A SYNOPTIC CIRCULATION PATTERNS EVALUATION FRAMEWORK FOR CMIP6 GCMS OVER THE EURO-MEDITERRANEAN REGION

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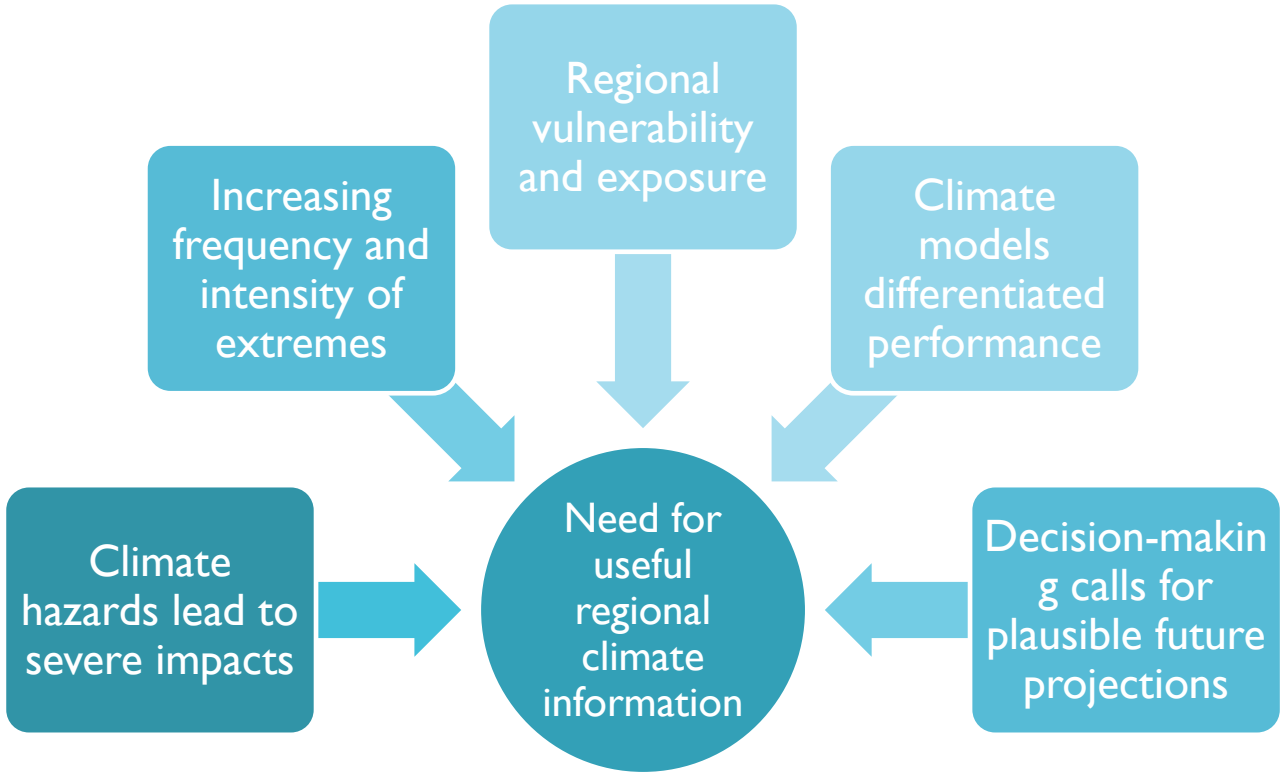
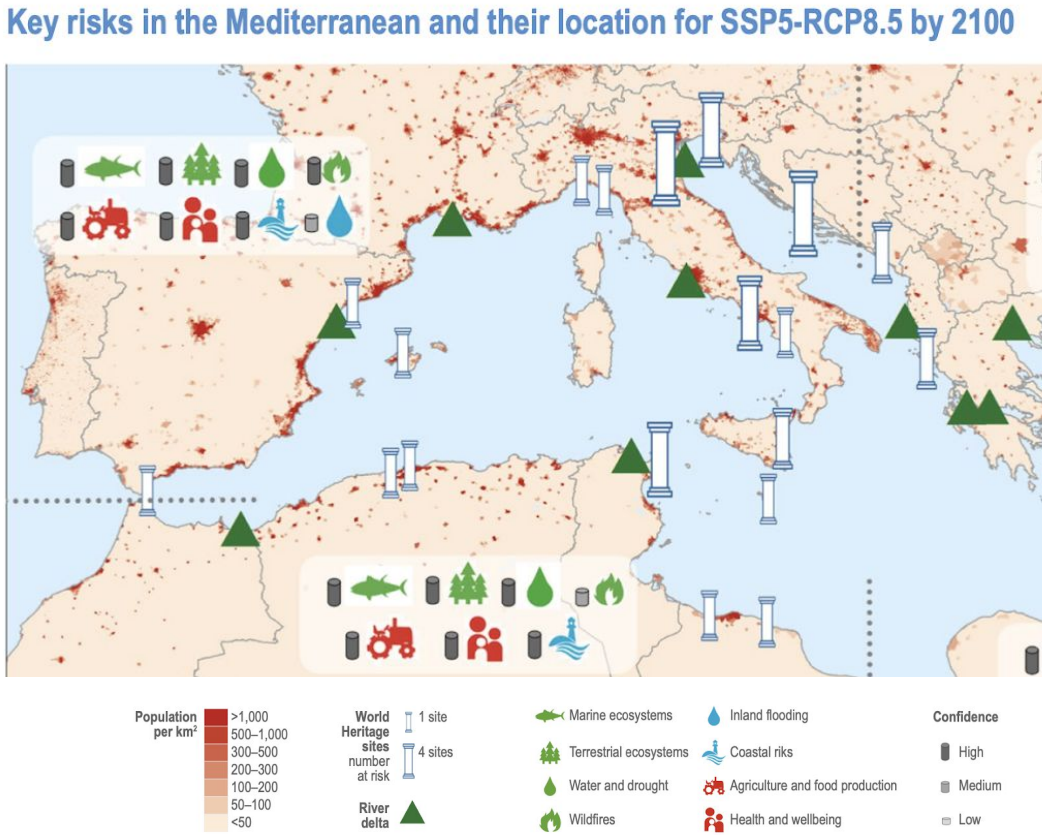
MOTIVATION



