A CMIP6 evaluation of summer synoptic circulations linked to short-term droughts over Europe

Pedro Herrera Lormendez[1], Amal John[2], Hervé Douville[2], Jörg Matschullat[1]

[1] TU Bergakademie Freiberg, Germany

[2] Météo-France, France

pedro.herrera-lormendez@ioez.tu-freiberg.de

PedroLormendez

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
The University of Resources. Since 1765.

METEO FRANCE

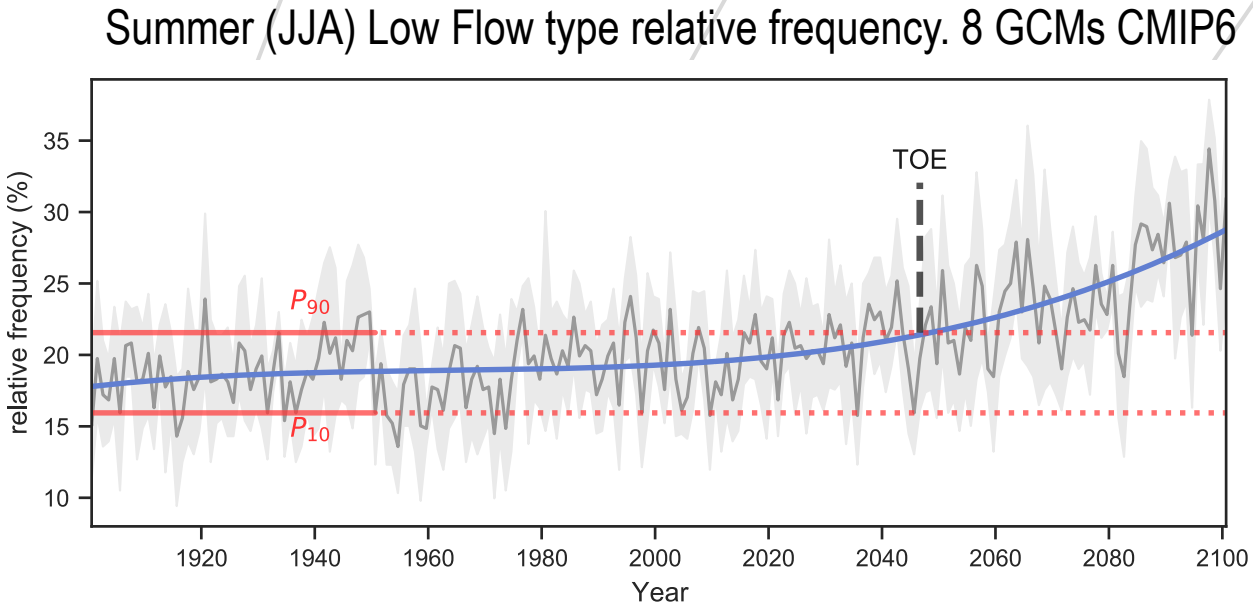
CAFE
Climate Advanced Forecasting of sub-seasonal Extremes

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 813844

Motivation

"One of the key questions of synoptic climatology is whether a certain circulation type is directly linked to typical surface weather, and whether this relationship remains stable over long time periods"

