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A WORLDWIDE ASSESSMENT OF THE JENKINSON-COLLISON ATMOSPHERIC CIRCULATION CLASSIFICATION AND OBSERVATIONAL UNCERTAINTY BASED ON DIFFERENT REANALYSIS

Juan Antonio Fernández-Granja[1], Swen Brands[2], Joaquín Bedia[1], Ana Casanueva[1] and Jesús Fernández[1]

Contact: juan.fernandez@unican.es

[1]Santander Meteorology Group, Instituto de Física de Cantabria (IFCA), Universidad de Cantabria-CSIC, 39005, Santander, Spain

[2]MeteoGalicia, Consellería de Medio Ambiente, Territorio y Vivienda, Xunta de Galicia, Santiago de Compostela, Spain.

AIM OF THE STUDY

- **Adapt the Jenkinson-Collison (1977) Weather types (JC-WTs) classification in order to apply it in the entire world.** That will allow us to:
  1. Explore the **limits of applicability** of the method.
  2. Perform a **global observational uncertainty analysis.**

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DATA

- 5 reanalysis products to work as pseudo-observations: ERA5, ERA-Interim, ERA-20C, NCEP reanalysis 1 and JRA-55
- Years: 1979-2005
- Variable: SLP (sea-level pressure)

METHODS

- **JC-WTs: automated equations from the Lamb WTs** [Lamb, 1972] → 27 circulation types
  1 JC-WT classification per grid-box → The cross formed by 16 SLP points is moved
- **Evaluation measures** in the global analysis per grid-box:
  1. **JC-WTs suitability**
     a) Number of types found
     b) Frequency of Unclassified type → barometric swamp
  2. **Observational Uncertainty:** one **Transition probability matrix score** (TPMS) value per grid-box

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Distribution of the 16 points forming a "cross" and used in the calculation of the JC-WTs for every grid-box from the globe. The cross is displaced.

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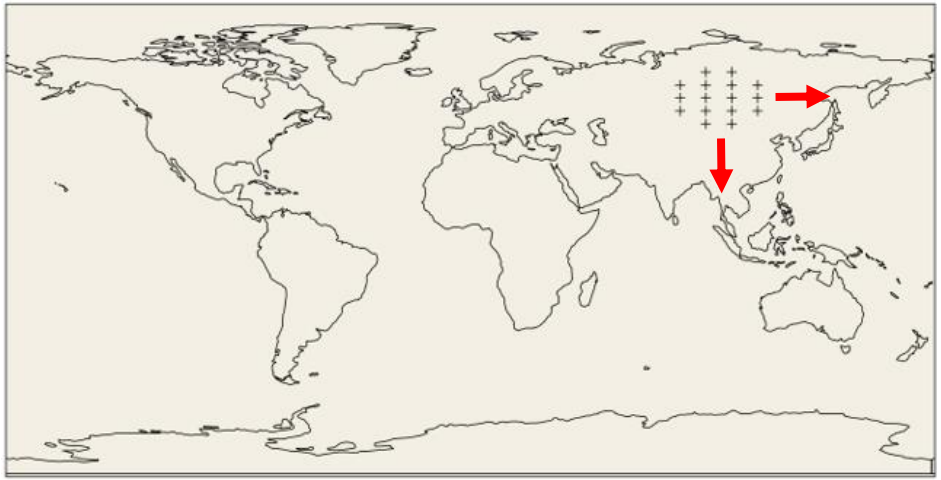
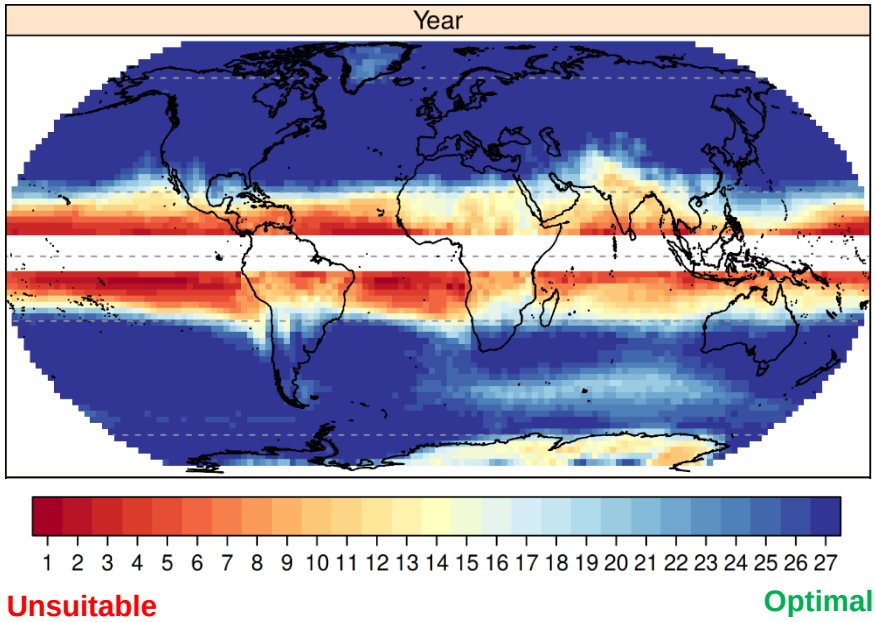