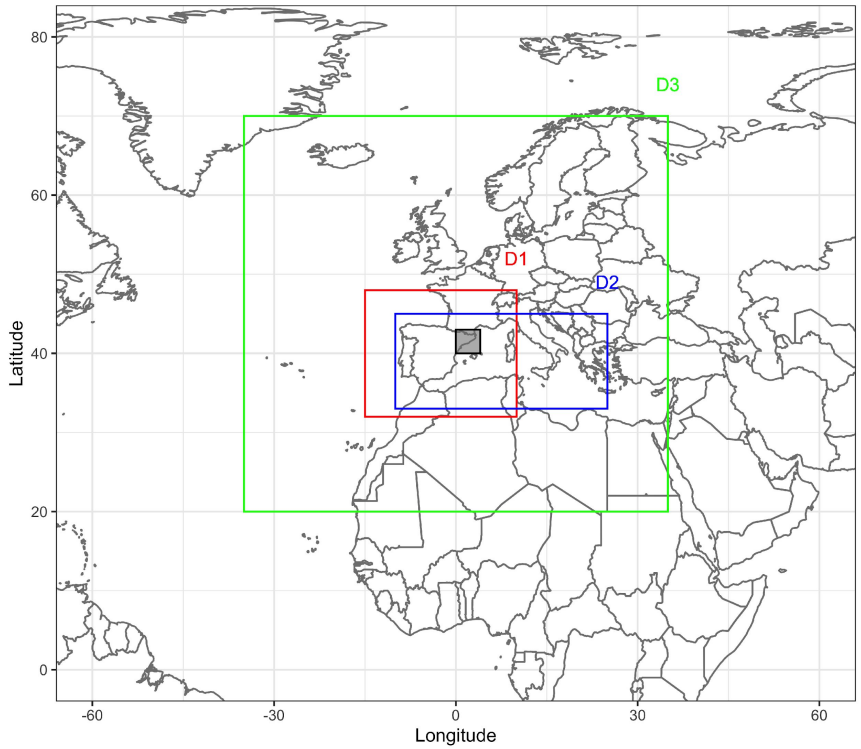


IPCC AR6 WGII, CCP4 Mediterranean Region.

OBJECTIVE

- Design a cross time-scales evaluation framework for CMIP6 GCMs based on synoptic circulation patterns and their impacts over the Euro-Mediterranean.

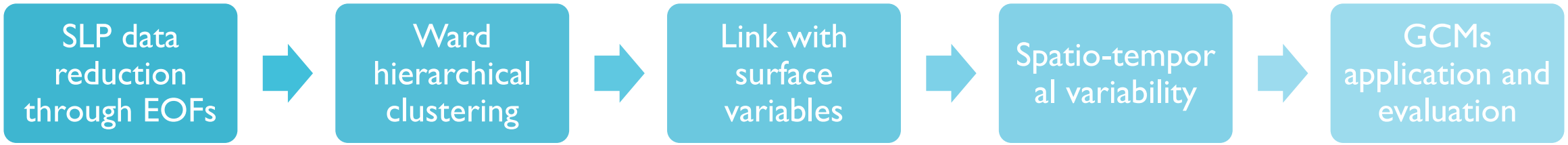
ECMWF ERA5 DAILY DATA (REFERENCE)
32 CMIP6 GCMS 1950-2014



Domains selected for the CPs.

- Atmospheric circulation domains
  - Mean sea level pressure (SLP)
  - Geopotential Height at 500 hPa
  - Zonal and meridional winds at 850 hPa
- Surface variables
  - Precipitation
  - Maximum temperature
  - Minimum temperature

METHODS AND WORKFLOW



Sensitivity to:
-Domain size
-Number of clusters
-Input data

Anomalies estimation

Cross-time scale evaluation of CPs variability

-ErrorCycle
-DISO

METHODS: EVALUATION METRICS

- ErrorCycle

Absolute difference in the daily frequency of each CP.

$$\text{Error}_{CP} = \frac{\sum_{i=1}^{D} |fERA5_{CP}i - fGCM_{CP}i|}{D}$$

Olmo et al. 2022
Agudelo et al. 2023

- Distance between Indices of Simulation and Observation (DISO)

Summary of a Taylor Diagram.

$$r = \frac{\sum_{k=0}^{n}(a_i - \bar{a})(b_i - \bar{b})}{\sqrt{\sum_{k=0}^{n}(a_i - \bar{a})^2}\sqrt{\sum_{k=0}^{n}(b_i - \bar{b})^2}},$$

