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Characterization of Mediterranean large-scale atmospheric circulation based on Jenkinson-Collison Weather Type classification.

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1. INTRODUCTION

- The **European climate is affected by** large-scale anomalous situations operating at multiple scales (Soares et al., 2018), such as teleconnection indices (i.e. **NAO, SCAND or EA**) or **atmospheric blocking** situations.
- The **evaluation of** new generations of global climate models (**GCMs) with respect to their large-scale circulation** features **is crucial** for model development and has also been brought into focus by the downscaling community, interested in the suitability of GCMs for downscaling purposes.
- Weather typing techniques are a useful tool to classify the full diversity of synoptic situations into a few recurrent patterns that can serve as objective characterizations of either global or regional atmospheric circulation. A well-known weather typing classification algorithm is the **Jenkinson-Collison Weather Type** (JC-WT, Jenkinson and Collison, 1977) approach.
- We assess the **ability of the JC-WT** classification **to characterize** the low-level spatiotemporal signature of the **large-scale major modes of atmospheric variability** relevant for Europe, and its seasonal variation.

2. METHODS AND DATA

- **Jenkinson-Collison Weather Type (JC-WT):** 6-hourly catalogue derived from ERA-Interim reanalysis, openly available on Zenodo (Fernández-Granja et al., 2021). We considered the latitudinal band 20ºN - 80ºN, 1979-2005 (Fig. 1)
- **Blocking Index (BI):** Jury et al. (2019). Calculated using Z500 from ERA-Interim, 1981-2005. 3 different BI series, one for each region (ATL, EUR and RUS, see "purple" polygons from Fig. 2a).
- **Teleconnection indices North Atlantic Oscillation (NAO), Scandinavian pattern (SCAND) and East Atlantic pattern (EA)**: Derived from Z500, 1979-2005. Monthly series for the main teleconnection indices affecting Europe retrieved from the NOAA Climate Prediction Center (https://www.cpc.ncep.noaa.gov/data/teledoc/telecontents.shtml).

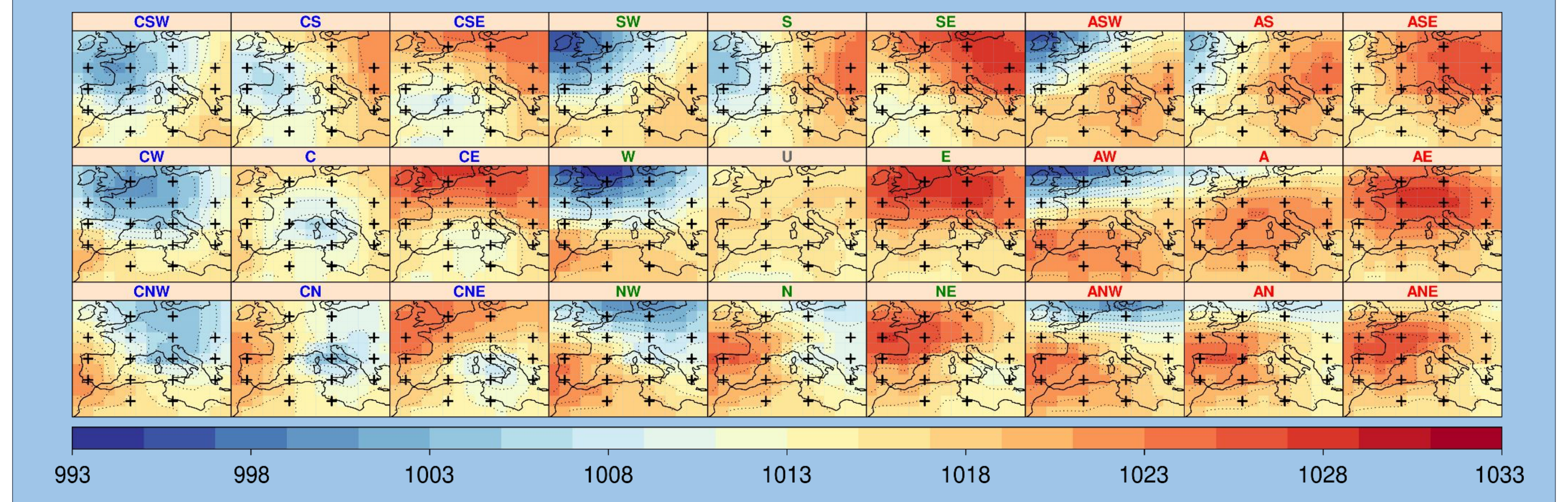

Fig. 1: Composite SLP maps (hPa) and isobars for the different JC-WTs for a classification centered over south-western Europe (40ºN, 10ºW).