Distribution of the 16 points forming a "cross" and used in the calculation of the JC-WTs for every grid-box from the globe. The cross is displaced.

RELEVANT RESULTS:

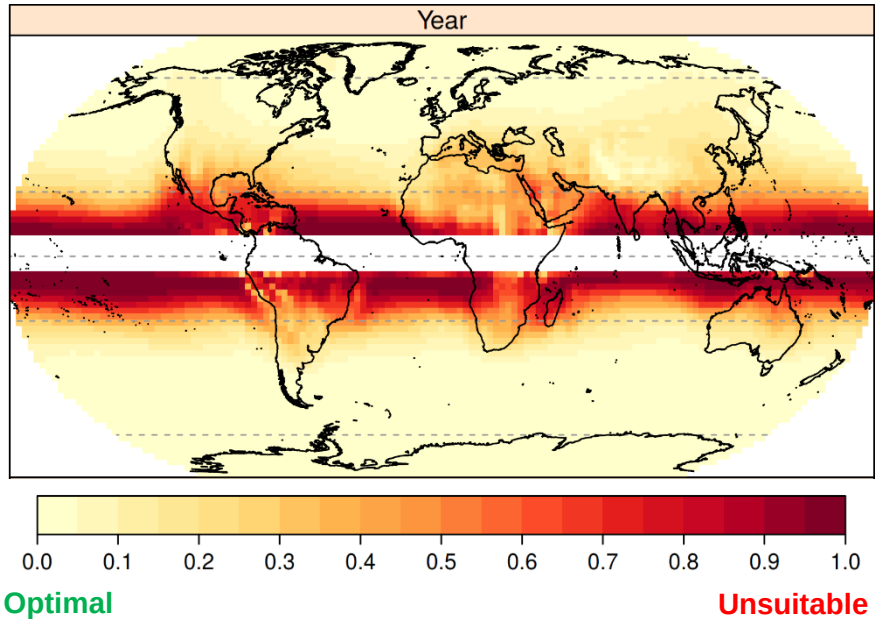
Number of WTs (ERA5)



Unsuitable — Optimal

✓ Suboptimal behavior when approaching the equator

Relative frequency of Unclassified (ERA5)



Optimal — Unsuitable

✓ Worst suitability in boreal and austral summer

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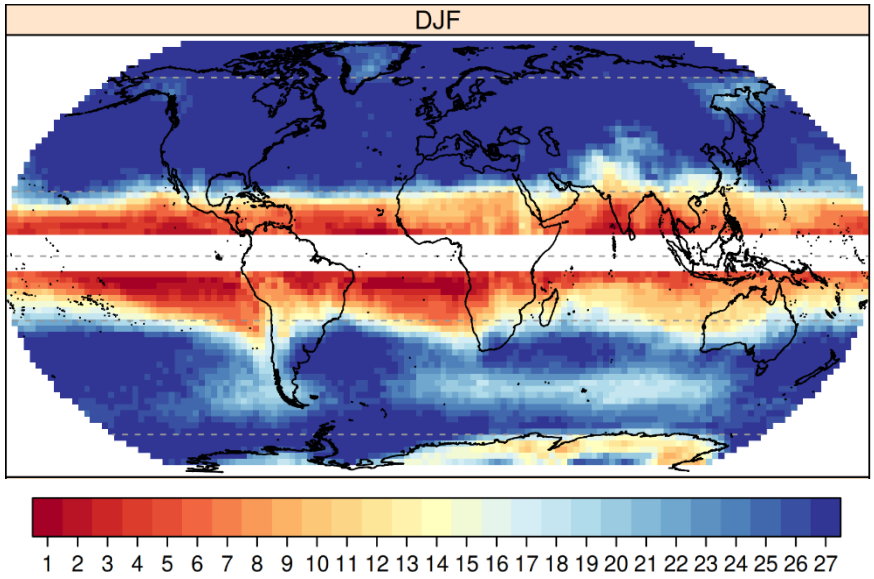