$$\text{AE} = \frac{1}{n}\sum_{k=0}^{n}(b_i - a_i),$$

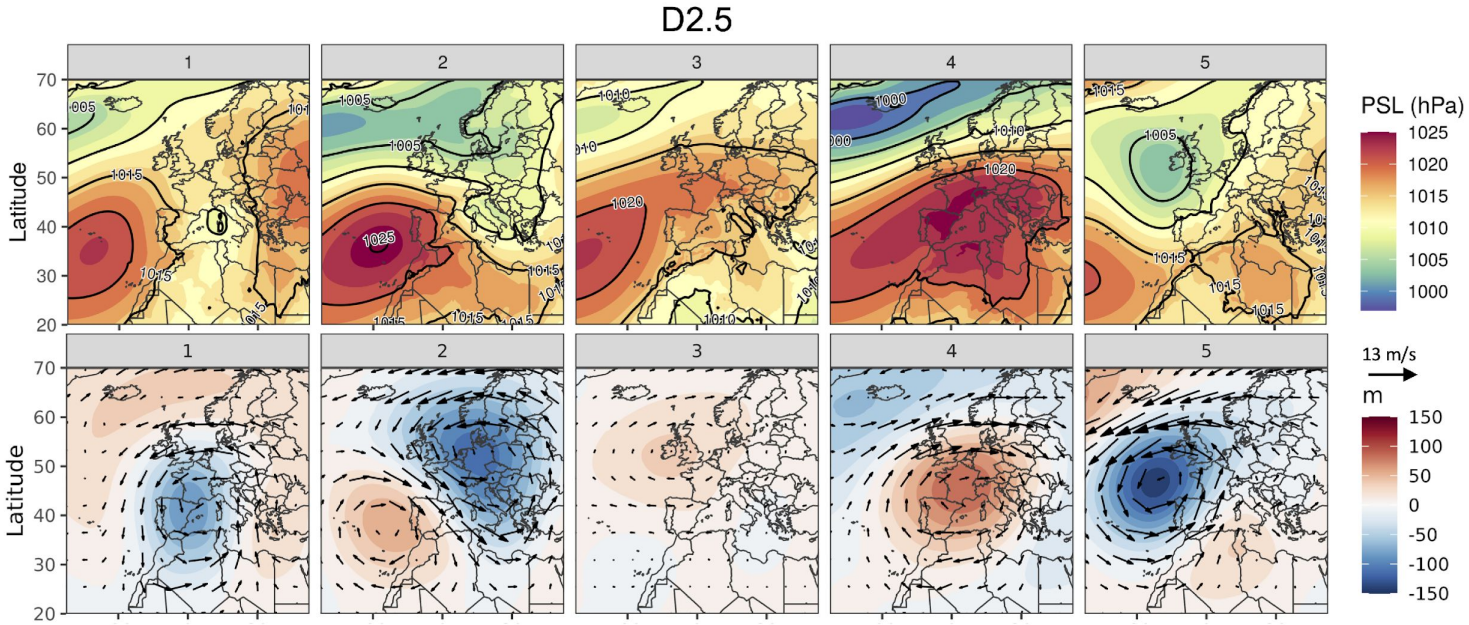
$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{k=0}^{n}(b_i - a_i)^2},$$

$$DISO = \sqrt{(r-1)^2 + NAE^2 + NRMSE^2}$$

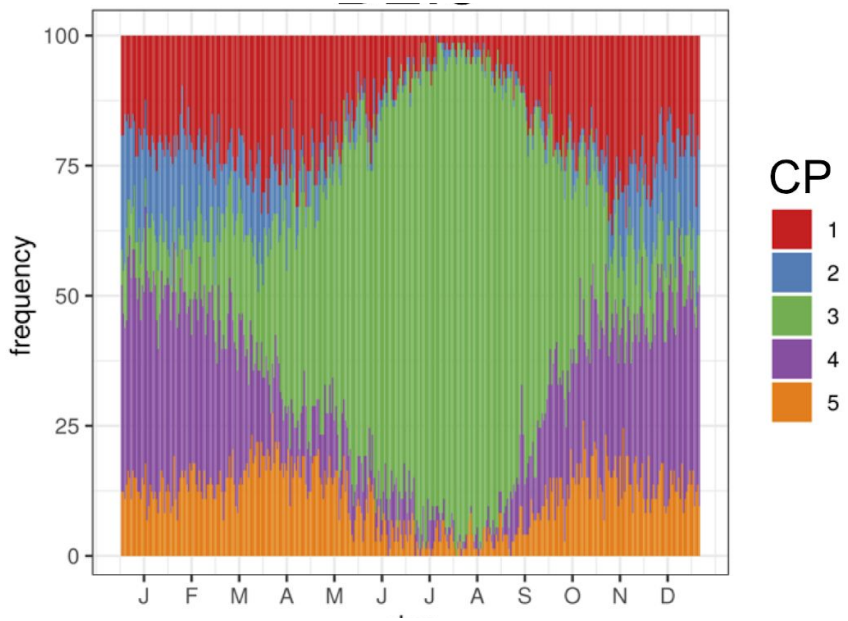
DISO mean = weighted mean of PR, TN and TX DISO

