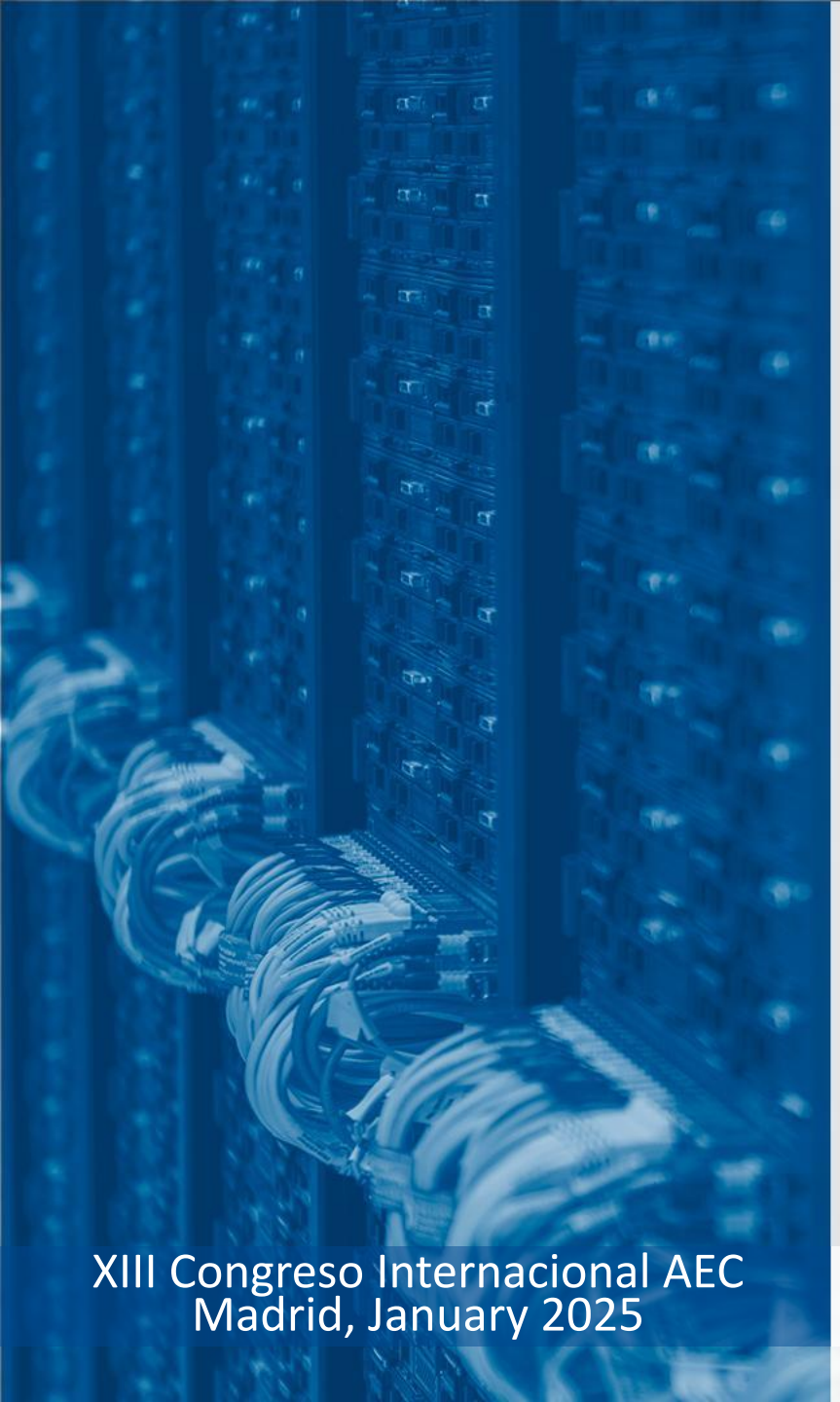

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ASPECT

Comparative Analysis of Statistical Downscaling Methods in a Multimodel Framework for Decadal Climate Predictions over the Western Europe Region

Sara Moreno-Montes*, Carlos Delgado-Torres, Eren Duzenli, Núria Pérez-Zanón, Raül Marcos-Matamoros, Albert Soret

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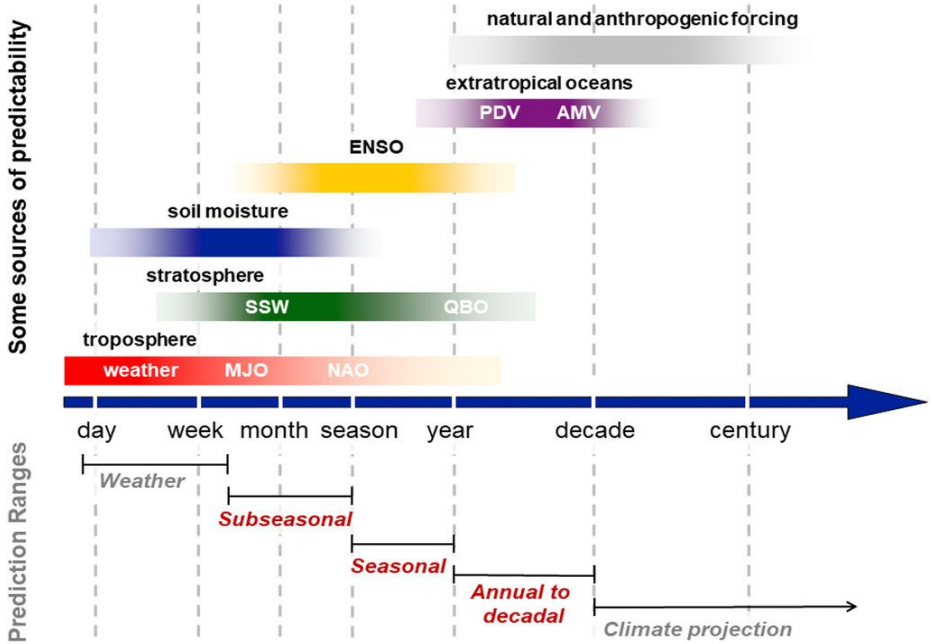
Introduction

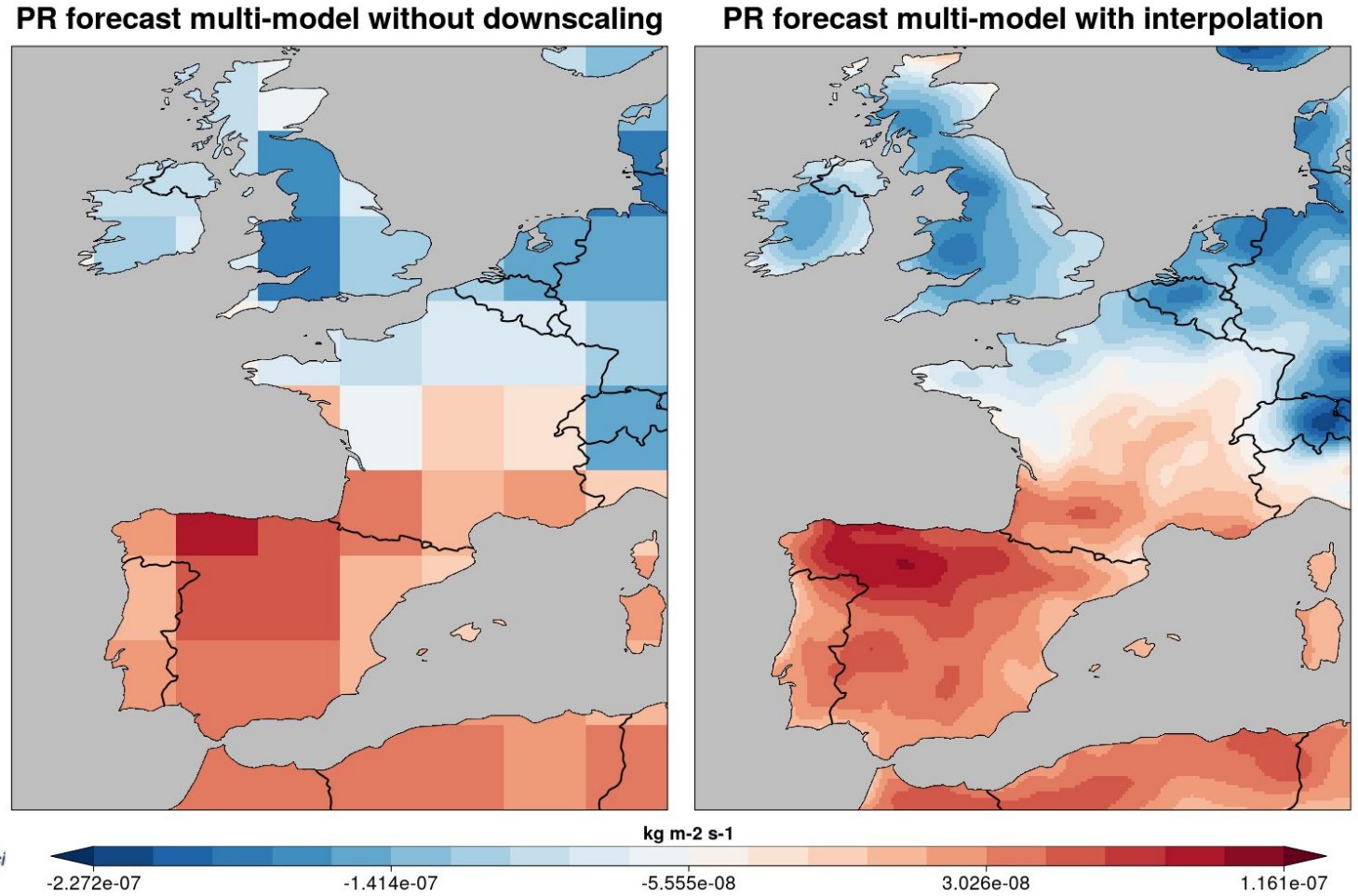
What are the decadal predictions?