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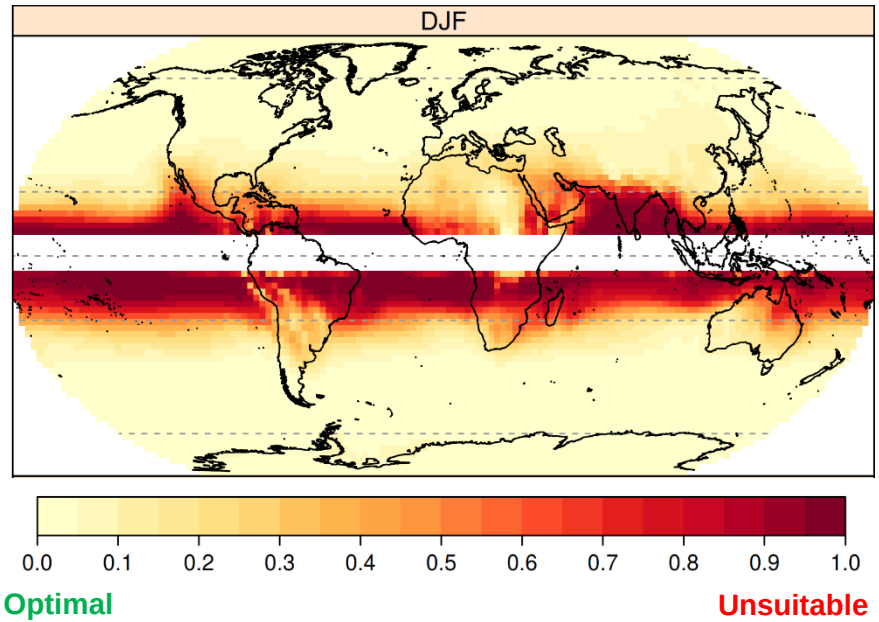

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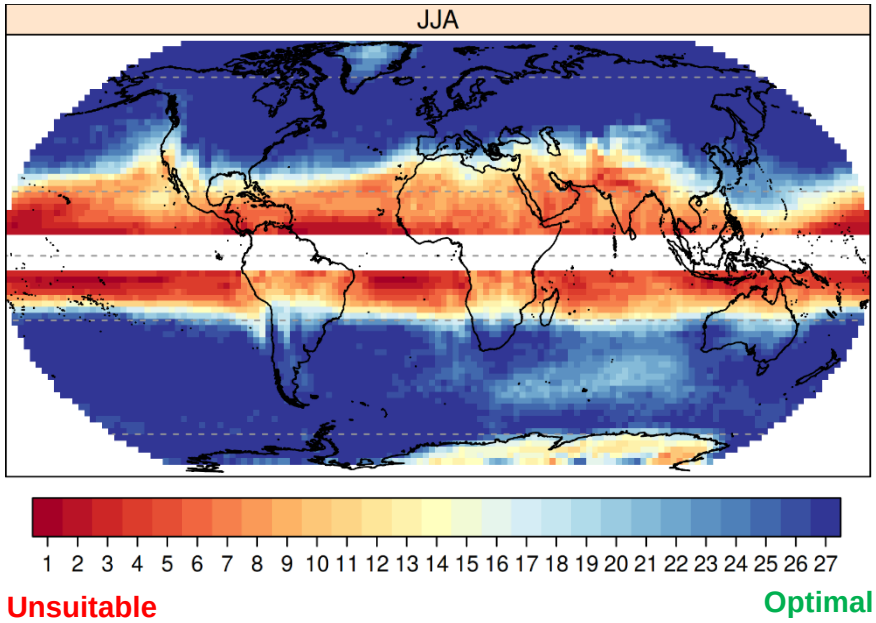