Hu et al. 2018
Liu et al. 2018

MAIN RESULTS: OBSERVATIONAL REFERENCE

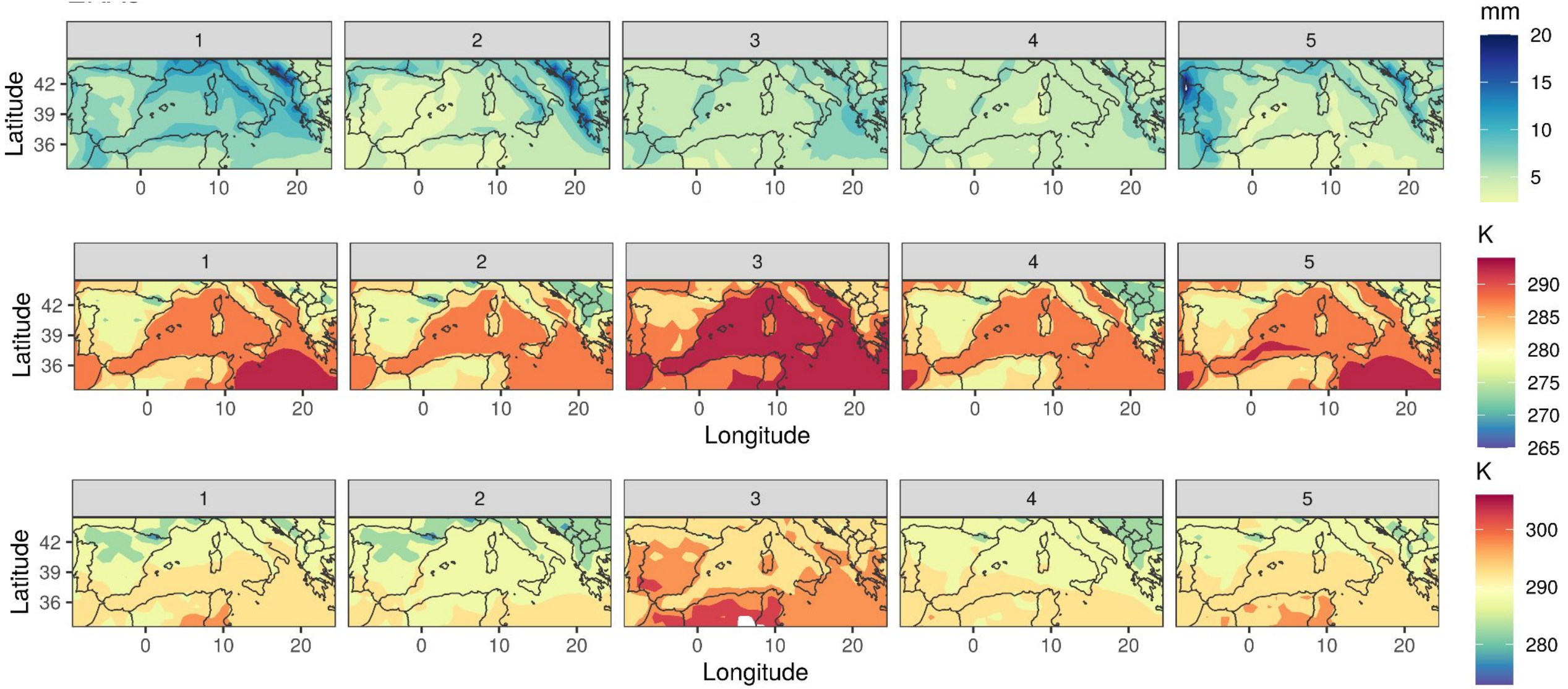


SLP spatial patterns
Z500 (shaded) and low-level winds (vectors)