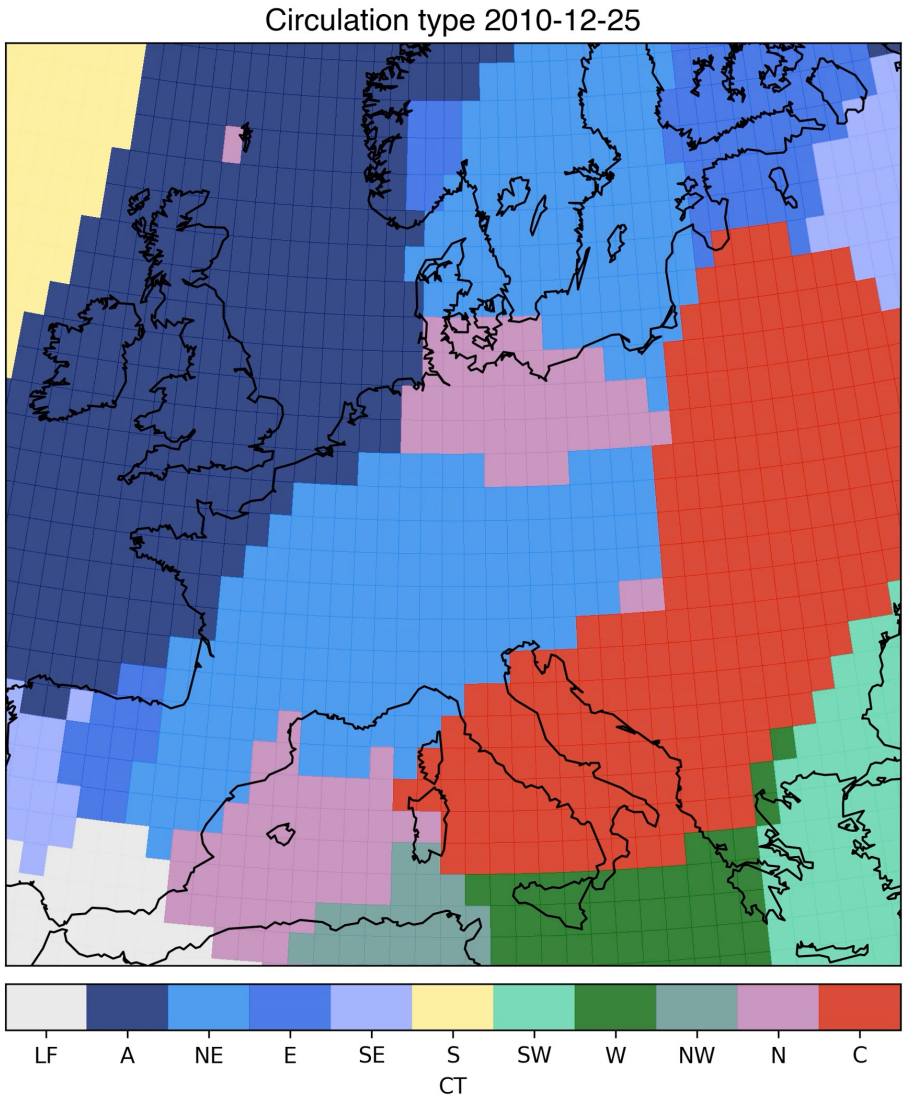
(Cahynová and Huth, 2016)