- Source of climate information from 1 to 10 years
- Sources of predictability: external forcings and natural variability



Why it is necessary to apply downscaling?

- Global models are usually run in low spatial resolution. Thus, climate information may not be useful for regional decision-making
- Goal: What is the best method to provide regional information?



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Data and Methodology

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Variables	Anomalies of mean air surface temperature (TAS) and precipitation (PR)
Prediction system	Multi-model ensemble of 13 systems from DCPPA-hindcast
Lead time	Forecast years 1-5
Hindcast period	Start dates 1960 - 2013; Years 1961-2018
Region	Western Europe (34.5 ºN to 58.8 ºN; and 12 ºW to 10 ºE)
Reference data	ERA5land (0.1° x 0.1°)
Temporal resolution	Yearly/Daily
Cross-validation	9 years out
Skill metrics	ACC (shown here), RMSSS, RPSS, CRPSS

Downscaling methods

Interpolations

First order conservative

Second order conservative

Bilinear

Bicubic

Nearest Neighbour

Analogs

Linear regressions

Calibrations

Bias adjustment (EVMOS)

Mean Square Error minimization (MSE-min)

Continuous Ranked Probability Skill minimization (CRPS)

Ratio Predictable Component based (RPC-based)

Quantile Mapping (q-q, exponential, gamma)*

Predictor: own variable (MOS)

Predictor: psl (PP)

Predictor: zg500 (PP)

Basic linear Regression

9 nearest neighbors Linear Regression

Teleconnection index (NAO, AMV, SPOD, TPI)** Linear and Multilinear Regressions with Model Output Statistics (MOS) and Perfect Prognosis (PP)

* only for precipitation

** NAO: North Atlantic Oscillation, AMV: Atlantic Multidecadal Variability, SPOD: South Pacific Ocean Dipole, TPI: Tripole Index

Results

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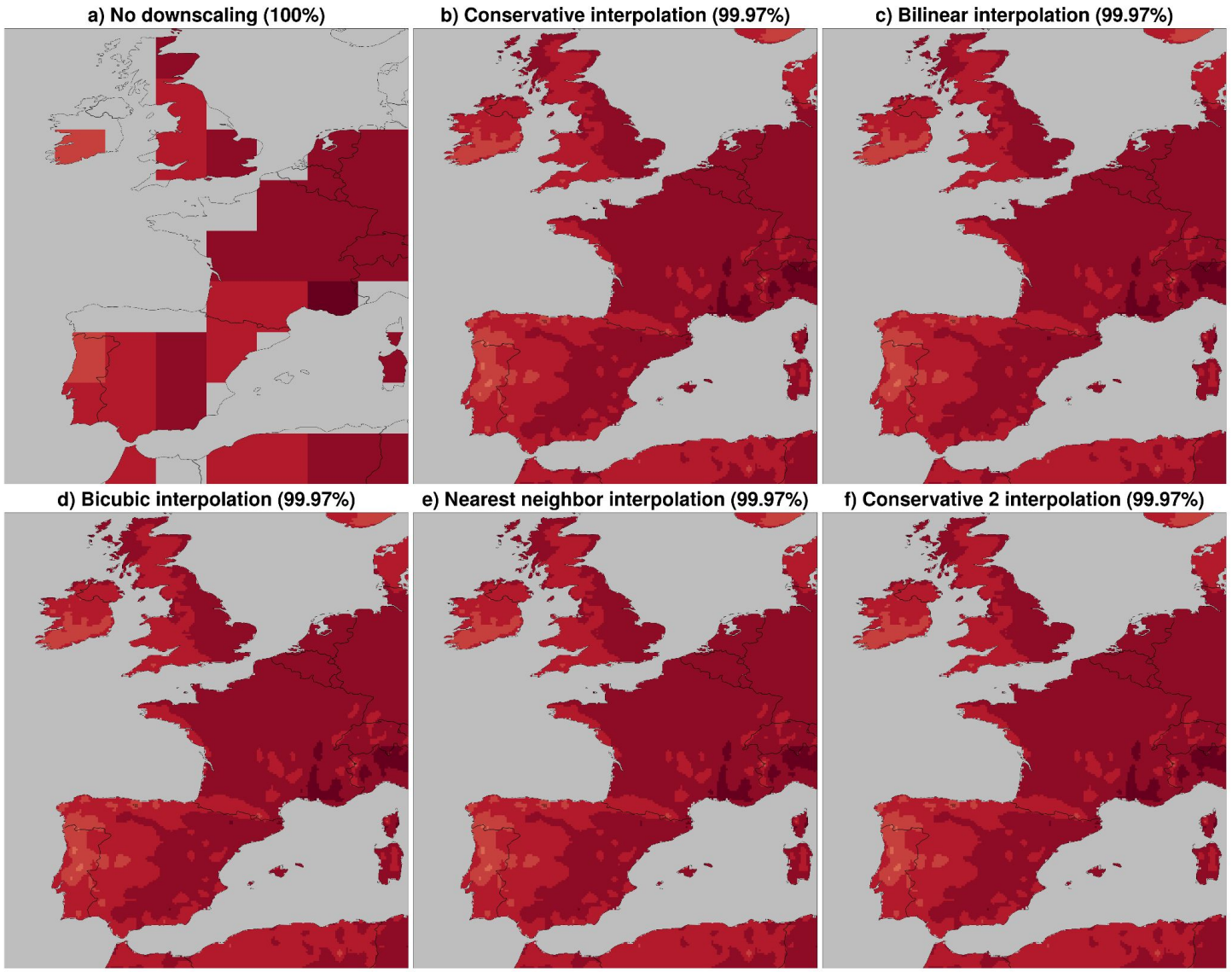
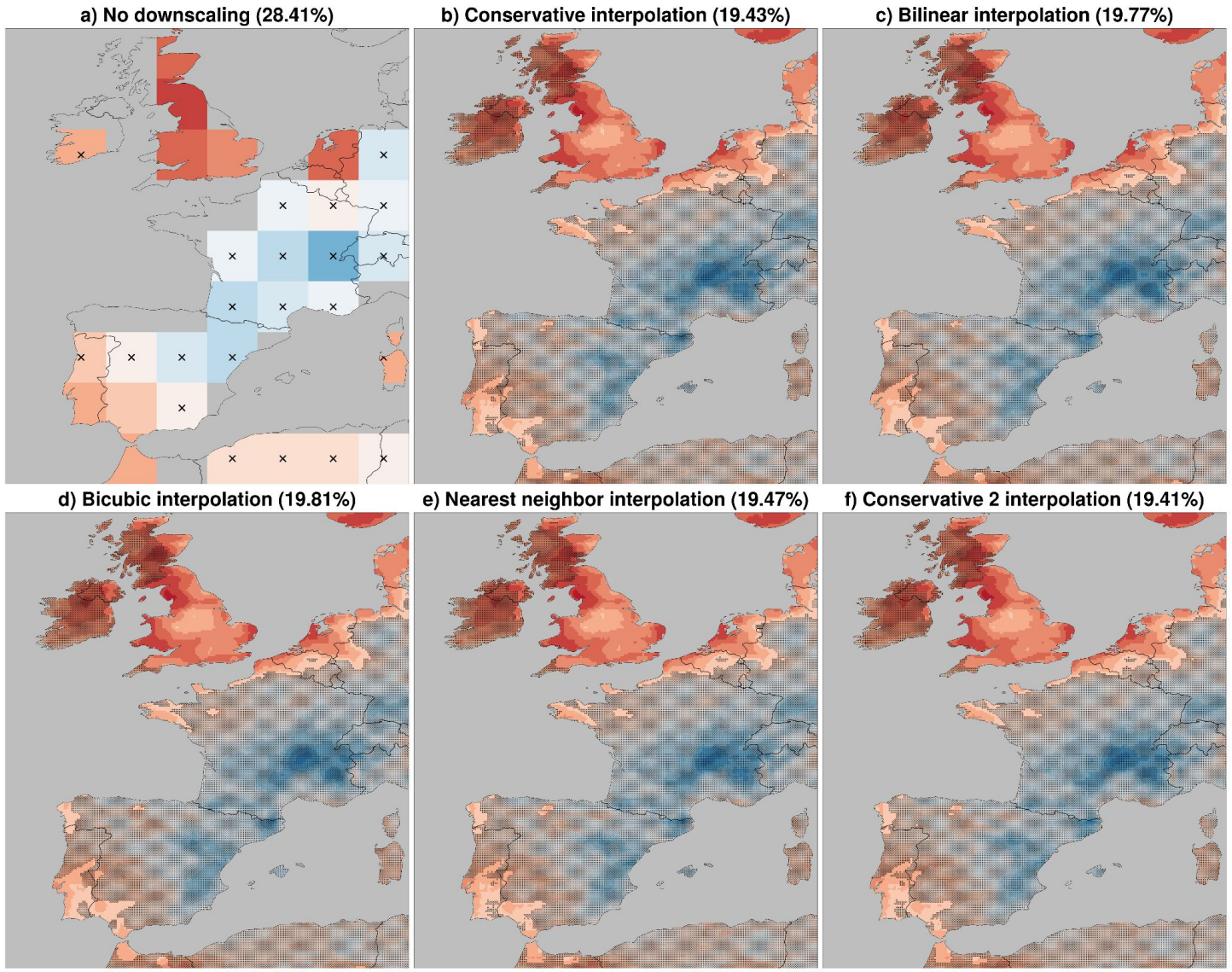
Interpolations TAS