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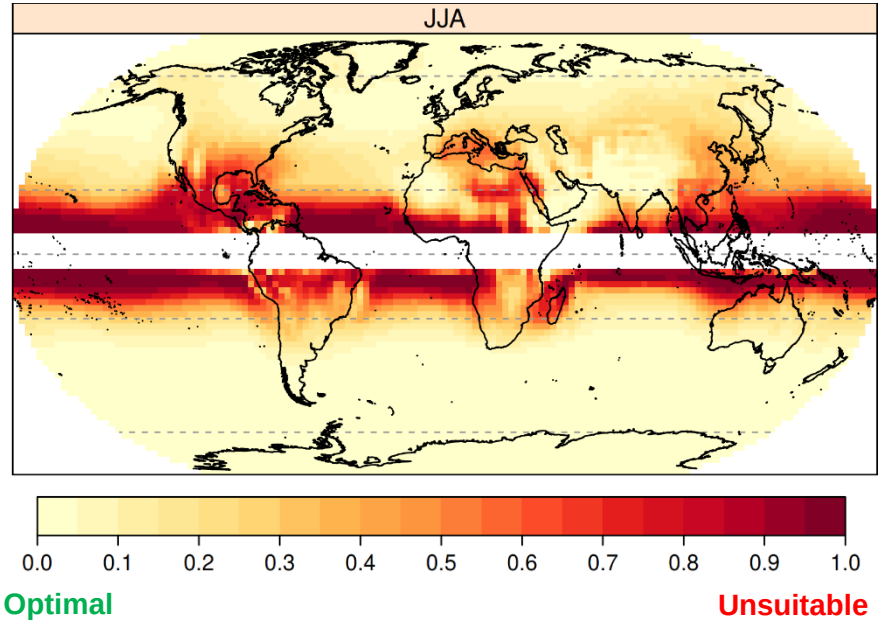

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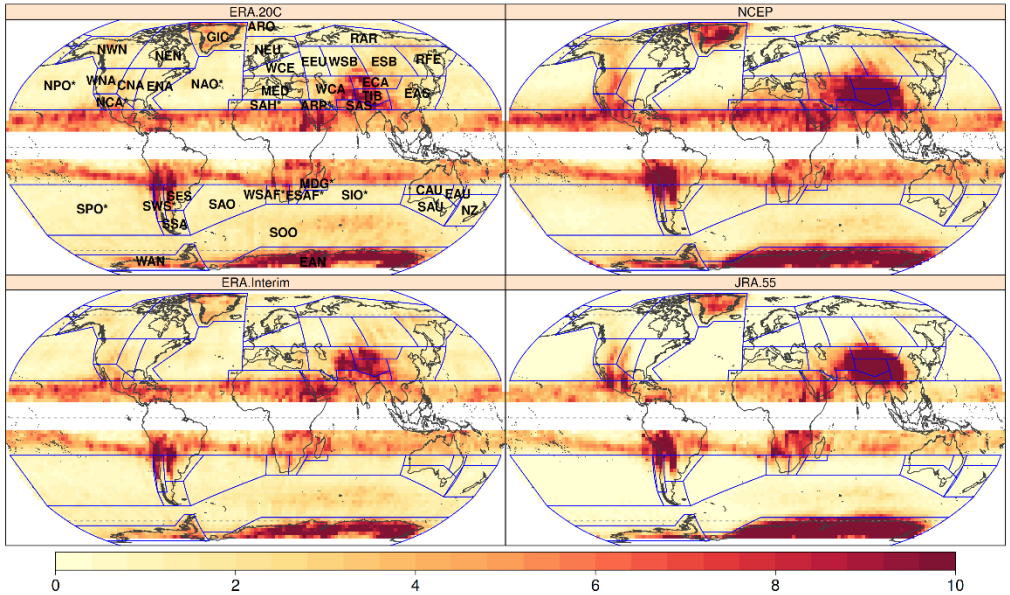
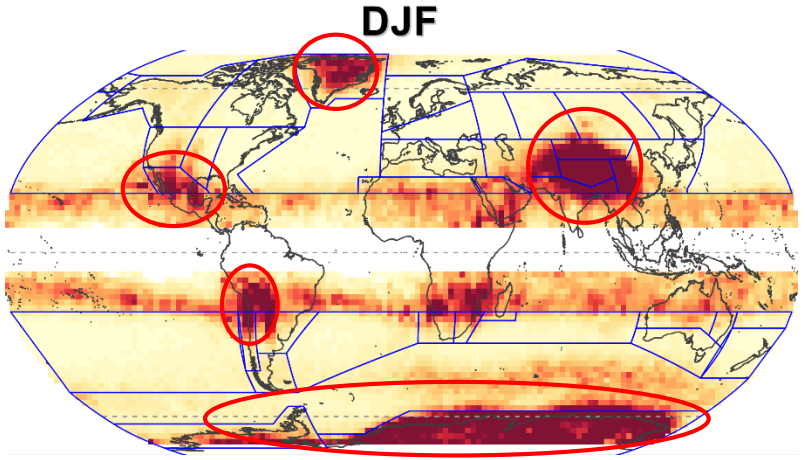
RELEVANT RESULTS:

TPMS reanalysis vs. ERA5 (as ref.)



Perfect agreement **Bad agreement**

DJF



TPMS JRA-55 vs. ERA5 (seasons)

- ✓ General agreement among reanalysis in the conflicting areas.
- ✓ Highest TPMS seen in summer
- ✓ Generally, high TPMS areas show complex orography.

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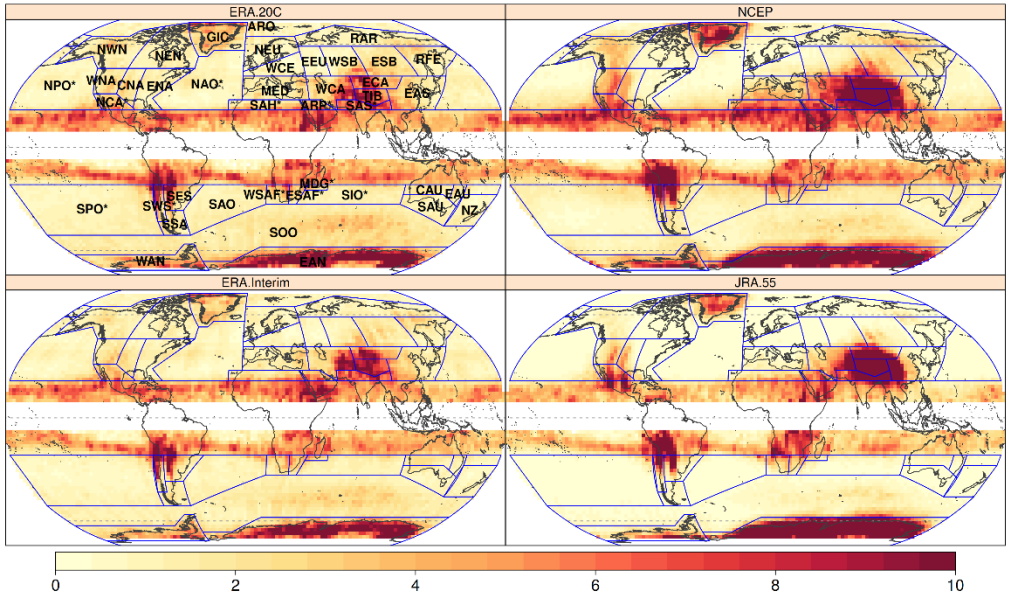

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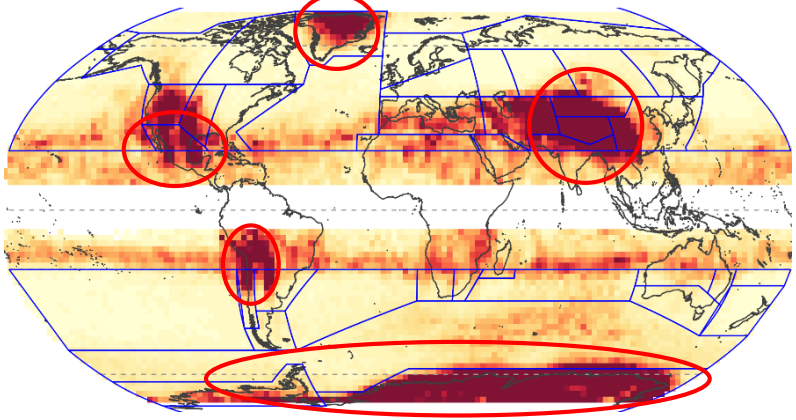
JJA



