed characteristics.

Objectives

- Identify main **discrepancies** between 5 global reanalyses.

- **Select** the source that better represents the observed wind speed features.

- **Verify** the newly provided **hub-height winds** from ERA5 and MERRA2 that were requested by the wind industry.

Methods

Multi-model mean climatology (1980-2017)
(ERA5, ERA-Interim, JRA55, MERRA2 & NCEP R1)
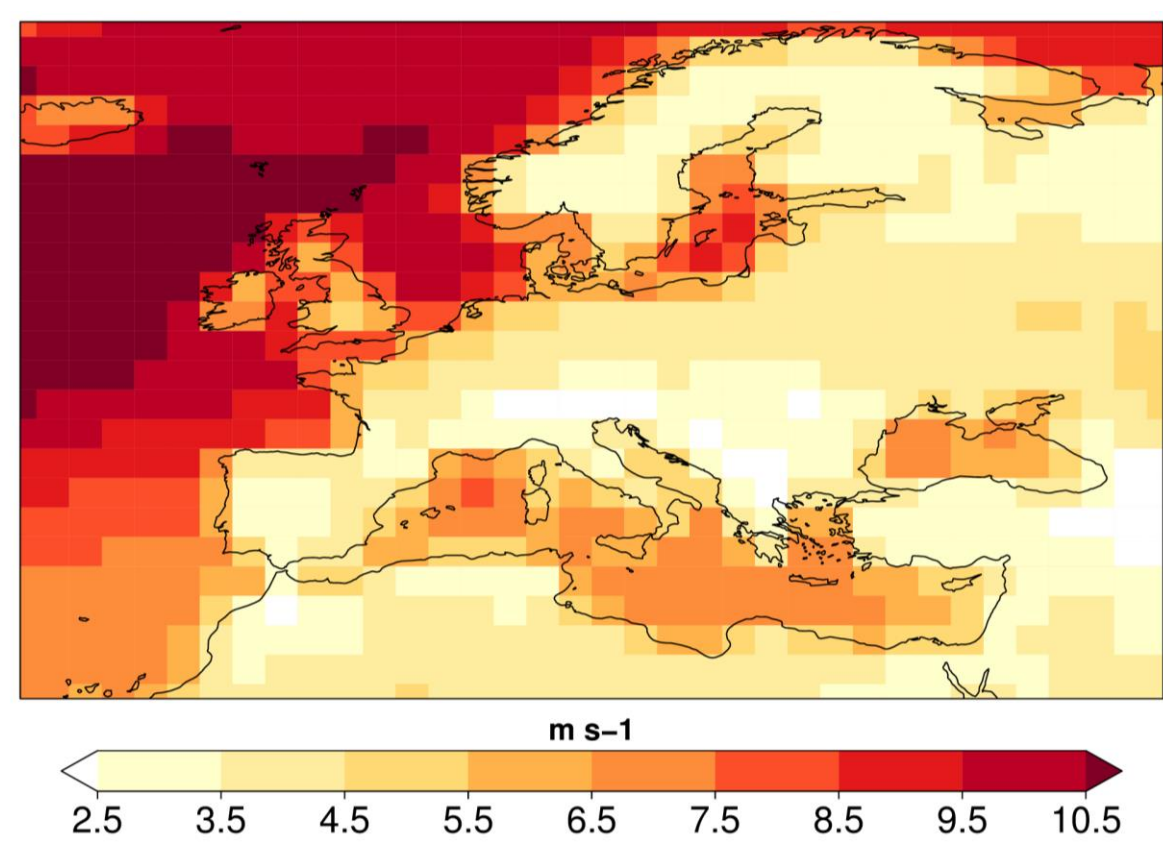
1. Study climatology and interannual variability of 5 reanalyses by computing seasonal averages (DJF-MAM-JJA-SON) in the 1980-2017 period.

   Employ a multimodel approach, studying departures of each reanalysis from the multimodel mean.