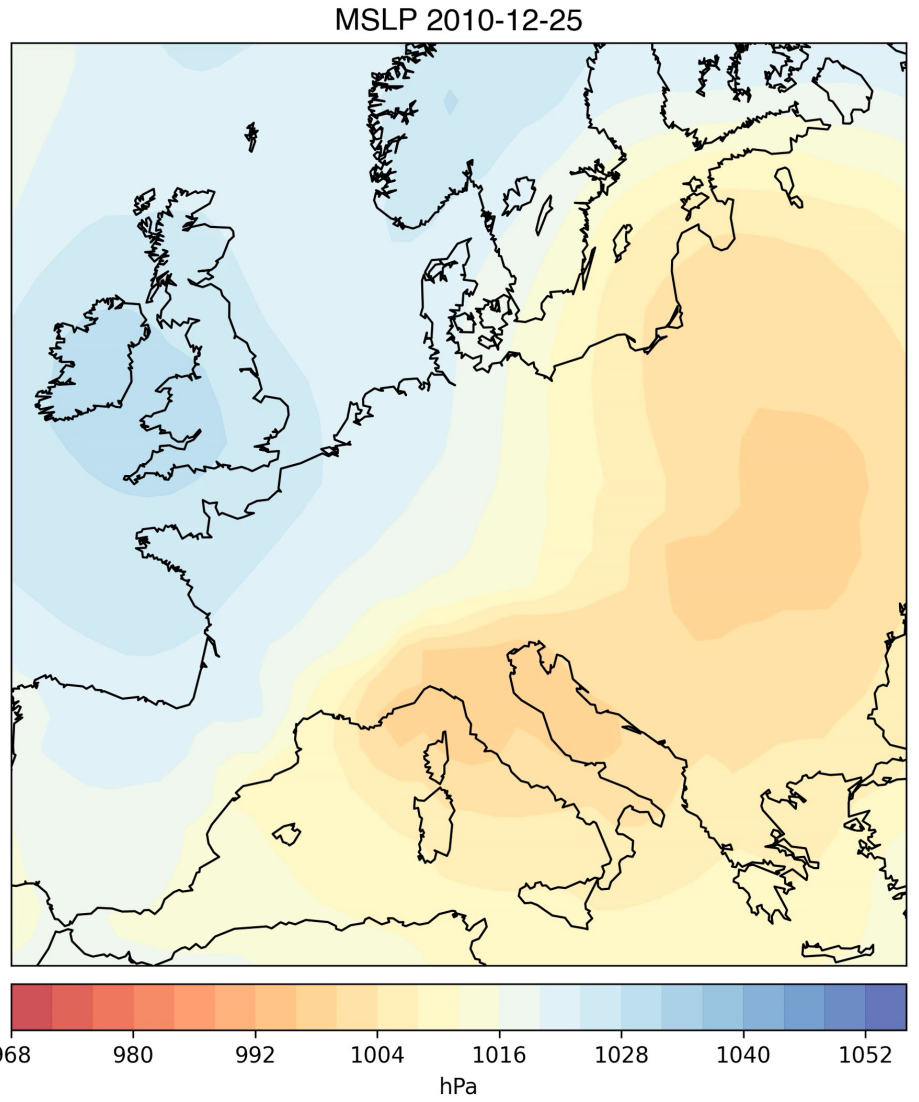


(Herrera-Lormendez et al., International Journal of Climatology, 2021)

Our approach

11 reduced circulation types based on the dominant pressure pattern and directional advection