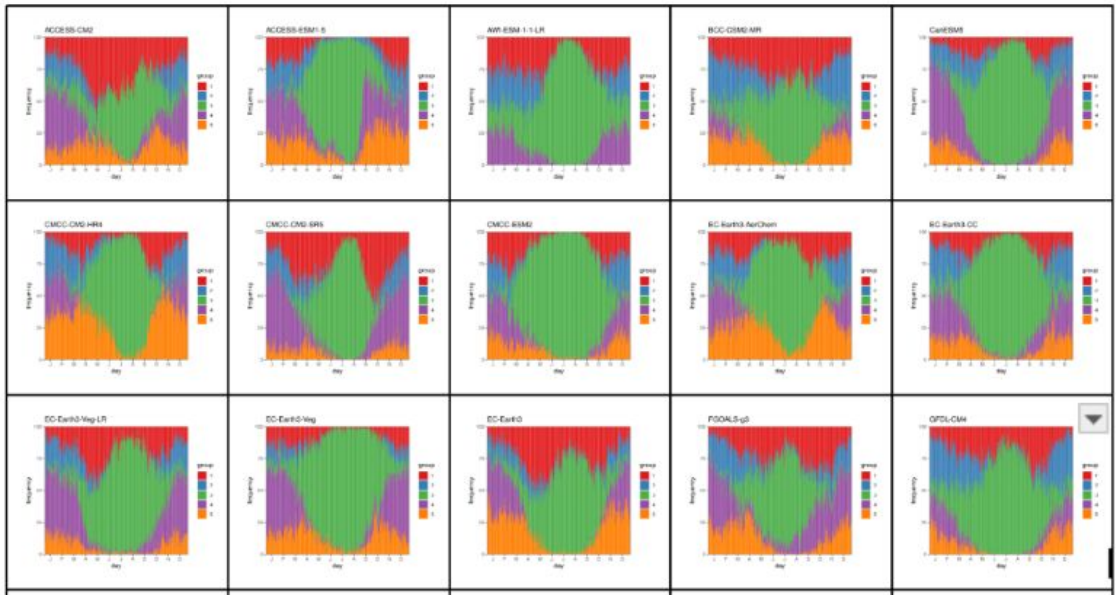


Annual cycles of CPs.

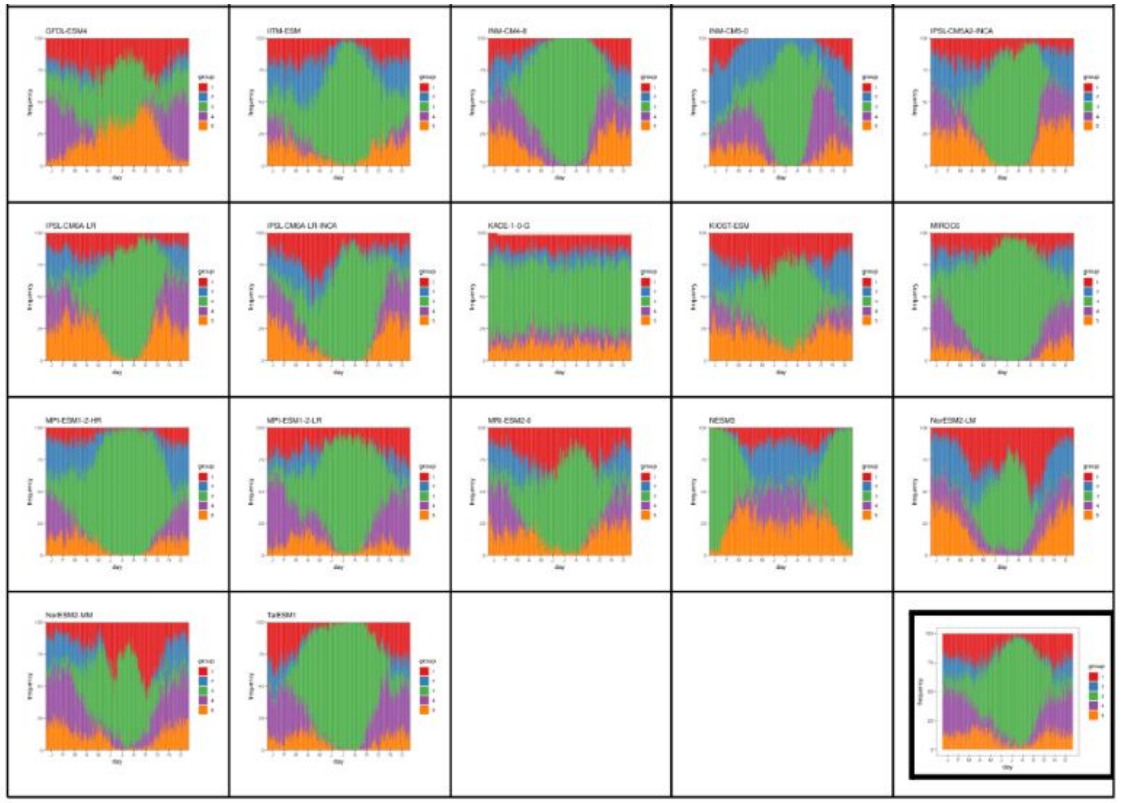
Olmo et al. 2024 JOC, under review.