Interpolations PR



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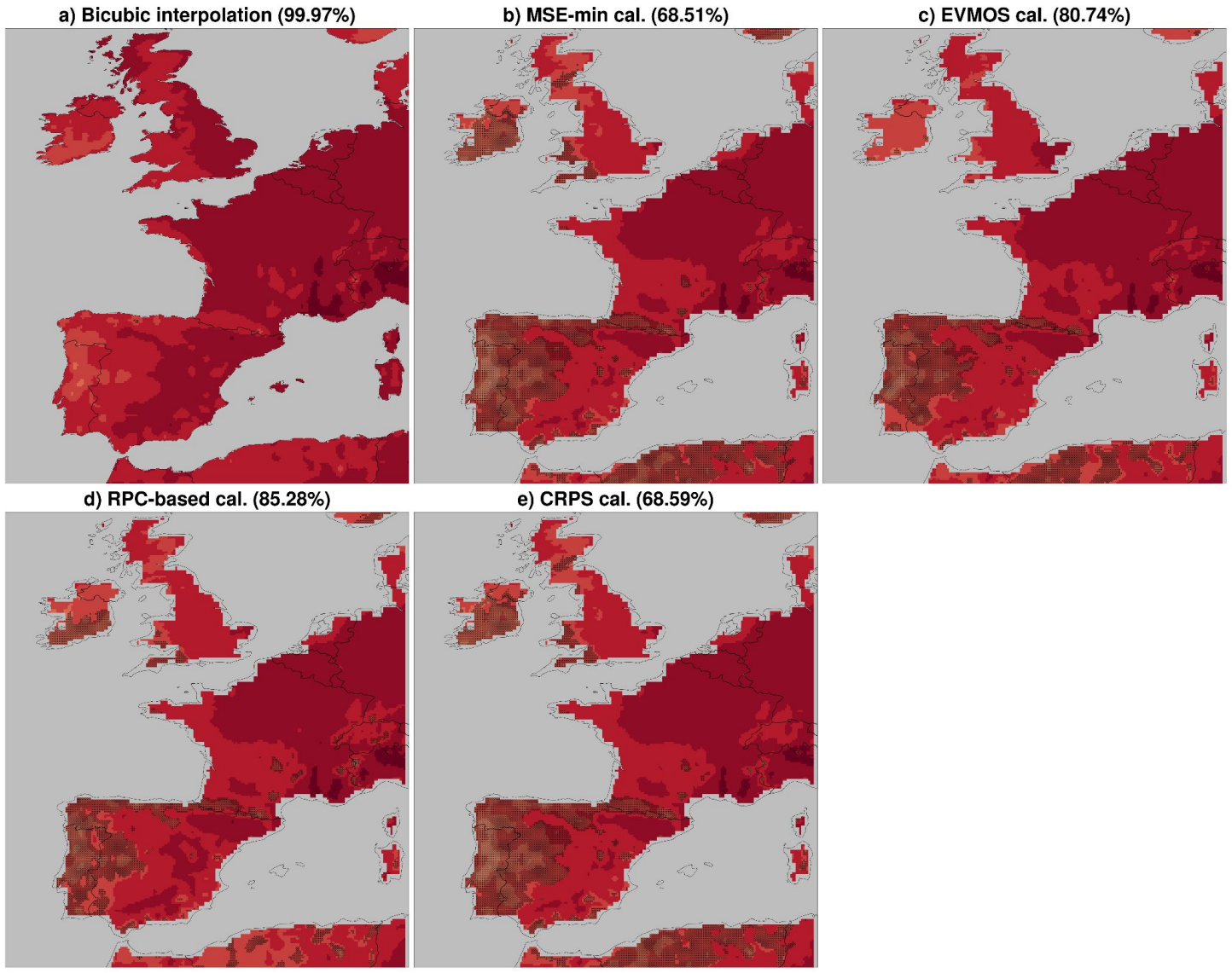
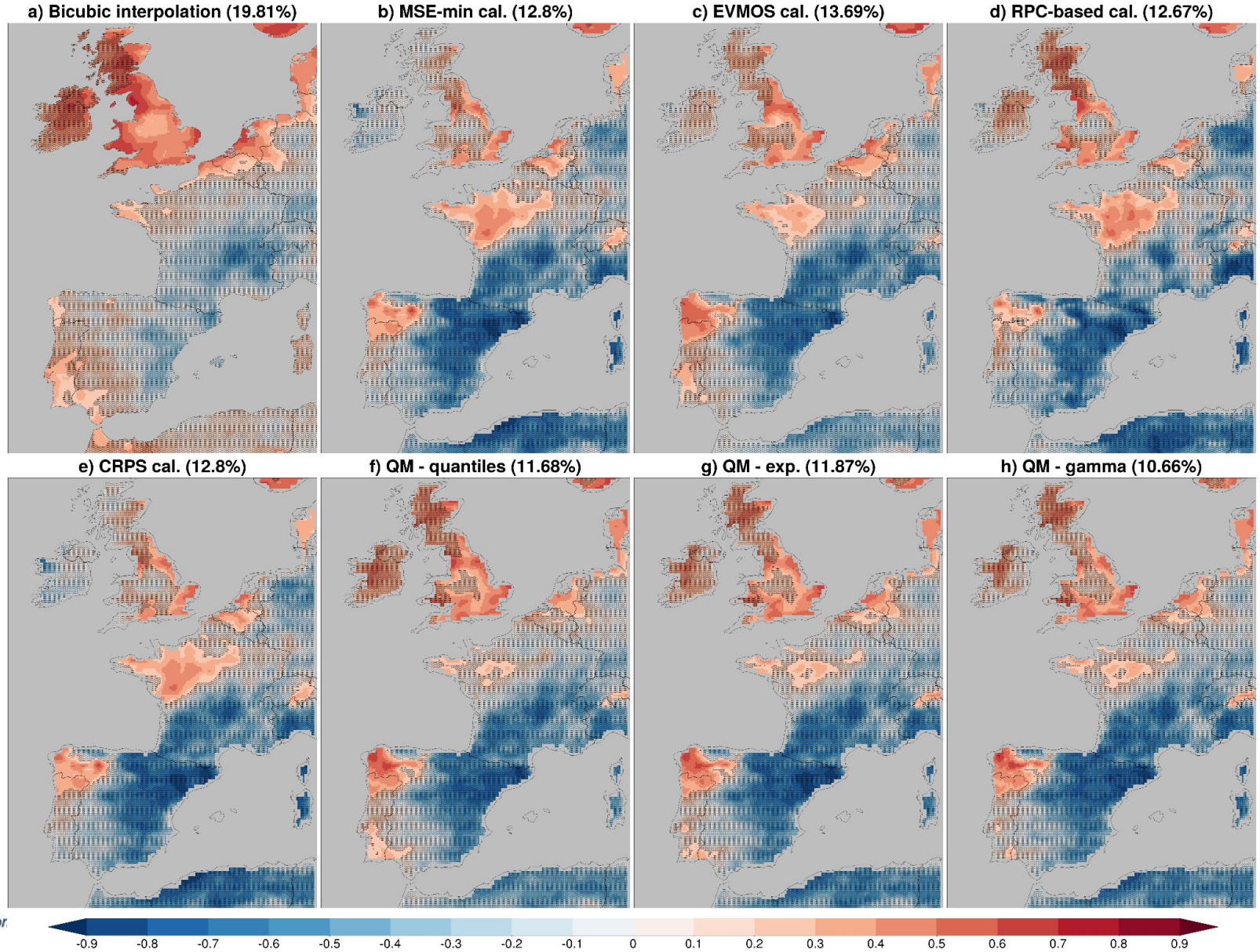
Calibrations TAS