Spatial characteristics

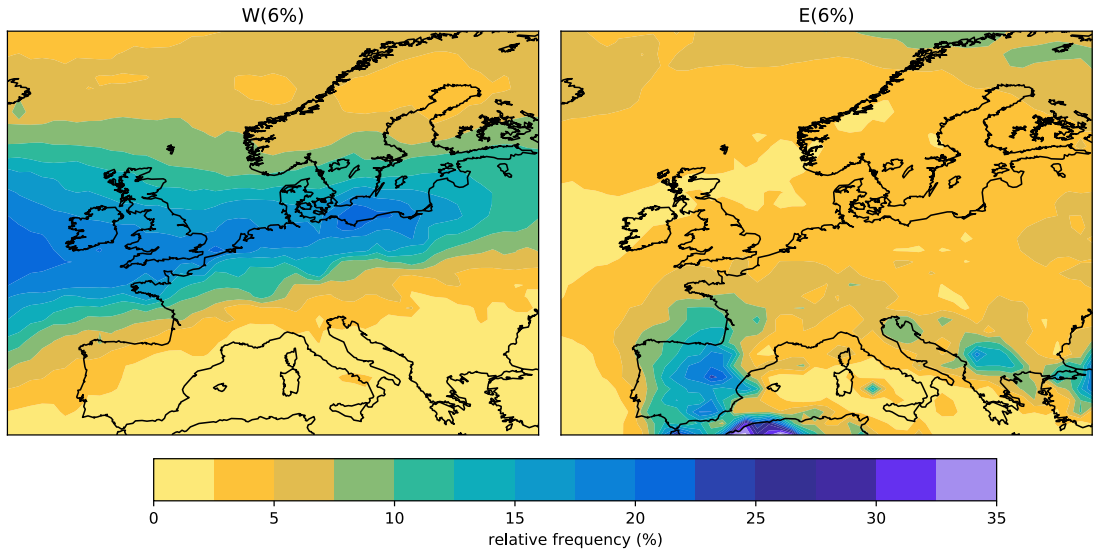
ERA5

E-OBS

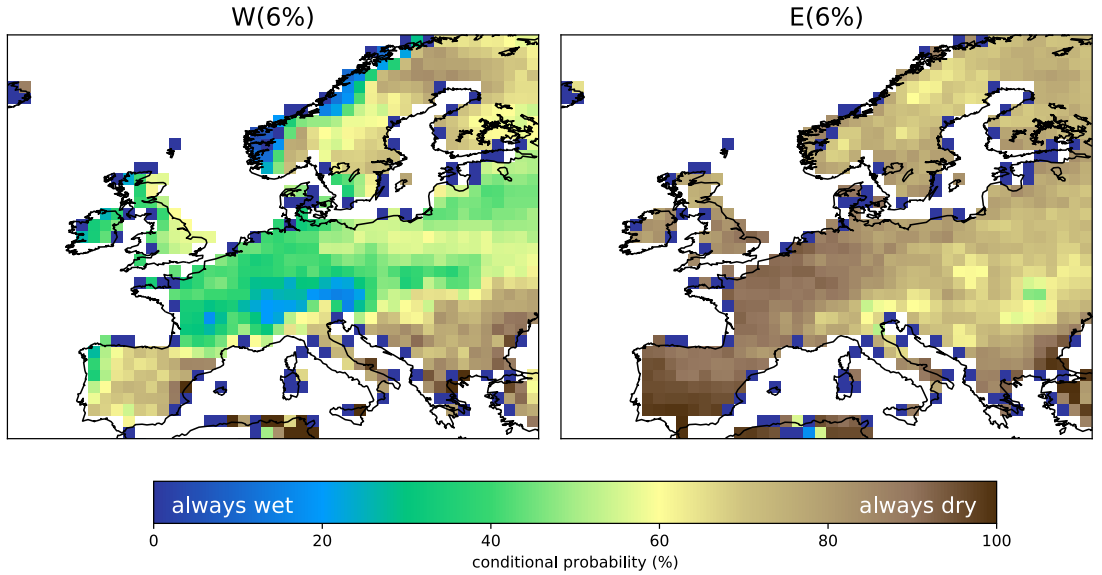
21 GCMs

Automated gridded Jenkinson-Collison classification

a) Summer (JJA) relative frequencies ERA5 1951-2000



b) Summer (JJA) Dry Conditional Probability E-OBS 1951-2000



Model evaluation

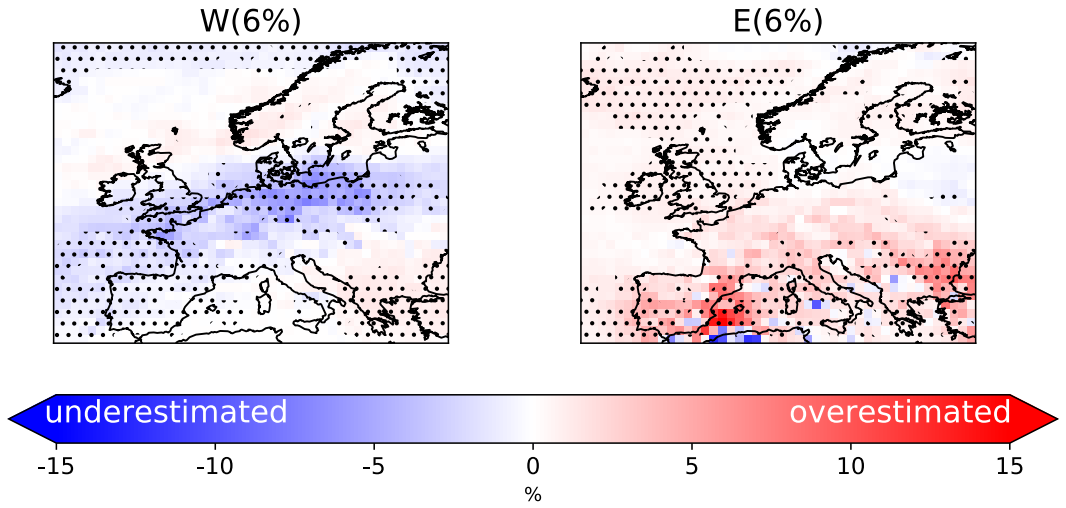