2. Verify results with met mast data with at least 3 years of records.

   Reanalysis surface winds are horizontally interpolated (bilinear interp.) and then vertically interpolated to the tower level closest to 100 m (with a power law).
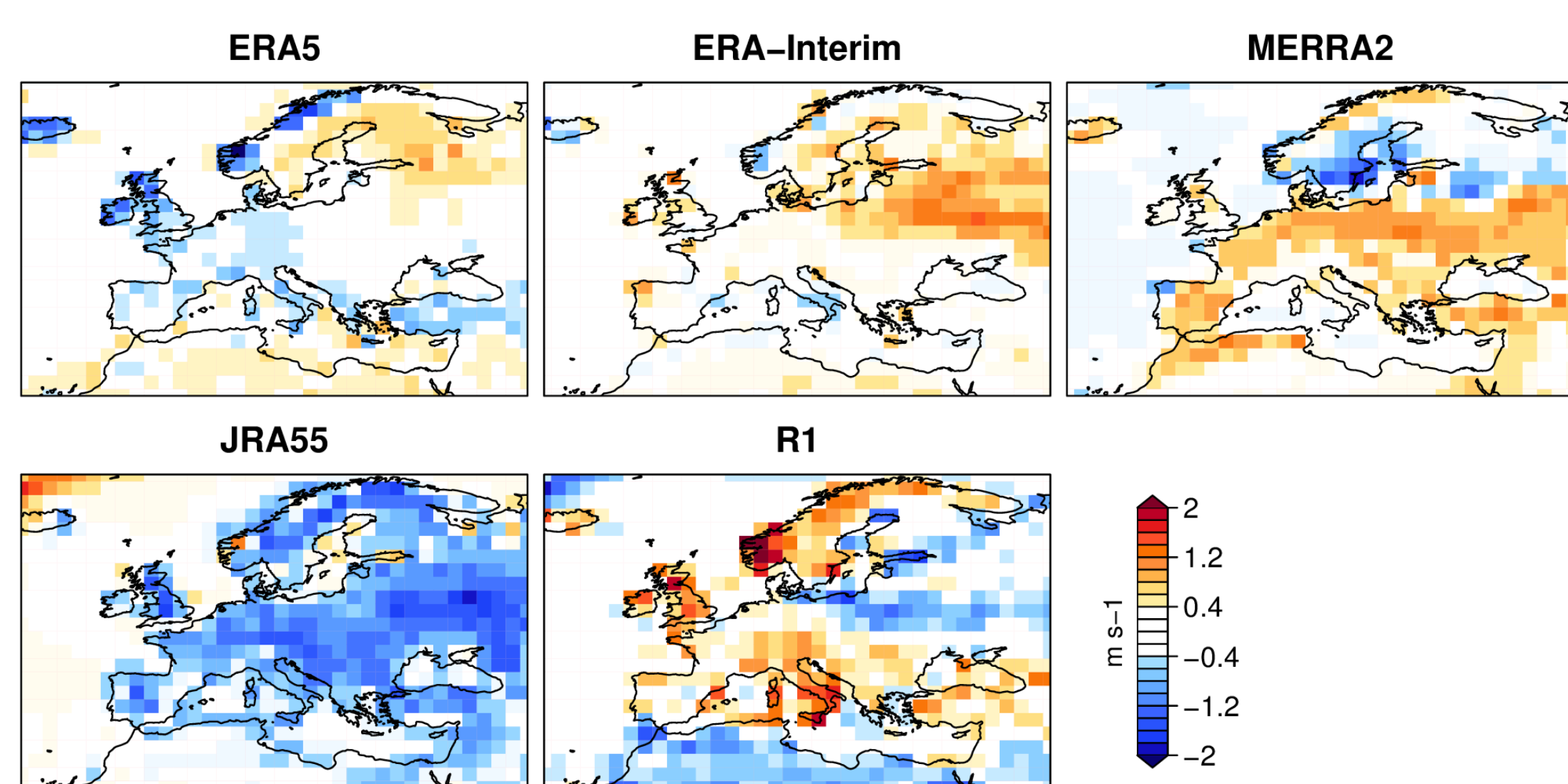
3. The **ERA5 100 m** winds and **MERRA2 50 m** winds have been assessed.
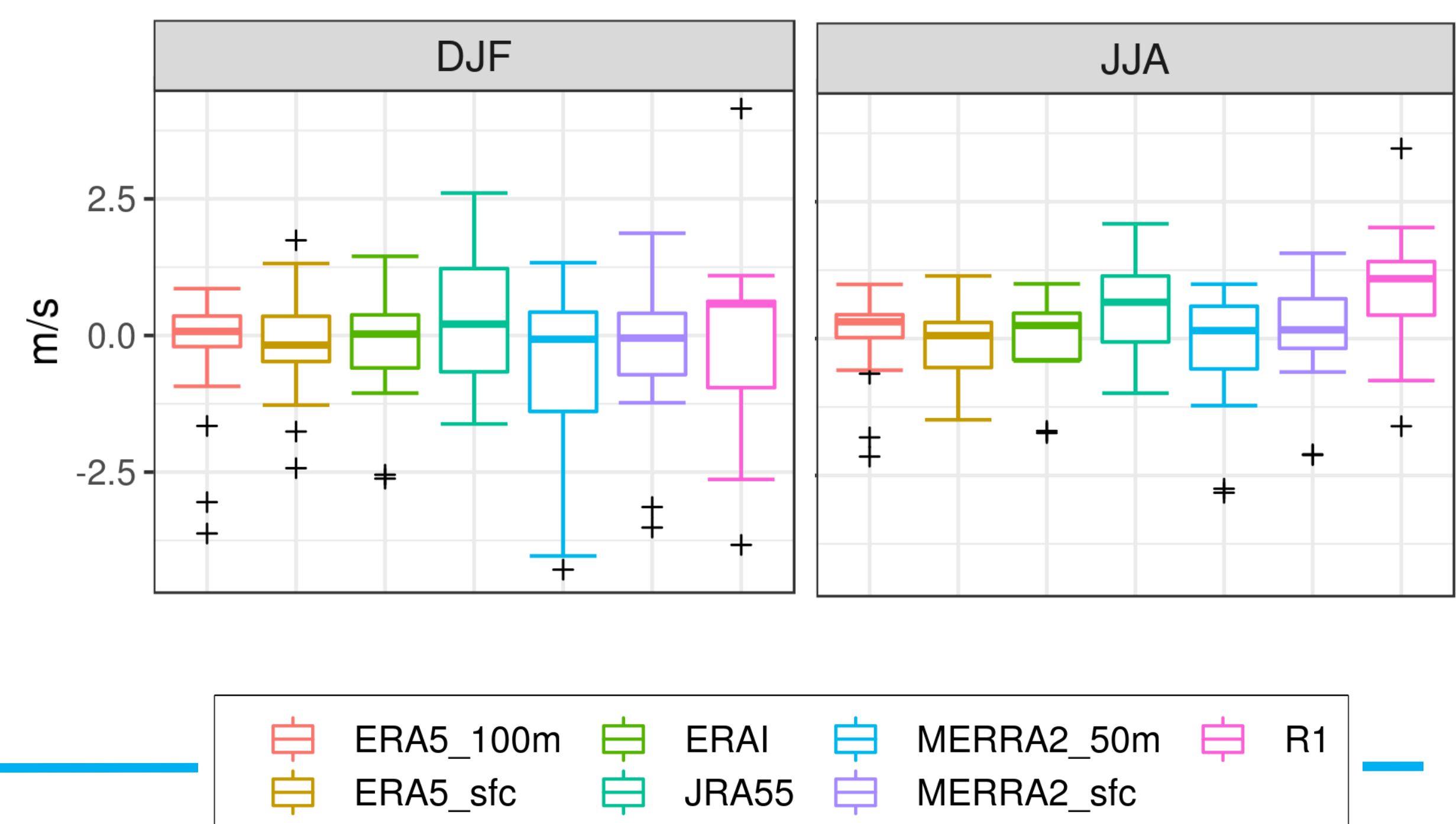