Calibrations PR



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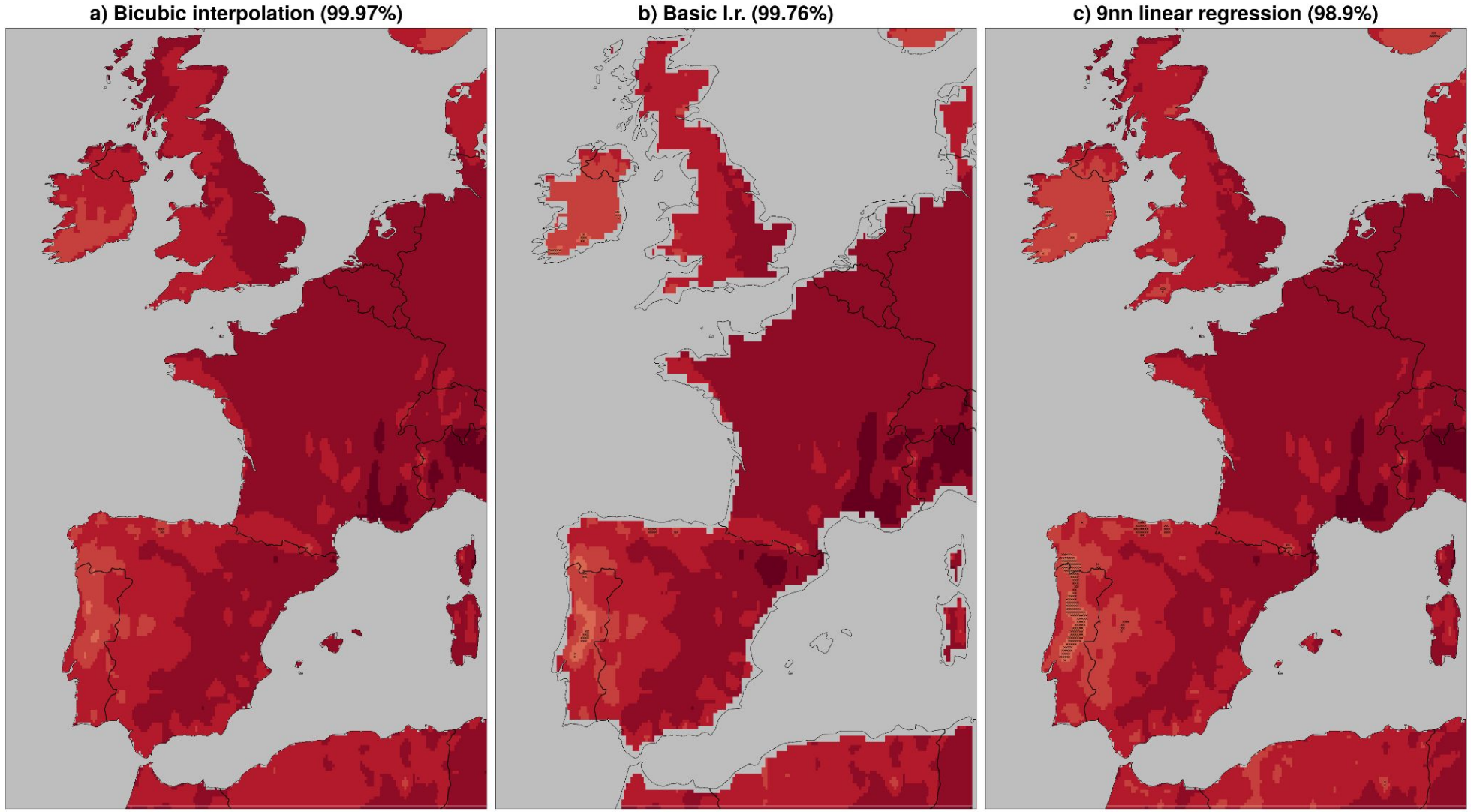
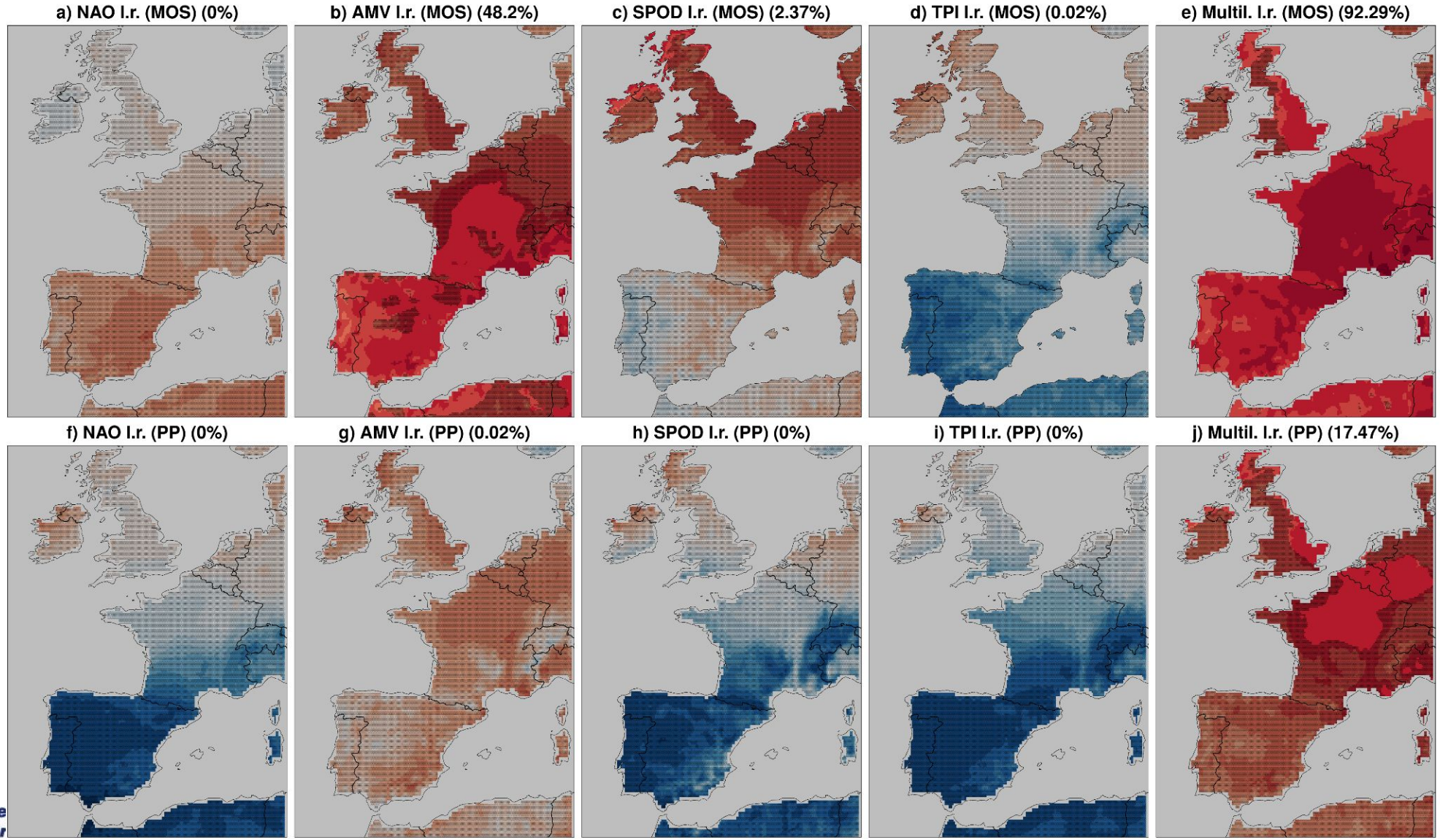
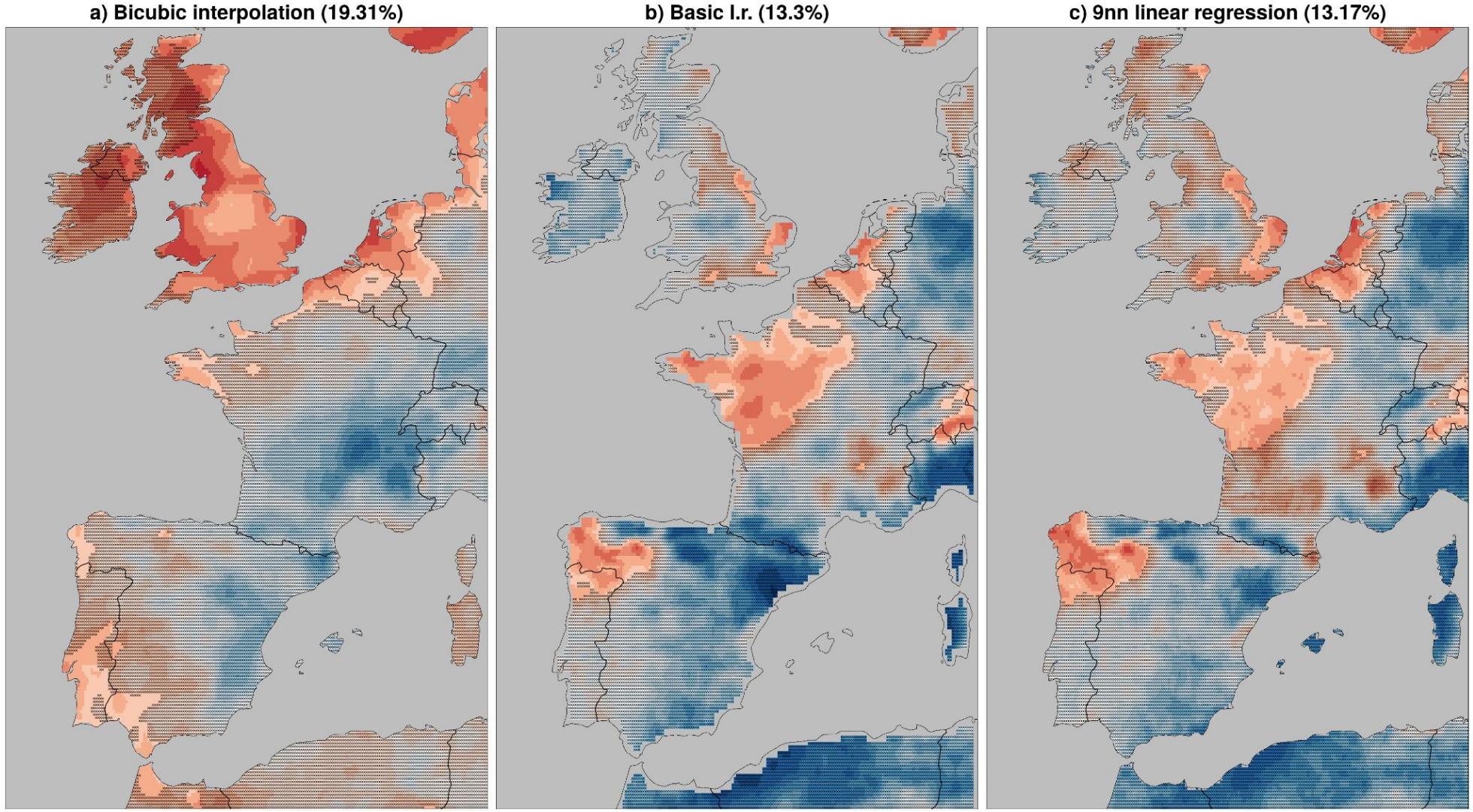
Linear regressions TAS - predictor: the own variable