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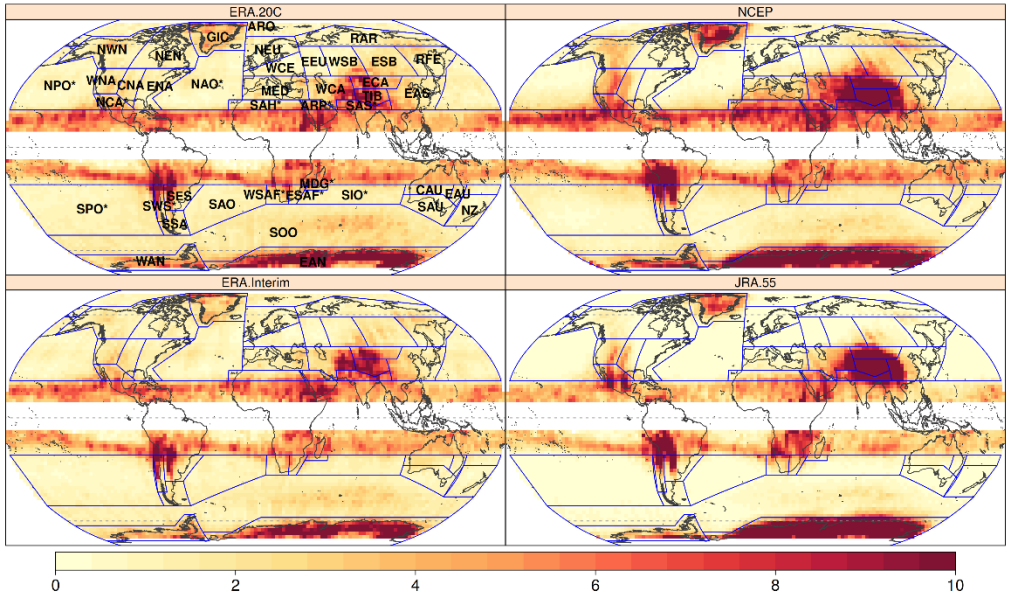

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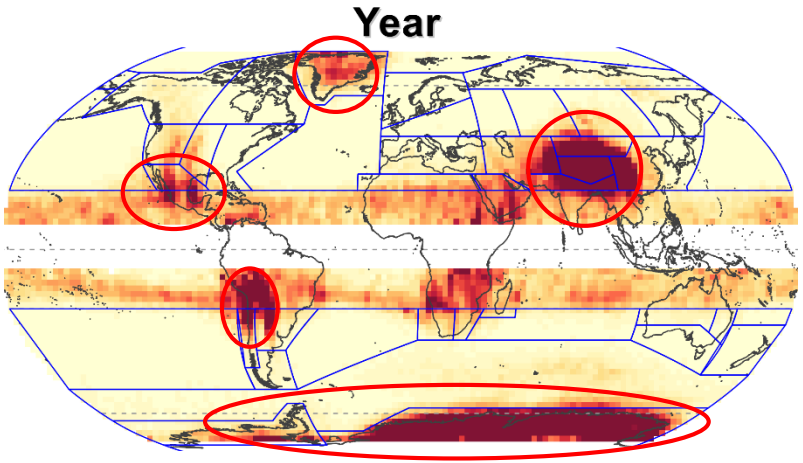