25 met masts around the North Sea
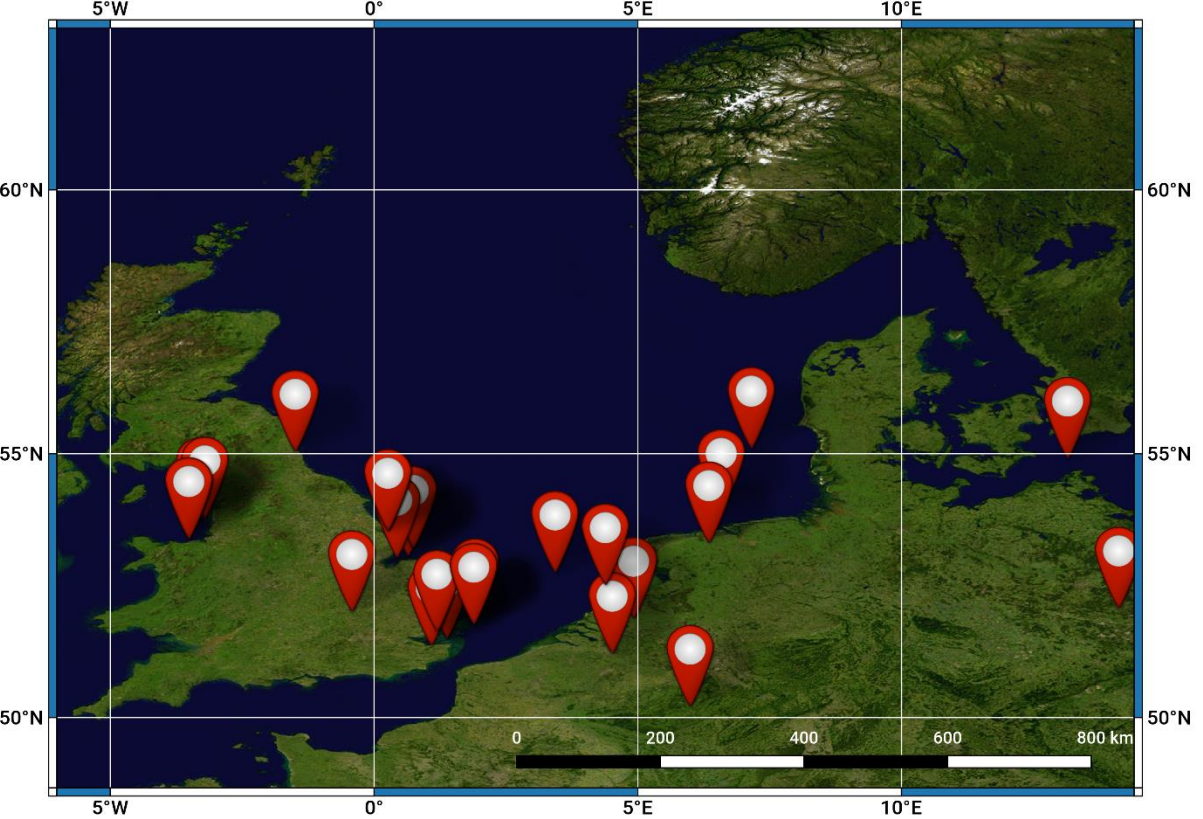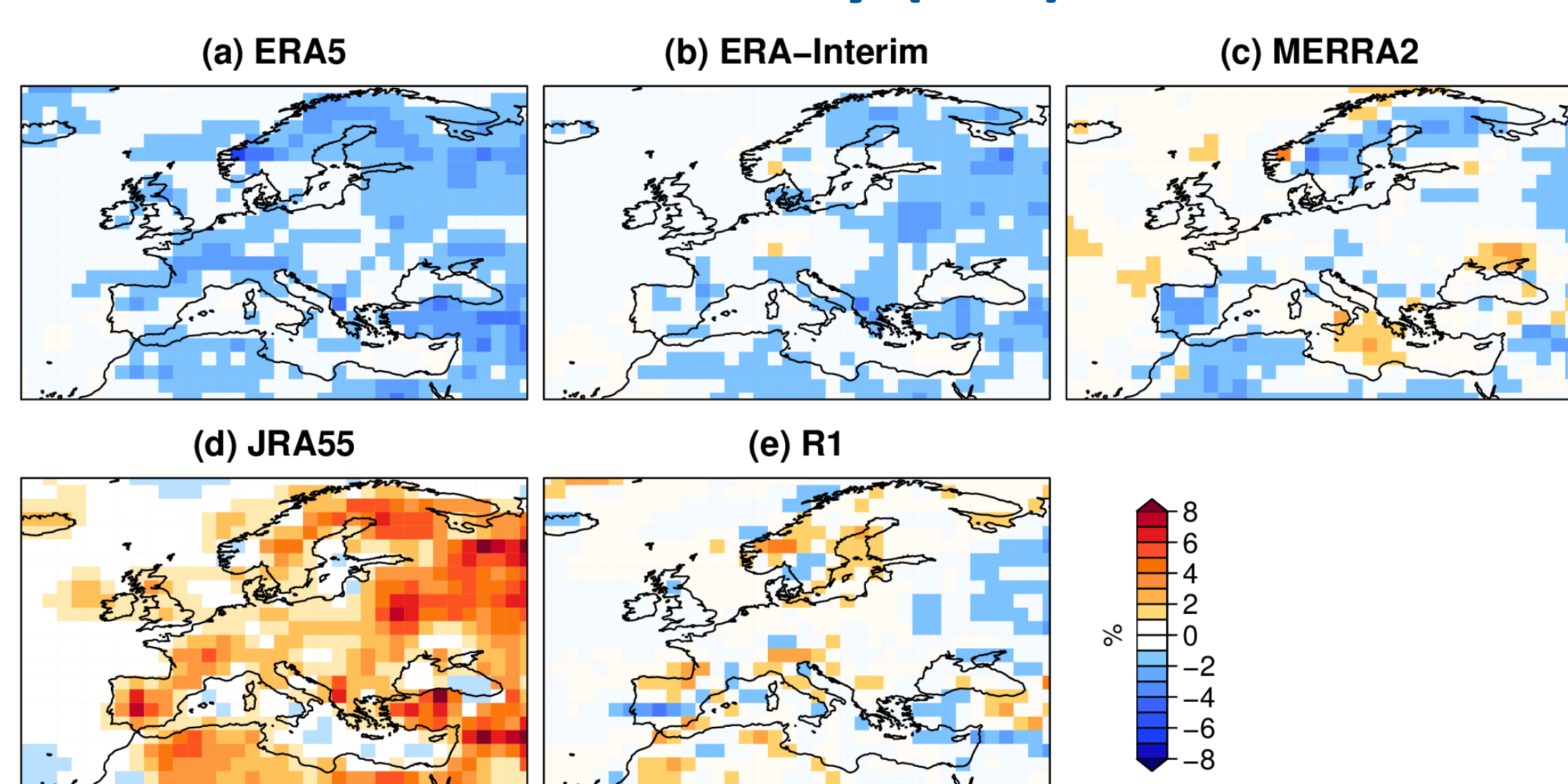