CP SURFACE PATTERNS: PR, TN AND TX



Annual cycle of CPs by GCM.

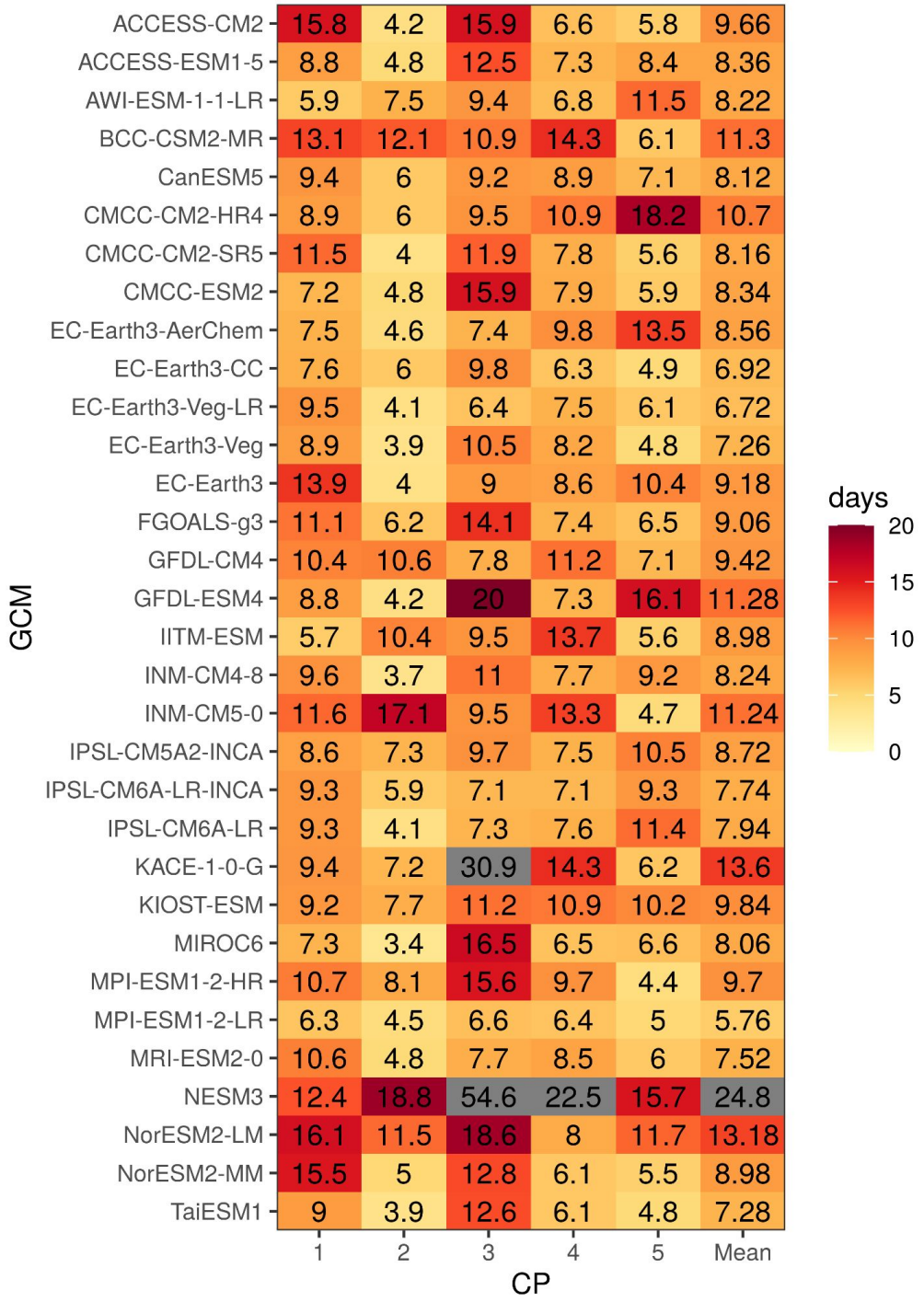


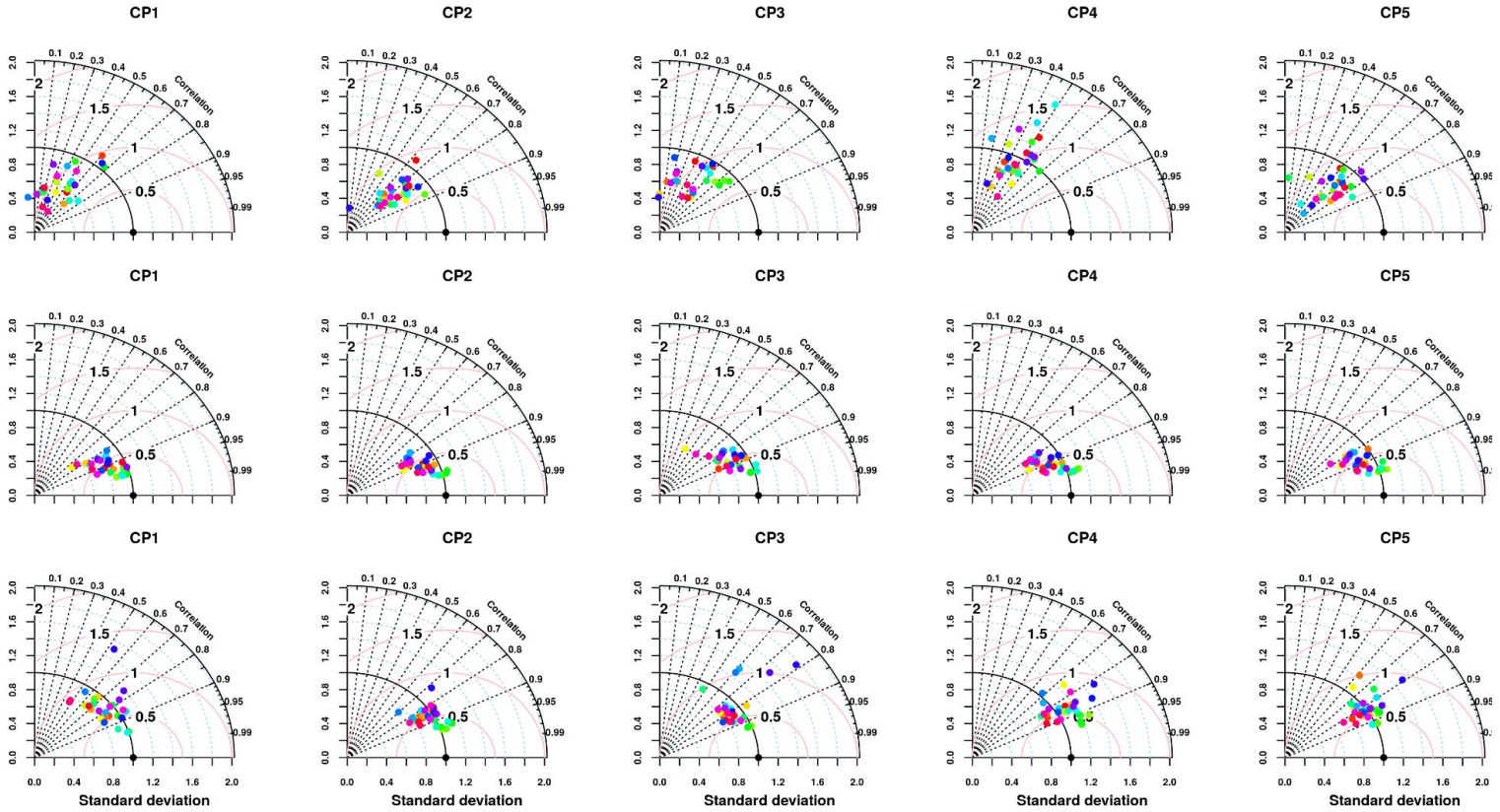
ERA5

CP ANNUAL CYCLE

- Larger ErrorCycle in CP3 (most frequent) and in transitional patterns (CP1, CP5)