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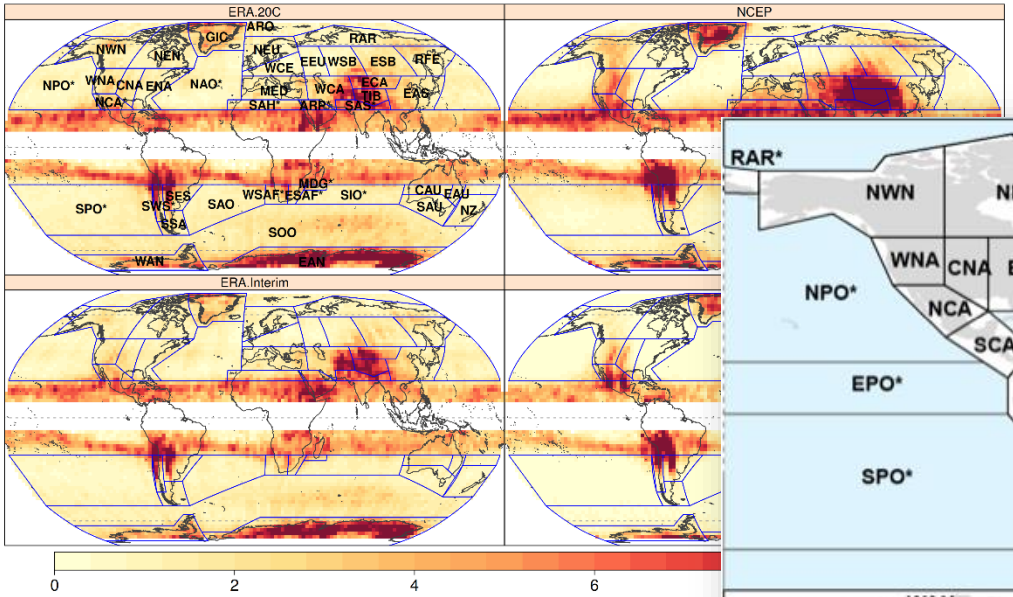