ERA5

E-OBS

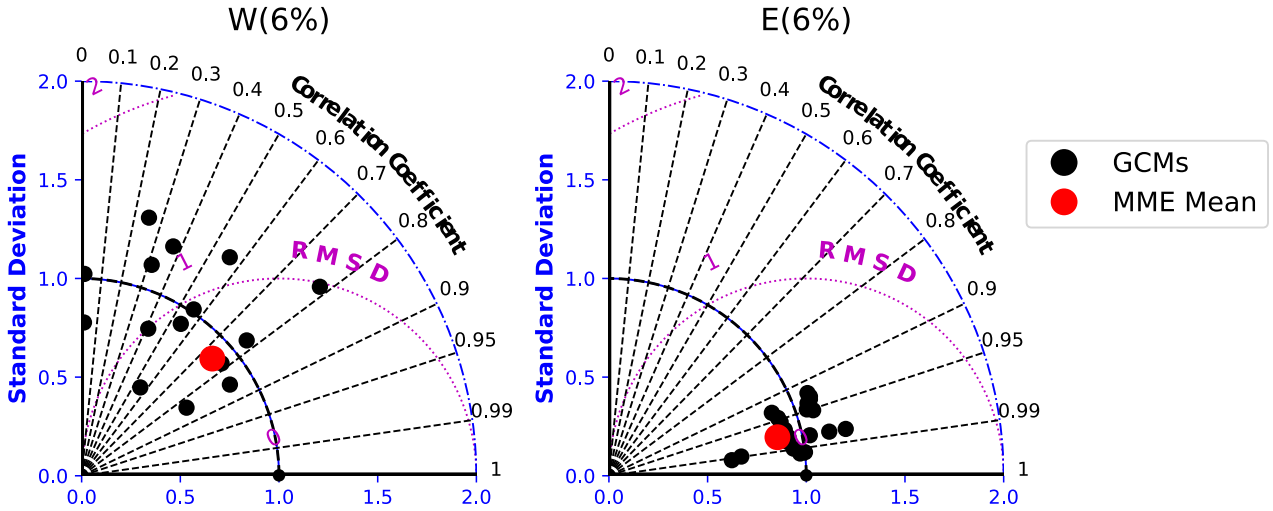
21 GCMs

Automated gridded Jenkinson-Collison classification

a) Differences in summer(JJA) relative frequencies MME vs ERA5



b) Taylor Diagrams summer(JJA) rel. freq. differences GCMs and MME vs ERA5



GCMs: Global Climate Models
MME: Multi-model Ensemble
••• 66% Model Agreement

Model evaluation