3. RESULTS

JC-WT with the most frequent type at a given grid-box of the Northern Hemisphere conditioned on blocking events (Fig. 2a):

- Purely anticyclonic (A) type is most frequent at the blocking centre (see "purple" polygons) in all cases (ATL, EUR and RUS) of blocking conditioning.
- A zonal circumpolar belt is located at mid-to-high latitudes over the continents and shifting southward to the sub-tropics over the ocean areas.
- Frequency of annual A type conditioned on the different blocking situations increases to 32, 38 and 38% of days for ATL, EUR and RUS, respectively, from marginal frequencies (all around 14-20% of days, not shown). Seasonal relative frequencies of A and C types under normal and blocking conditions are compared in Fig. 3. It can be observed an increase in A type seasonal frequency and a decrease in C type seasonal frequency.
- White hatched pixels exhibit frequencies that are not significantly different from the "not conditioned" frequency after two-sided Z-test of proportions with a confidence level of 95 %.

JC-WT yielding the highest positive Pearson correlation coefficient with the NAO, SCAND and EA (Fig. 2b):

- JC-WT classification exhibits a remarkable sensitivity to the typical dipole structure of NAO and SCAND patterns and the EA monopole west of the British Isles with extended opposite anomalies over subtropical areas.
- In general, typical global patterns and links of the three teleconnection indices are captured by the JC-WT, in addition to some previously undocumented relationships, i.e. an association between cyclonic circulation types in the western Sahara desert and the SCAND index (active in DJF and JJA), or a dipole of cyclonic types in the Bering and Arctic Seas, contrasted by anticyclonic types in the subtropical central North Pacific (active in JJA).
- Seasonal teleconnection patterns shifts are also captured by the JC-WT.
- White hatching hides grid points with non-significant correlation for a confidence level of 95%.