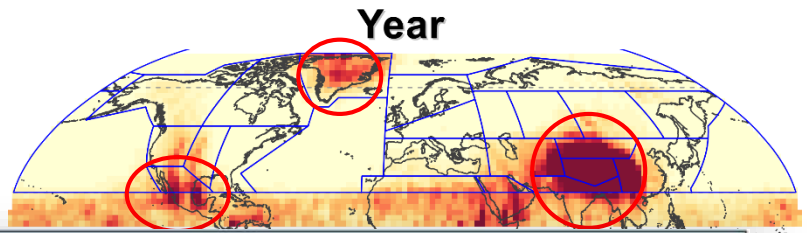

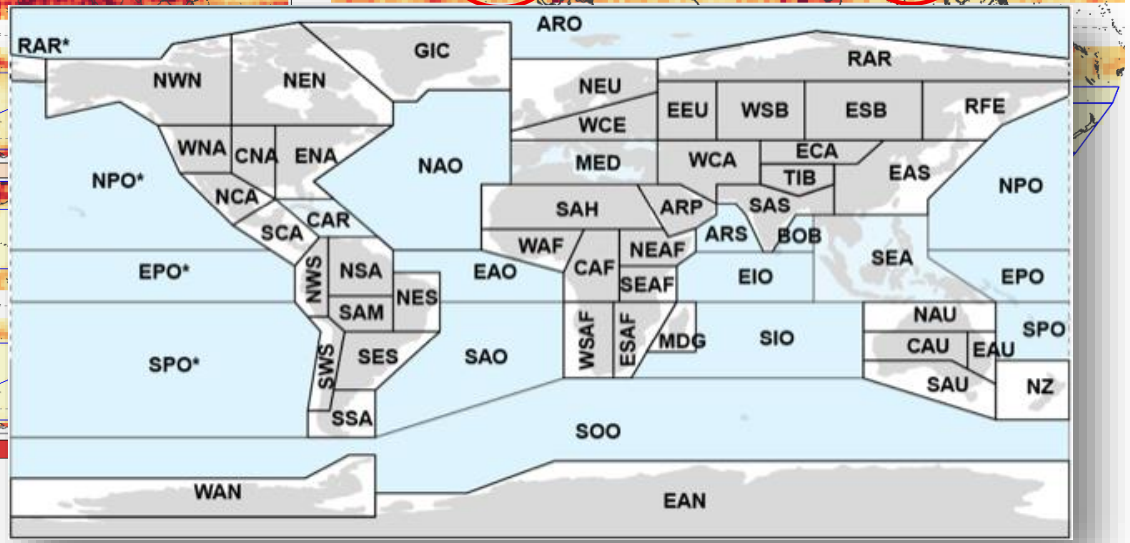

Perfect agreement

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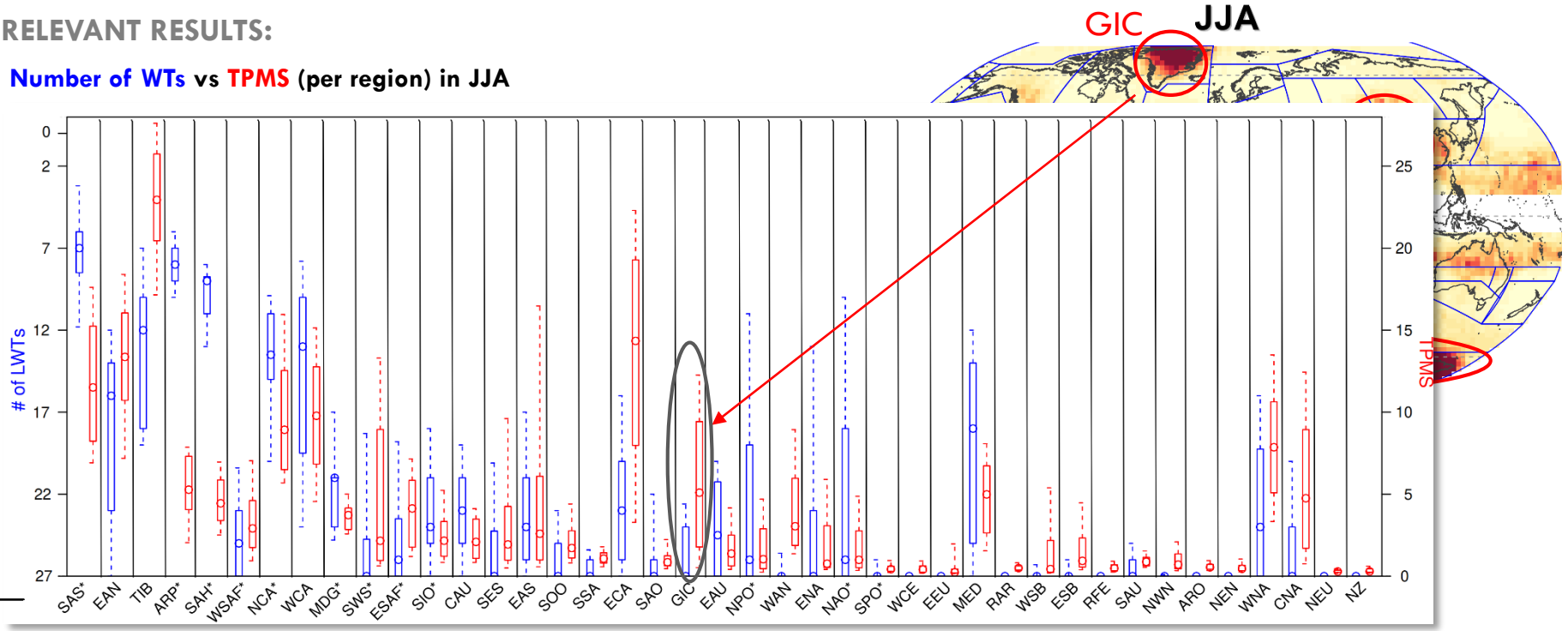
RELEVANT RESULTS:

Number of WTs vs TPMS (per region) in JJA



Ordered following minimum # of WTs from the regions in the anual time-scale

CONCLUSIONS:

- ✓ **Increase the region of applicability of JC-WTs recommended by Jones et al. (2013).**
- ✓ **Caution is needed in regions with suboptimal methodology behaviour or high TPMS**

For more details…

Go to Article

Fernández-Granja, J. A., Brands, S., Bedia, J., *et al* (2022) Exploring the limits of the Jenkinson-Collison classification scheme for atmospheric circulation: A global assessment based on various reanalyses. PREPRINT (Version 1) https://doi.org/10.21203/rs.3.rs-1415588/v1

References

Lamb H (1972) British isles weather types and a register of the daily sequence of circulation patterns 1861-1971. METEOROL OFF, GEOPHYS MEM; GB; DA 1972; NO 116; PP 1-85; BIBL 2P1/2

Jenkinson A, Collison F (1977) An initial climatology of gales over the north 662 sea. synoptic climatology branch memorandum. Meteorological Office, 62

Jones P.D., Harpham C., Briffa K.R. (2013) Lamb weather types derived from reanalysis products. International Journal of Climatology 33(5):1129–1139. DOI: 10.1002/joc.3498

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