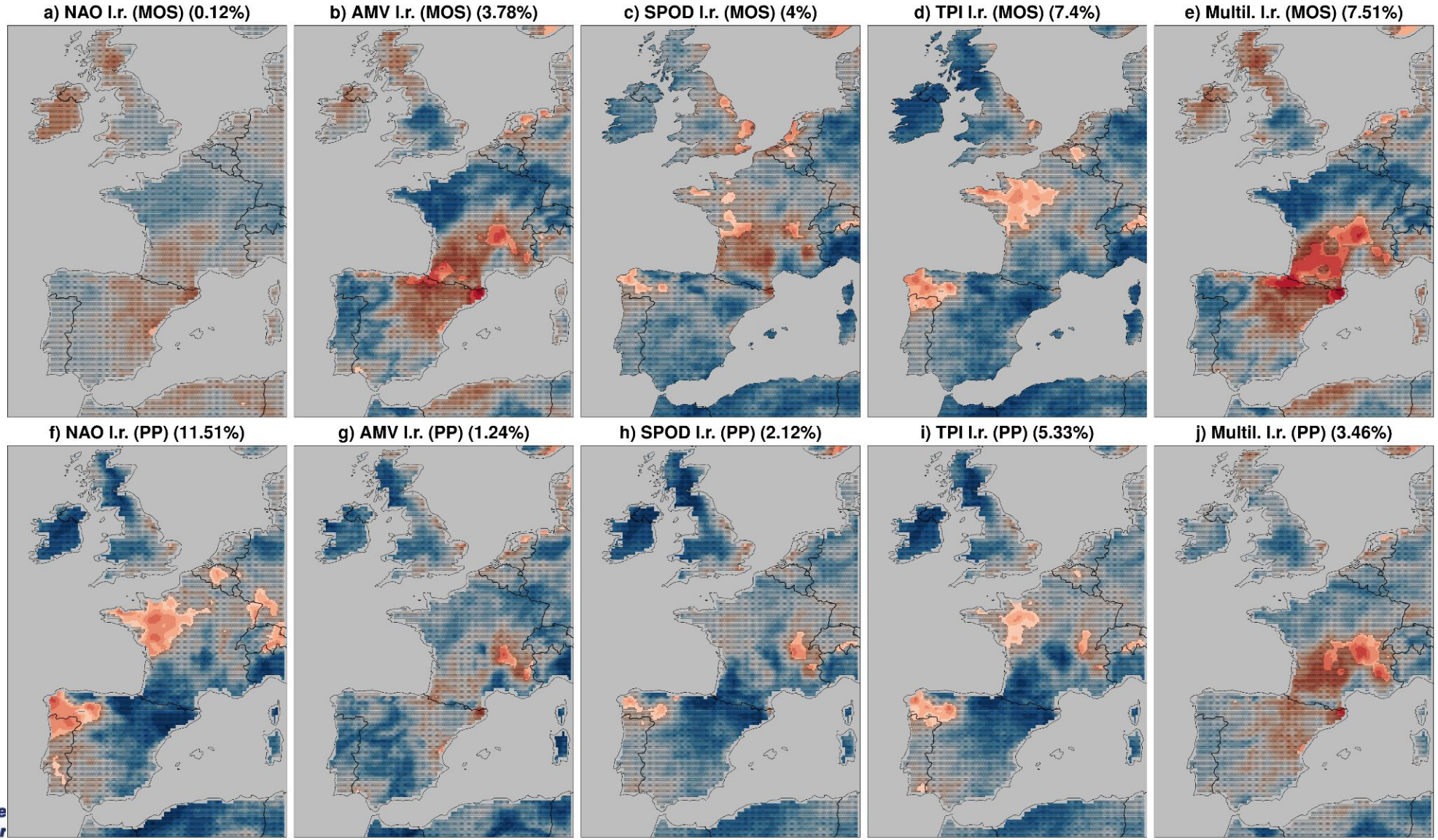
Linear regressions TAS - predictor: teleconnection indices