Results

Climatology

- Departures from multi-model mean (←) show a strong disagreement between JRA55 and the other reanalyses.

- The comparison against mast observations (→) reveals that (1) the mean winds are generally underestimated by the reanalyses and (2) ERA5 displays the narrowest range of values.

clim. obs - clim. rean

Legend: ERA5_100m, ERA5_sfc, ERAI, JRA55, MERRA2_50m, MERRA2_sfc, R1

Interannual variability (IAV)*

(a) ERA5 (b) ERA–Interim (c) MERRA2 (d) JRA55 (e) R1

** Normalized by the climatology and presented as a percentage*

- JRA55 shows the highest variability whereas the two European datasets display the lowest values of IAV (←).

- Observed IAVs in the North Sea are well reproduced by all the five reanalyses, specially in winter (→). Both ERA5 and MERRA2 hub height winds provide accurate results in DJF.

IAV obs - IAV rean
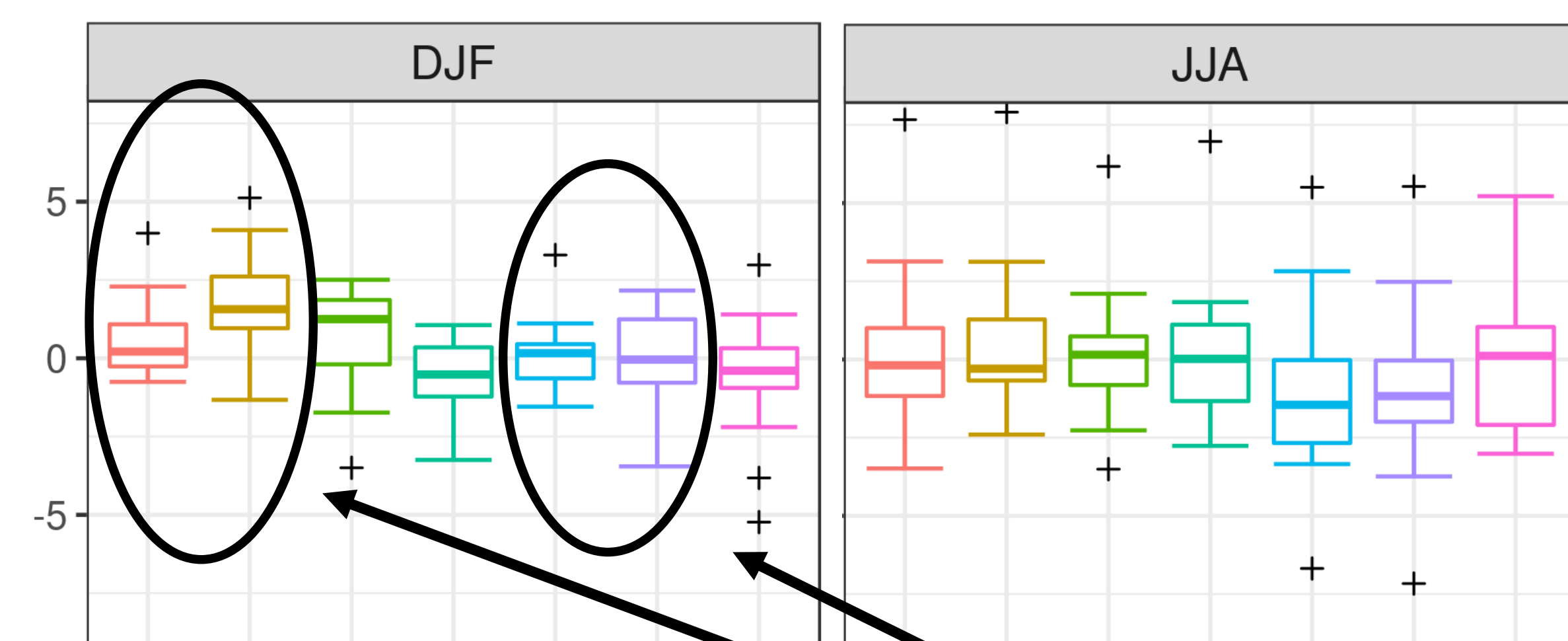
Important differences between IAVs derived from **surface** and **hub height** winds