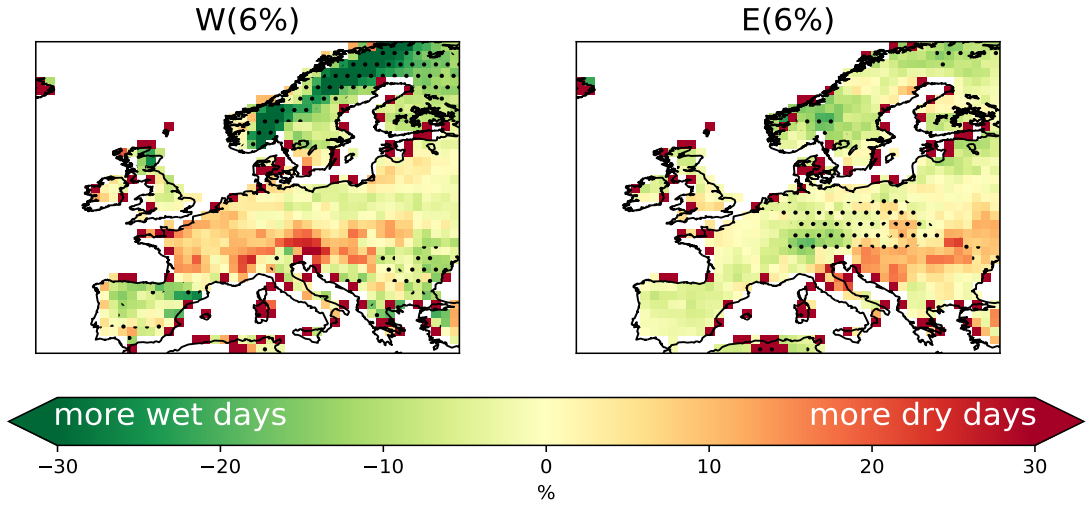
ERA5

E-OBS

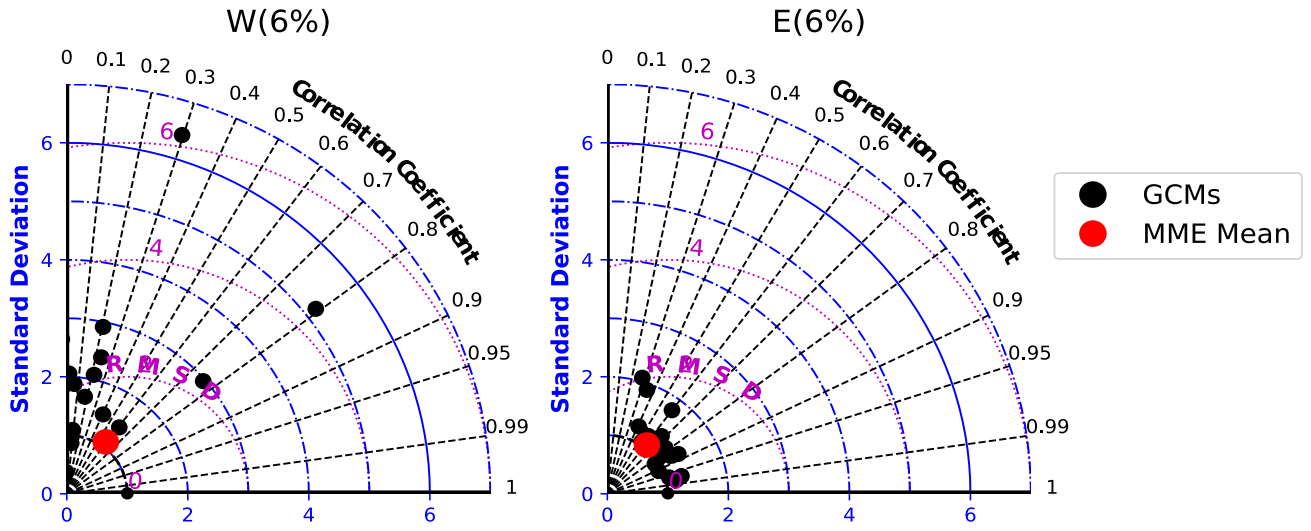
21 GCMs

Automated gridded Jenkinson-Collison classification

a) DCP differences MME vs E-OBS



b) Taylor Diagrams DCP differences GCMs and MME vs E-OBS



DCP: Dry Conditional Probability
GCMs: Global Climate Models
MME: Multi-model Ensemble
••• 66% Model Agreement