Linear regressions PR - predictor: the own variable



Linear regressions PR - predictor: teleconnection indices

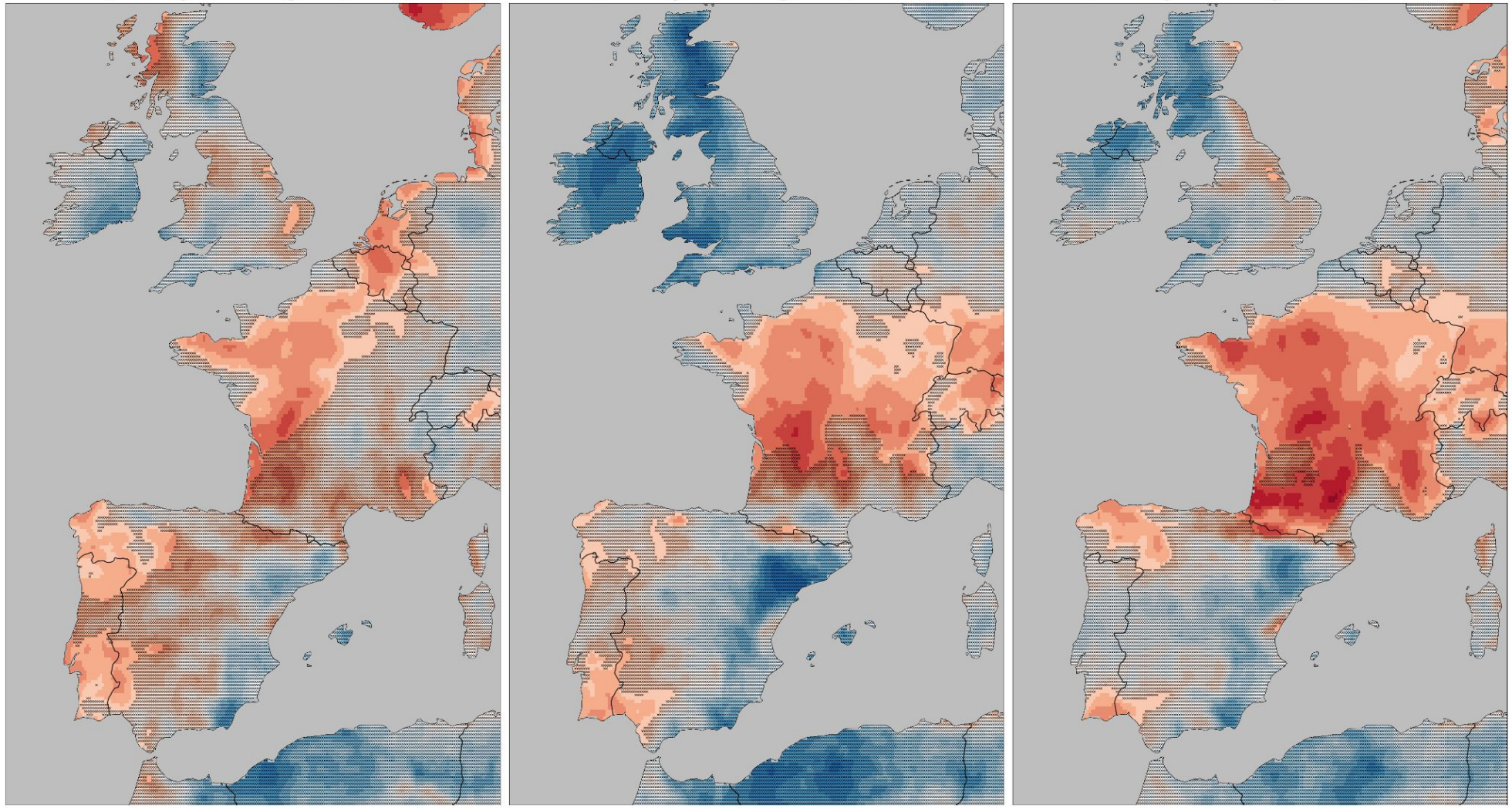


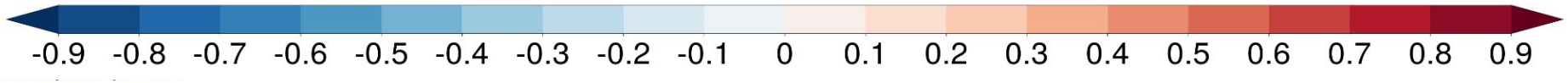
Analogs PR

a) Analogs PR using PR (19.3%)

b) Analogs PR using PSL (21.23%)

c) Analogs PR using ZG500 (29.74%)





Summary

Temperature

- Original predictions have high skill
- Interpolations: the skill patterns are preserved
- Calibrations: the skill is slightly reduced in some regions
- Linear regressions:
  - Using the own variable, the skill is well preserved
  - Using teleconnection indices, the skill is highly reduced for almost all of them

Precipitation

- Original predictions have moderate skill
- Interpolations: the skill patterns are preserved but there are less percentage of significant points
- Calibrations: the skill is reduced in the majority of the region but increased in some parts (West France and Galice)
- Linear regressions:
  - Using the own variable, the skill patterns are similar to those obtained with calibrations
  - Using teleconnection indices, the skill patterns are variable depending on the index
- Analogs: the skill is increased in some regions but reduced in others for all the predictors used

Next steps

- Investigate causes and justifications of precipitation results
- Apply this methodology to other variables such as minimum temperature indicator for frozen days
- Apply analogs methodology to temperature and combining different predictors
- Apply the methods to different regions if necessary
- Apply the methods to seasons instead of whole years
- Use other methodologies such as machine learning methods or generalized linear regressions

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Thank you!

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Supplementary Material

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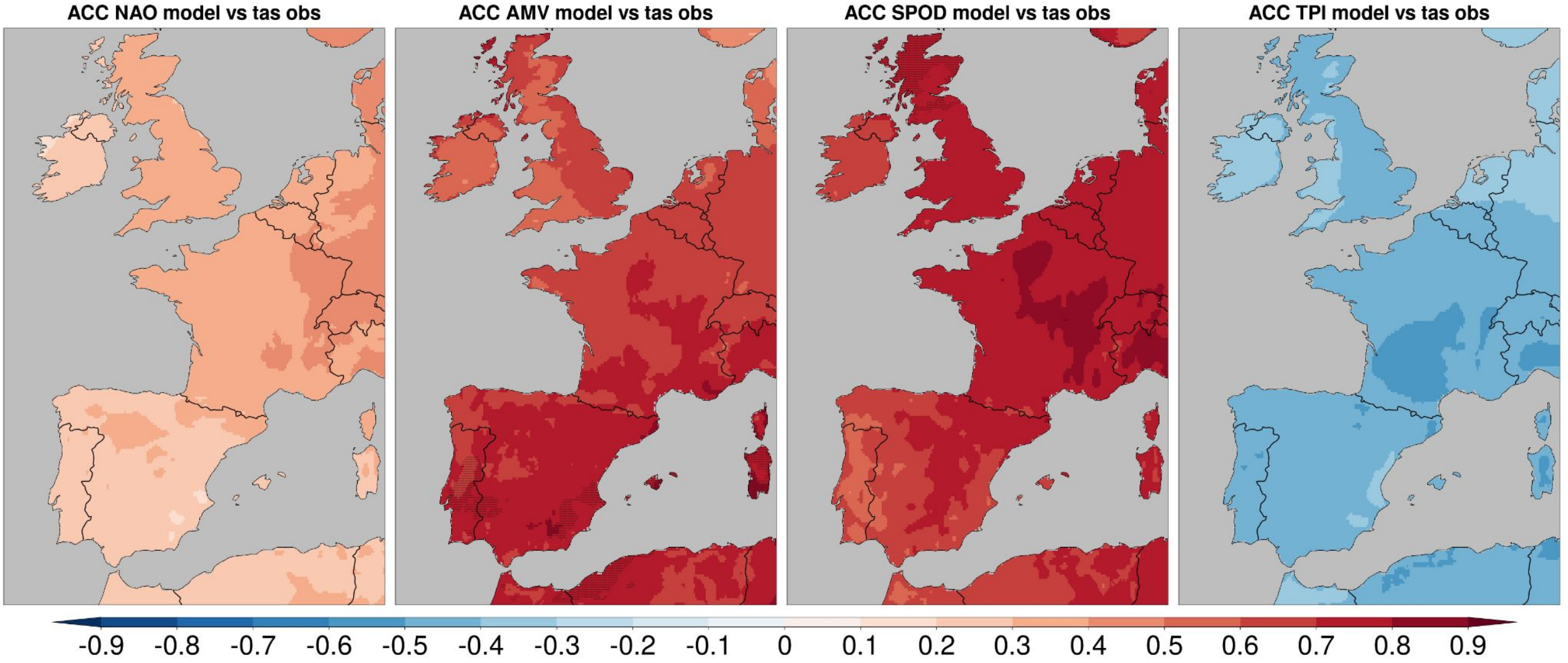
Correlations between teleconnection models and TAS observations