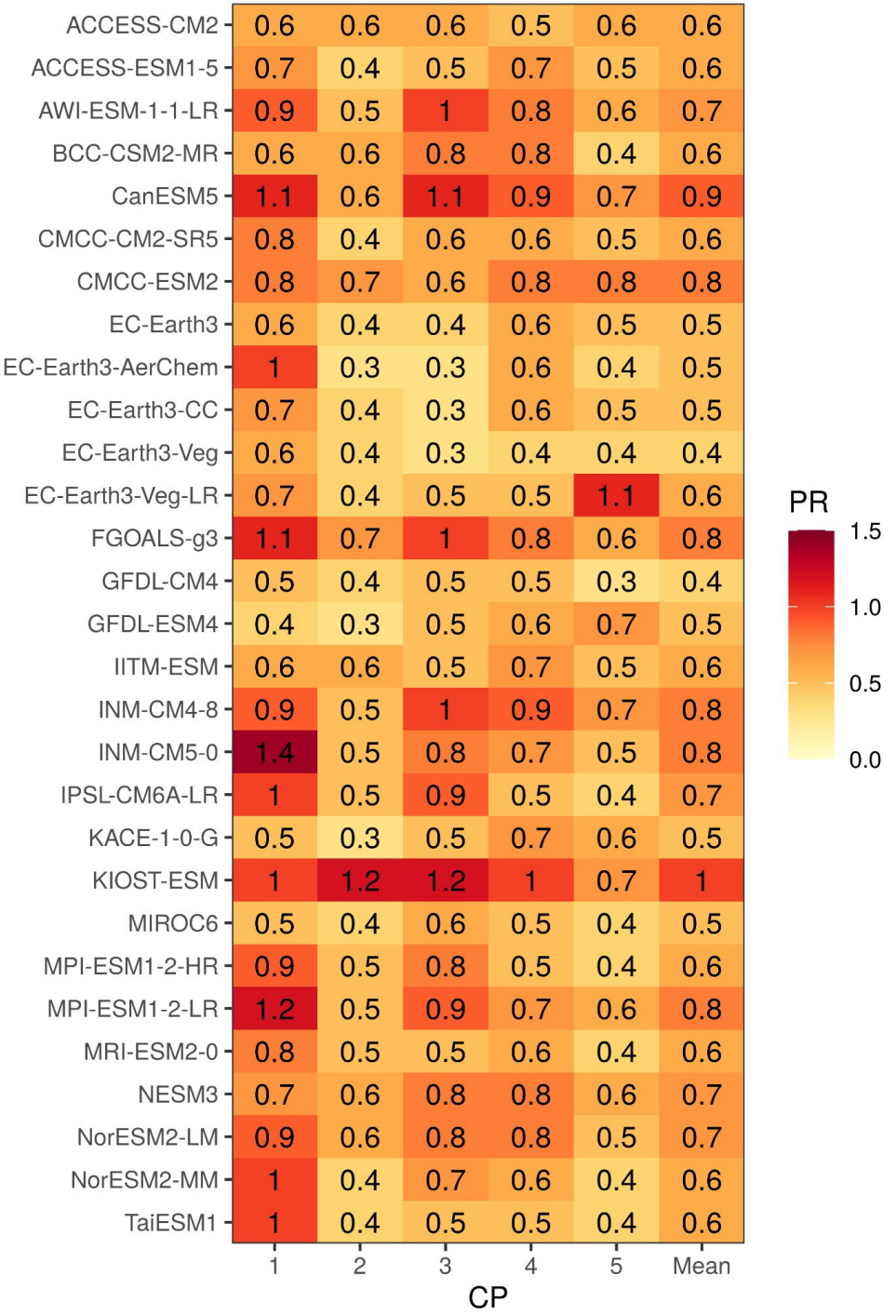
ERRORCYCLE

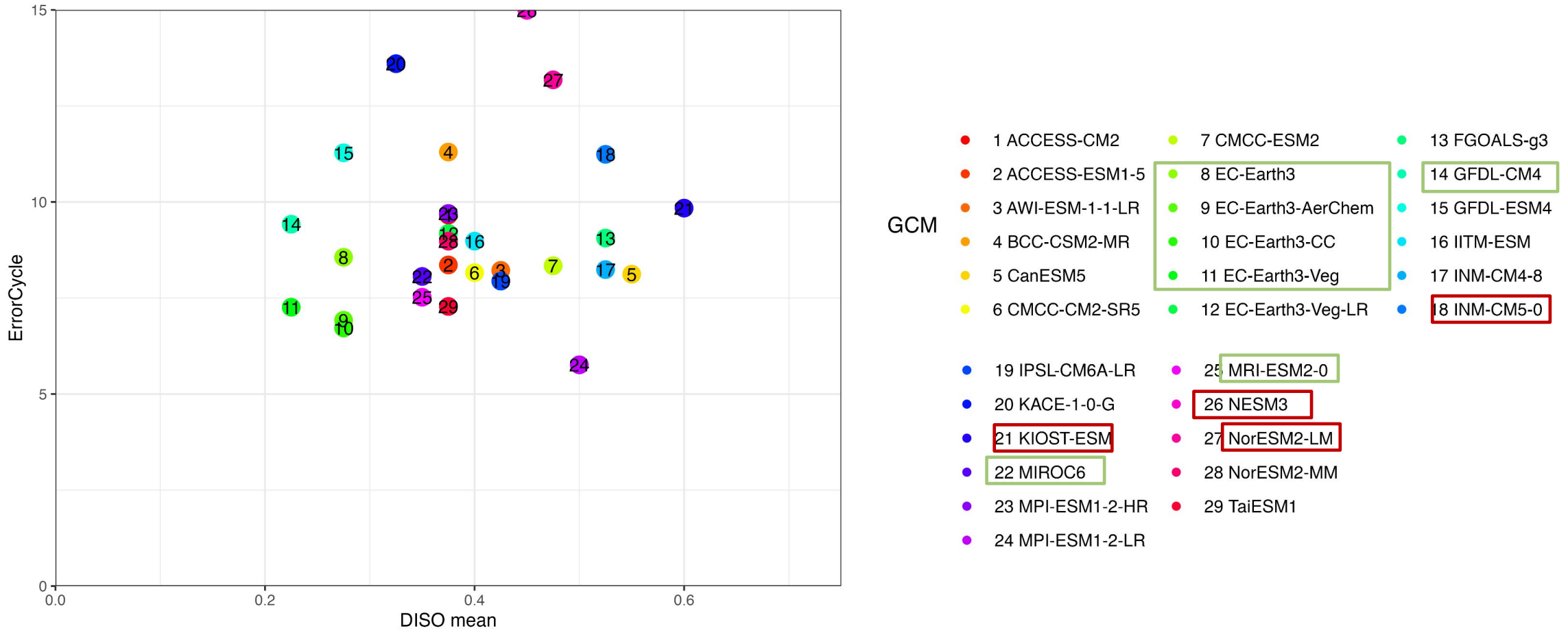




SPATIAL PATTERNS:
TAYLOR DIAGRAMS AND PR DISO

More difficulties in PR than TN and TX, particularly CP1.





MODEL PERFORMANCE: ERRORCYCLE VS. DISO MEAN (PR, TN AND TX)

MAIN CONCLUSIONS

- The classification of CPs can discriminate synoptic and surface structures with clear seasonal behaviour.
- CMIP6 GCMs have different performances in terms of spatio-temporal variability.
- This is a flexible framework for process-based model ranking and follow-up filtering of climate projections.

THANKS!