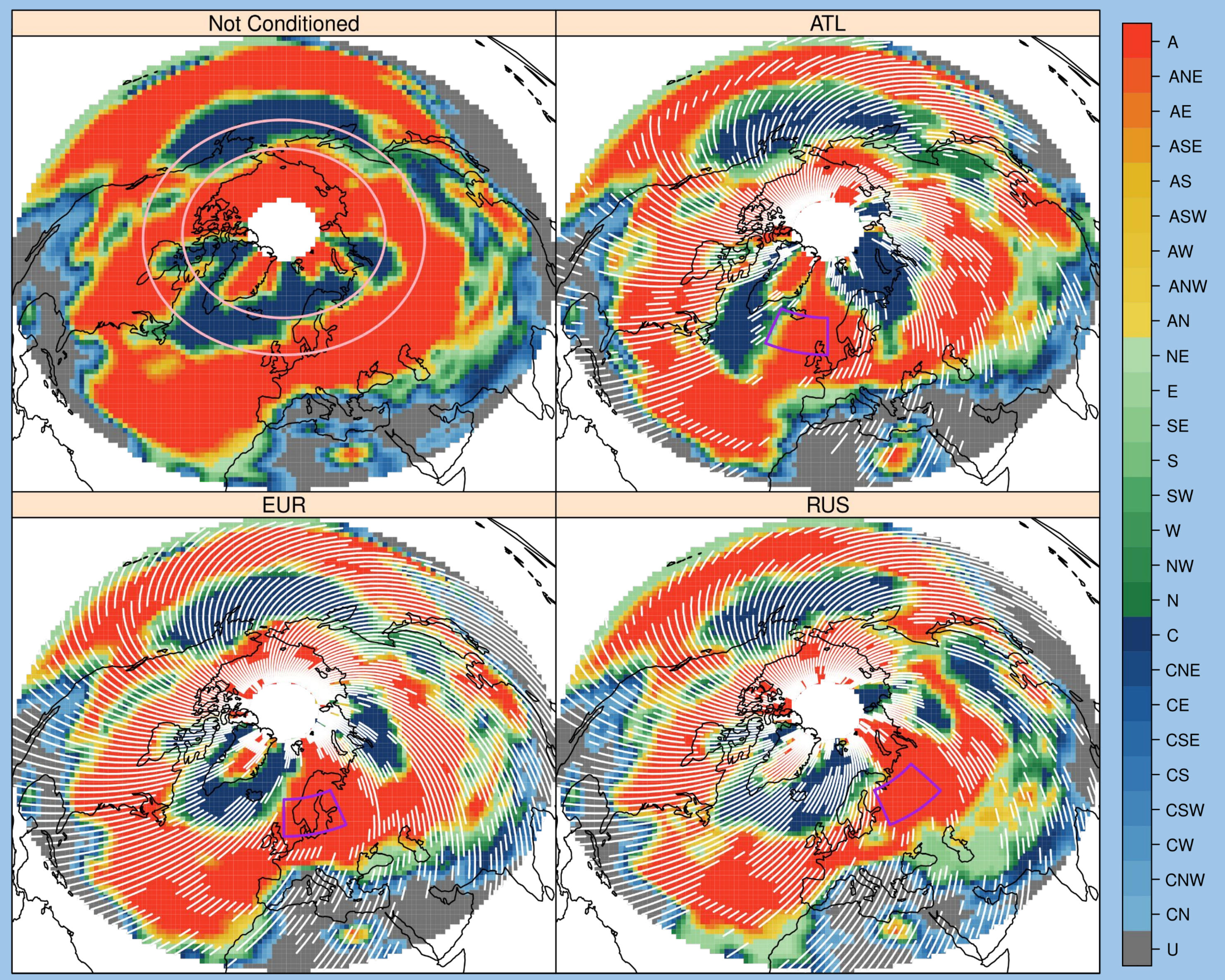

Fig. 2a: Sensitivity of JC-WT classification to blocking events.

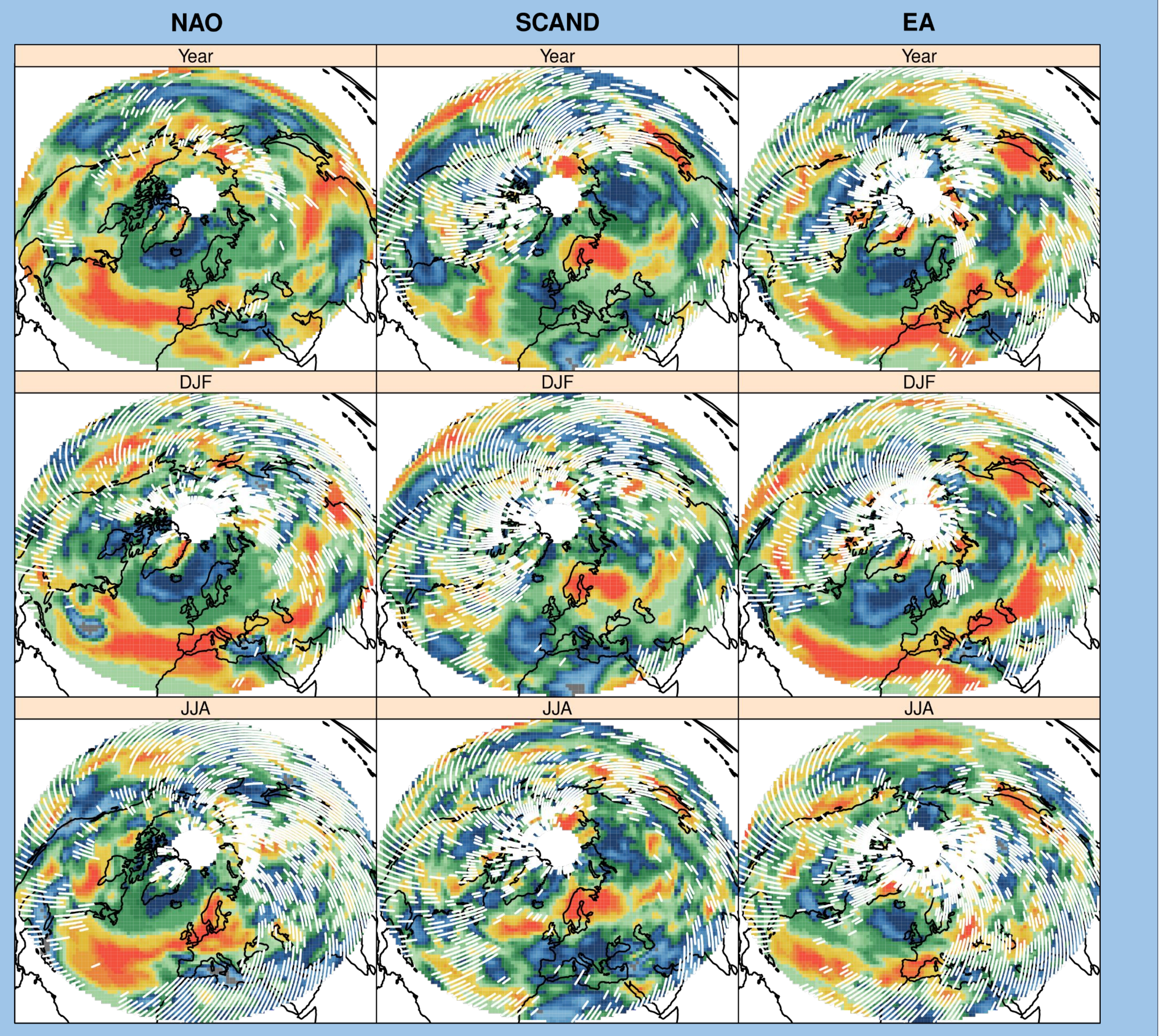

Fig. 2b: Sensitivity of JC-WT classification to teleconnection patterns.