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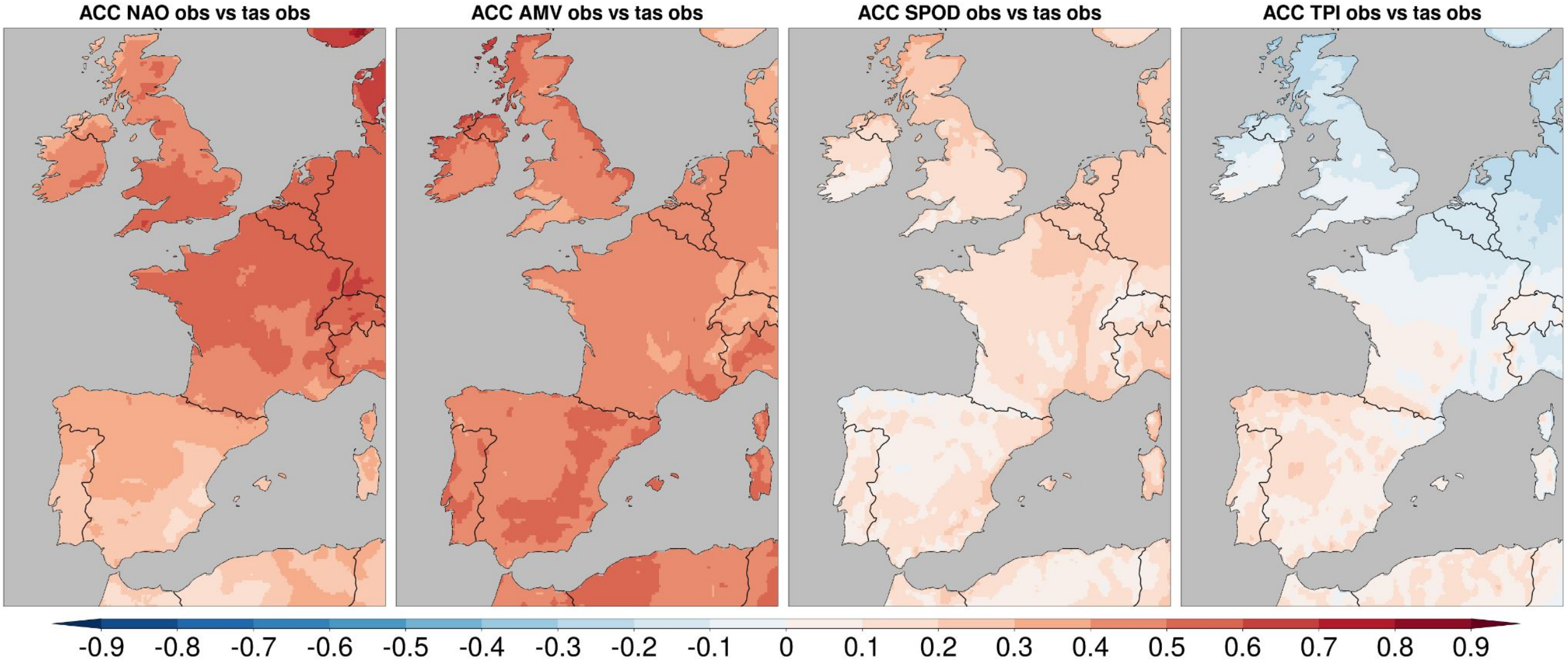
Correlations between teleconnection observations and TAS observations



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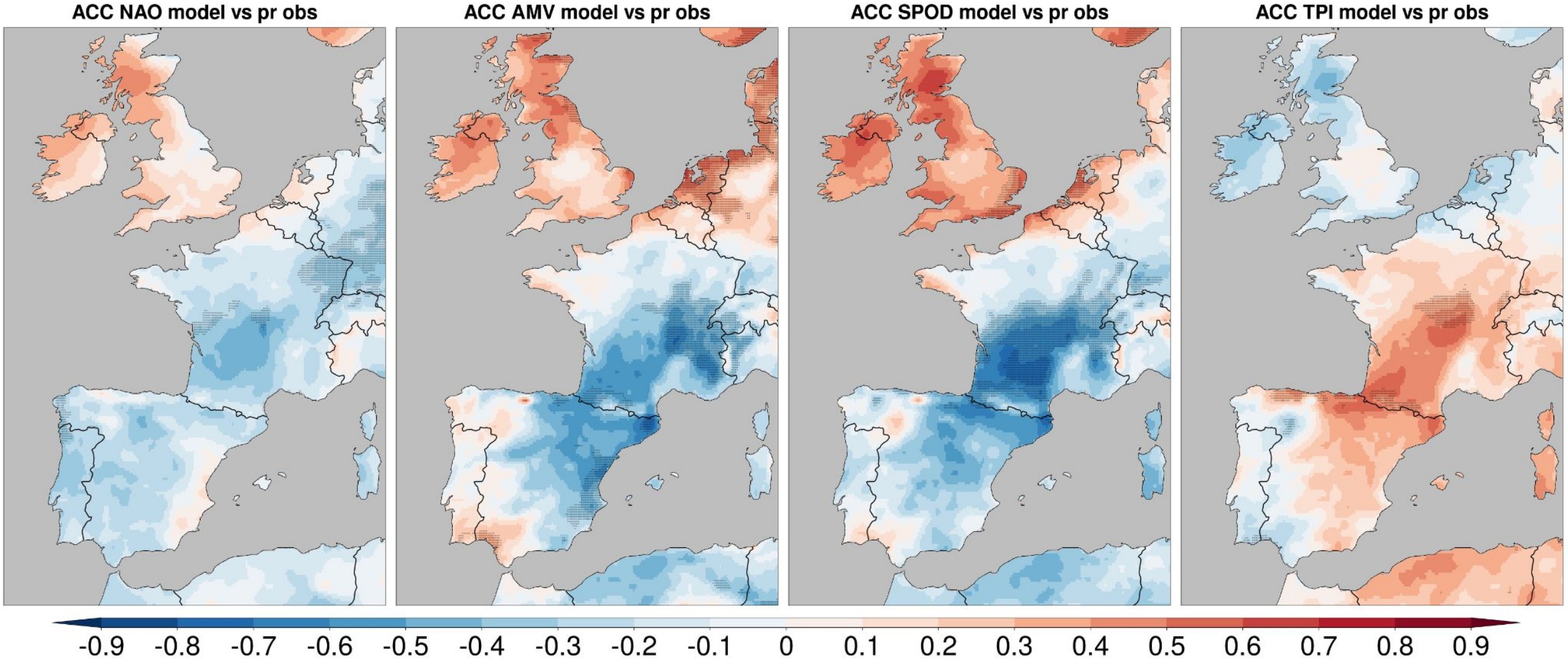
Correlations between teleconnection observations and PR observations