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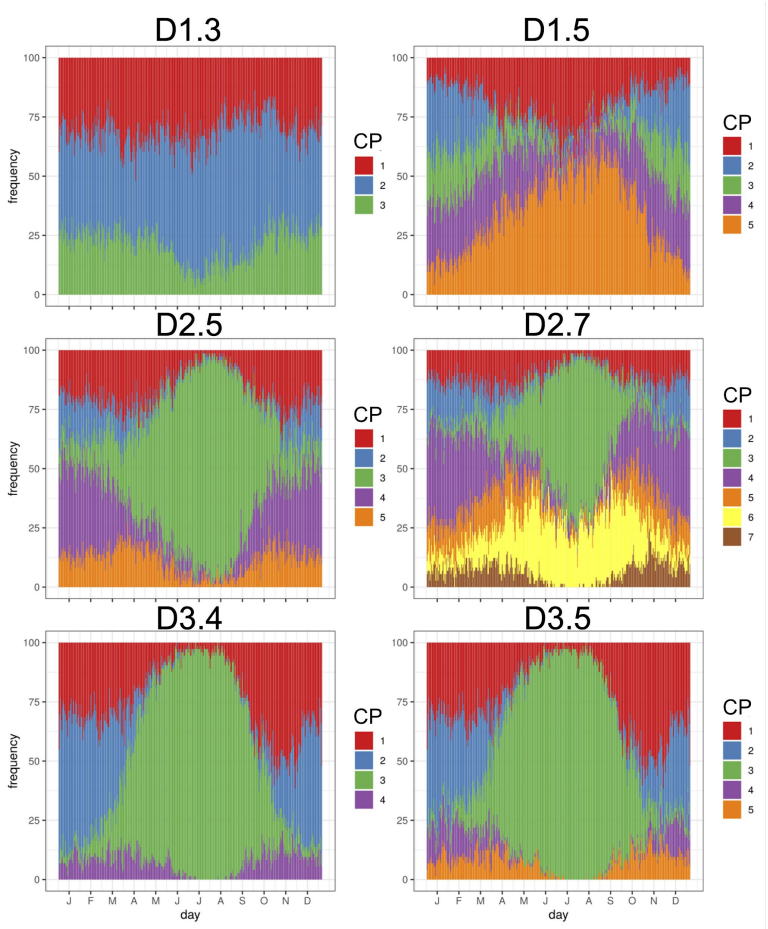
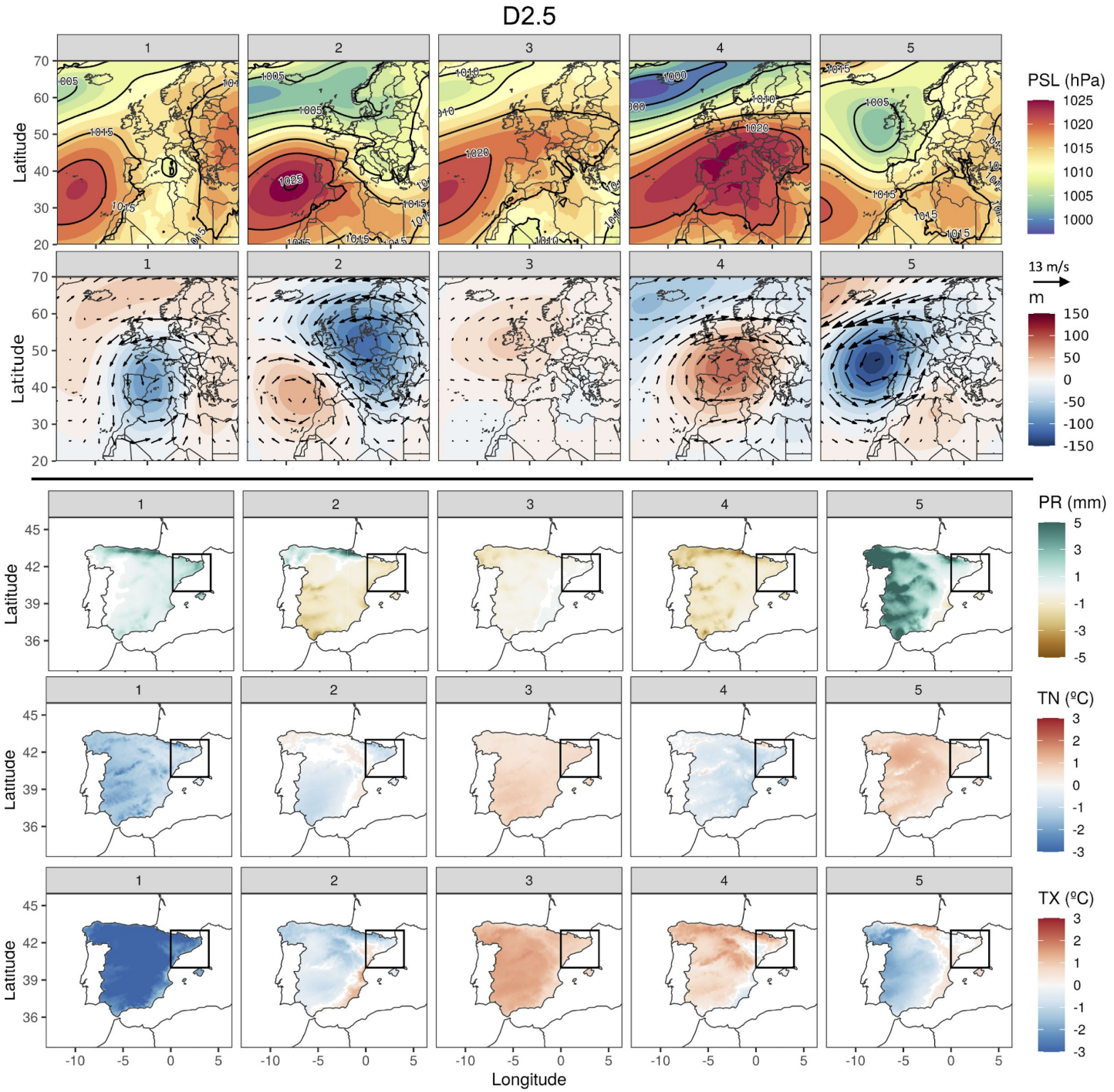
EXTRA SLIDE I





EXTRA SLIDE II