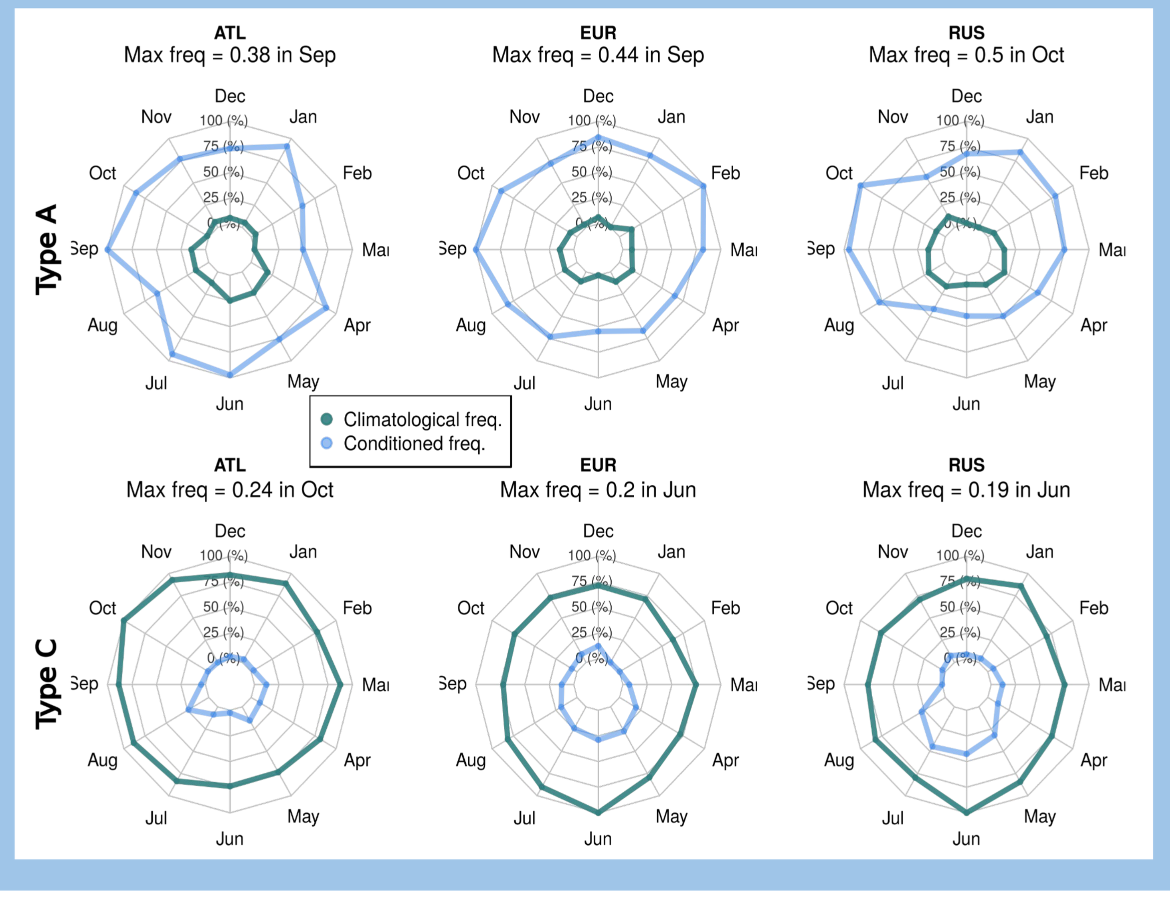

Fig. 3: Unconditioned monthly frequencies (green line) of circulation types A (purely anticyclonic, upper row) and C (purely cyclonic, lower row) as compared to their blocking-conditioned frequencies (blue line) for ATL, EUR and RUS subdomains (left, center and right columns respectively). Frequencies calculated for the period 1981-2005. Frequencies are relative to the maximum in each panel, indicated in the corresponding titles.

4. CONCLUSIONS

- Our findings underline the **potential of the JC-WT classification in detecting** the imprint of **the main modes of atmospheric** low-frequency **variability** on the regional near-surface circulation.
- **JC-WTs significantly correlate with** the monthly-averaged **main modes** of low-frequency variability (which have their imprint on the geopotential in the mid-troposphere) **and capture** a dedicated **blocking index.**
- **JC-WTs** reproduces well known teleconnection areas, and, to the authors' knowledge, it also **reveals some previously undocumented relationships**.
- For each large-scale configuration, a **spatially and temporally** coherent regional **signature is obtained in the form of** easily interpretable **types**.

5. REFERENCES AND ACKNOWLEDGEMENTS

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