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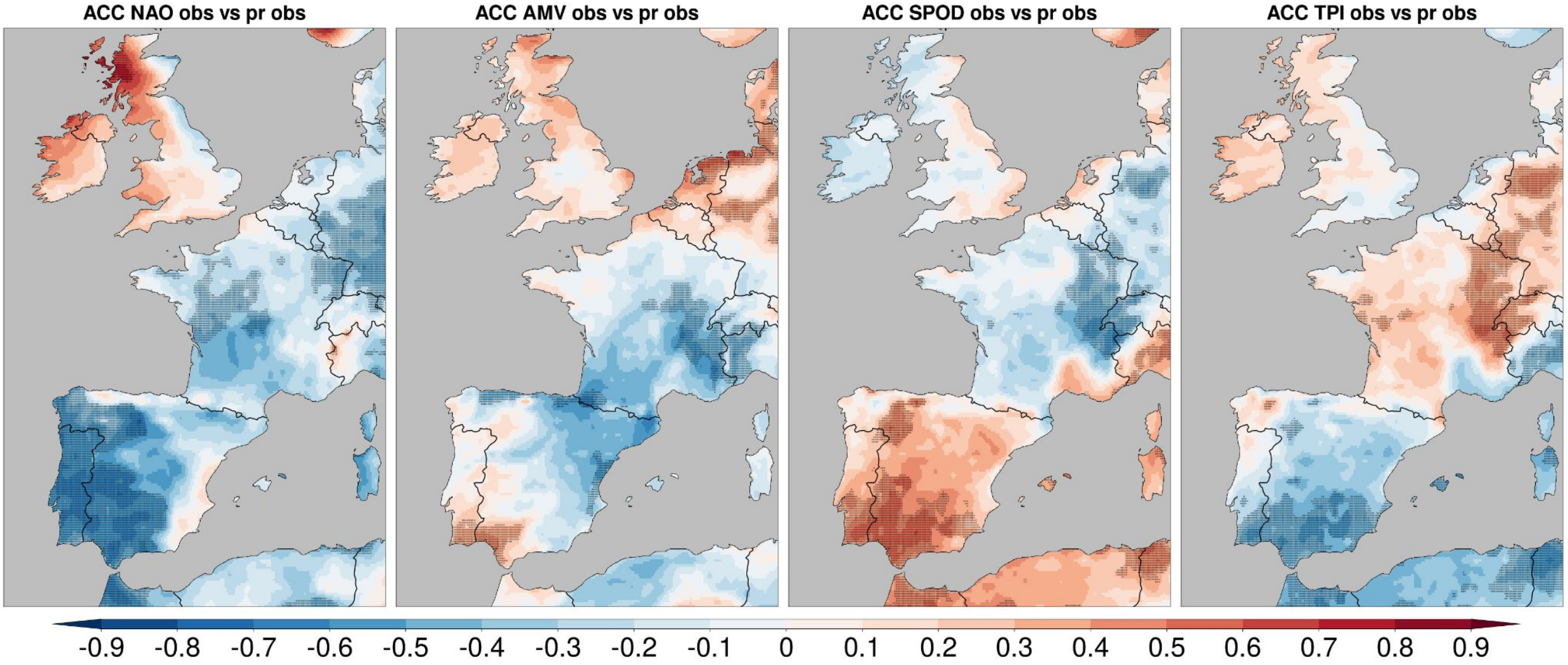
Correlations between teleconnection models and PR observations



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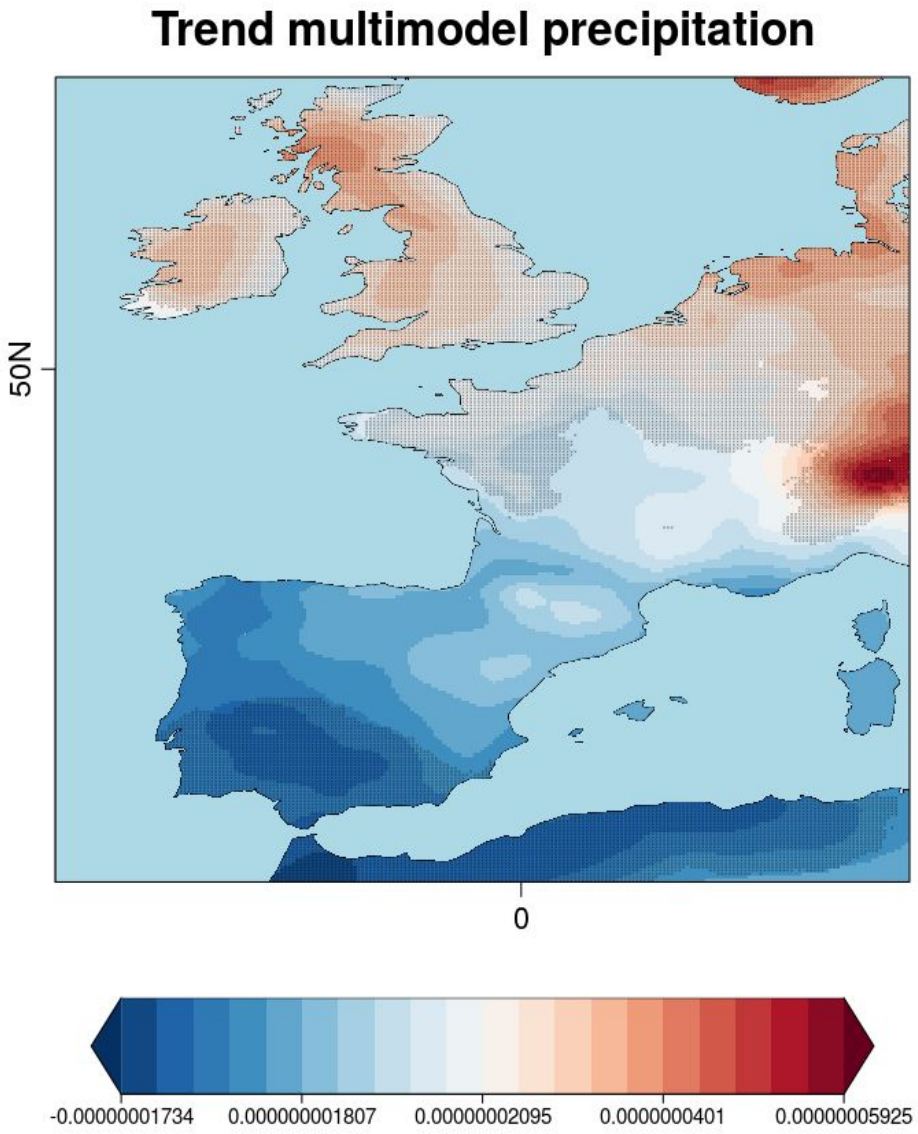
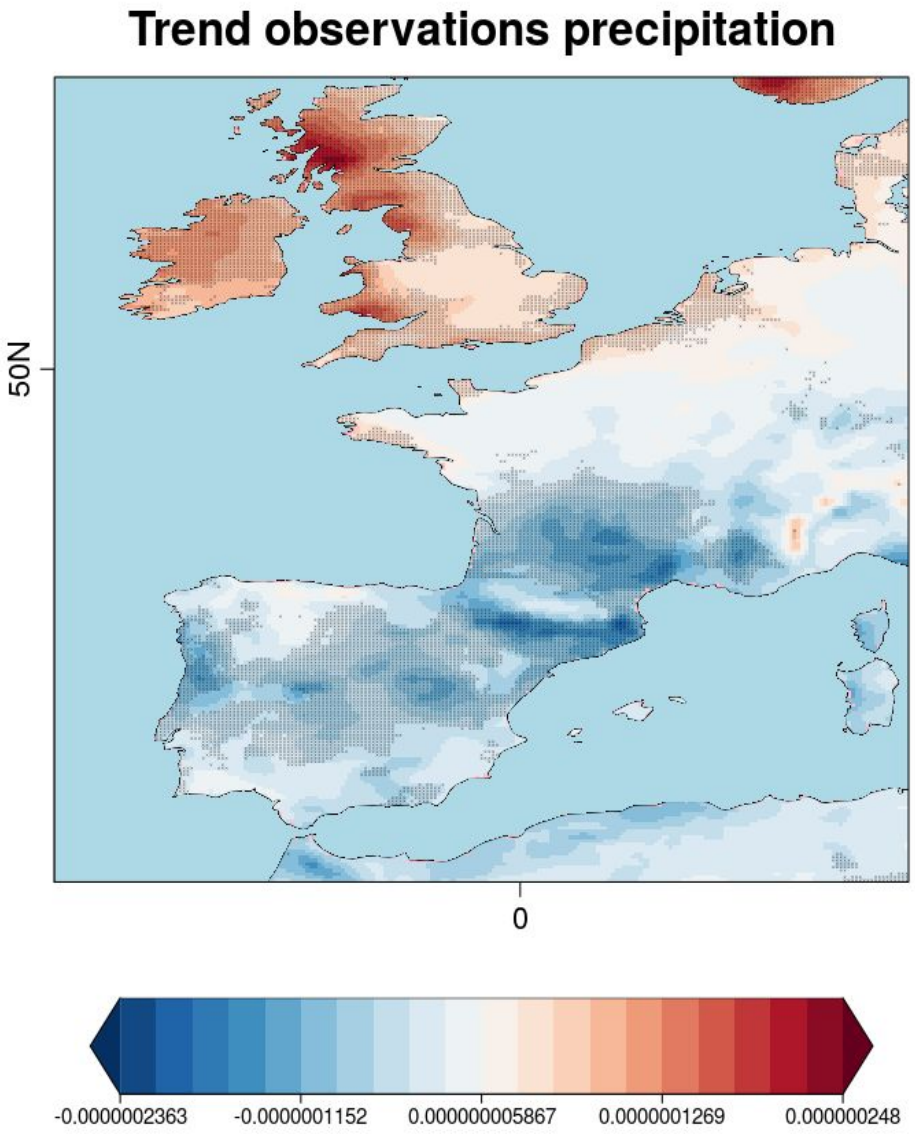
Trend of precipitation in multimodel and in observations





Analysis of the impact of the cross-validation in one point for precipitation using mse-min calibration