Correlation of monthly-averaged winds

Legend: ERA5_100m, ERA5_sfc, ERAI, JRA55, MERRA2_50m, MERRA2_sfc, R1
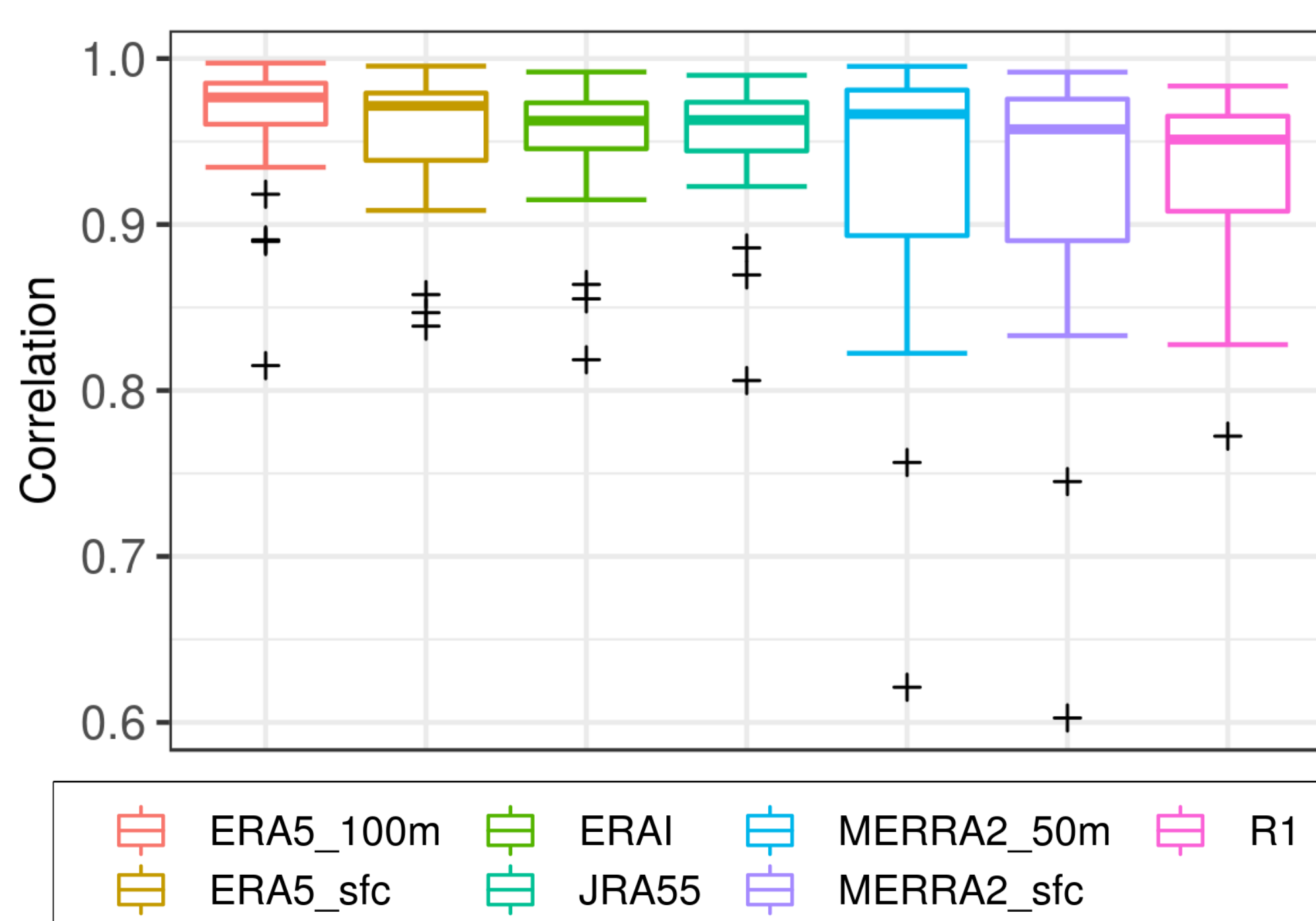
- In terms of correlation of monthly-averaged winds, **ERA5 100 m** winds show the highest correlation. MERRA2 provides poor correlations, similar to R1's (which has the coarsest grid out of the five reanalyses).

Conclusions

- Noticeable **disagreements** in surface wind speeds between reanalyses have been encountered over Europe, specially inland for both mean winds and interannual variability.
- Reanalysis tend to **underestimate** the observed **climatology** and but are able to reproduce the observed **IAV** in the North Sea region.
- ERA5 shows the **highest correlations** with monthly-averaged wind data. In general terms, **hub height** winds provide more accurate results than **surface** winds, specially for the computation of the IAV.

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