Influence on dry months

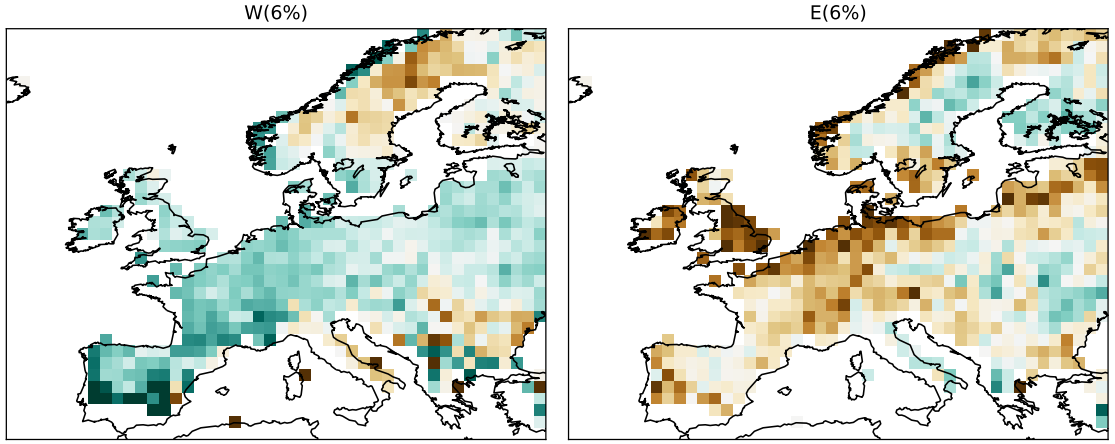
Monthly total precipitation

Monthly SPI

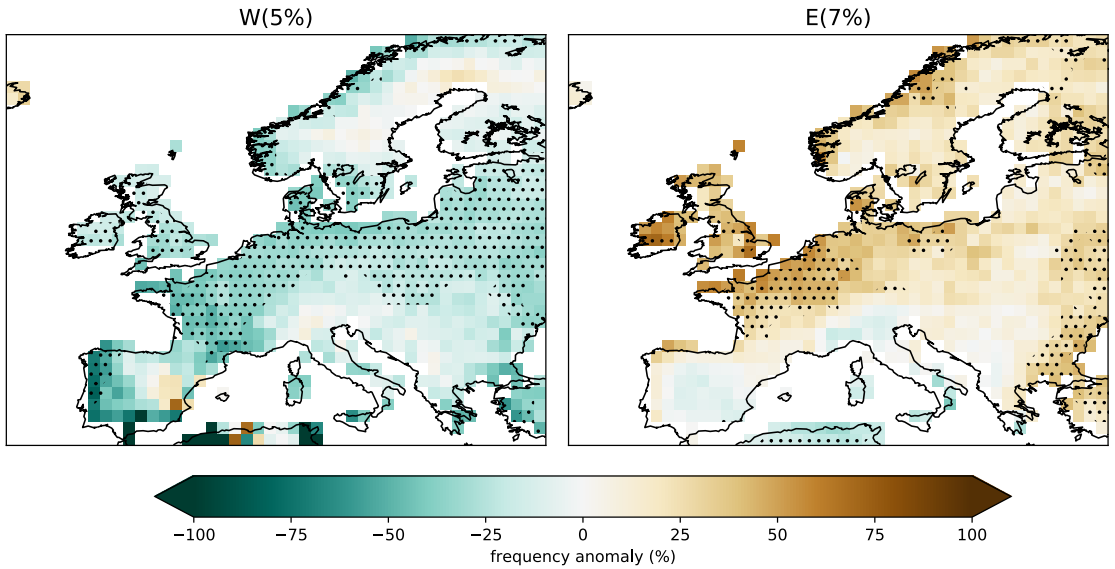
Gridded monthly frequency anomalies of CTs

Summer (JJA) MME Median

a) E-OBS and ERA5 summer(JJA) frequency anomalies during dry months (SPI<-1)



b) CMIP6 MME Median summer(JJA) frequency anomalies during dry months (SPI<-1)



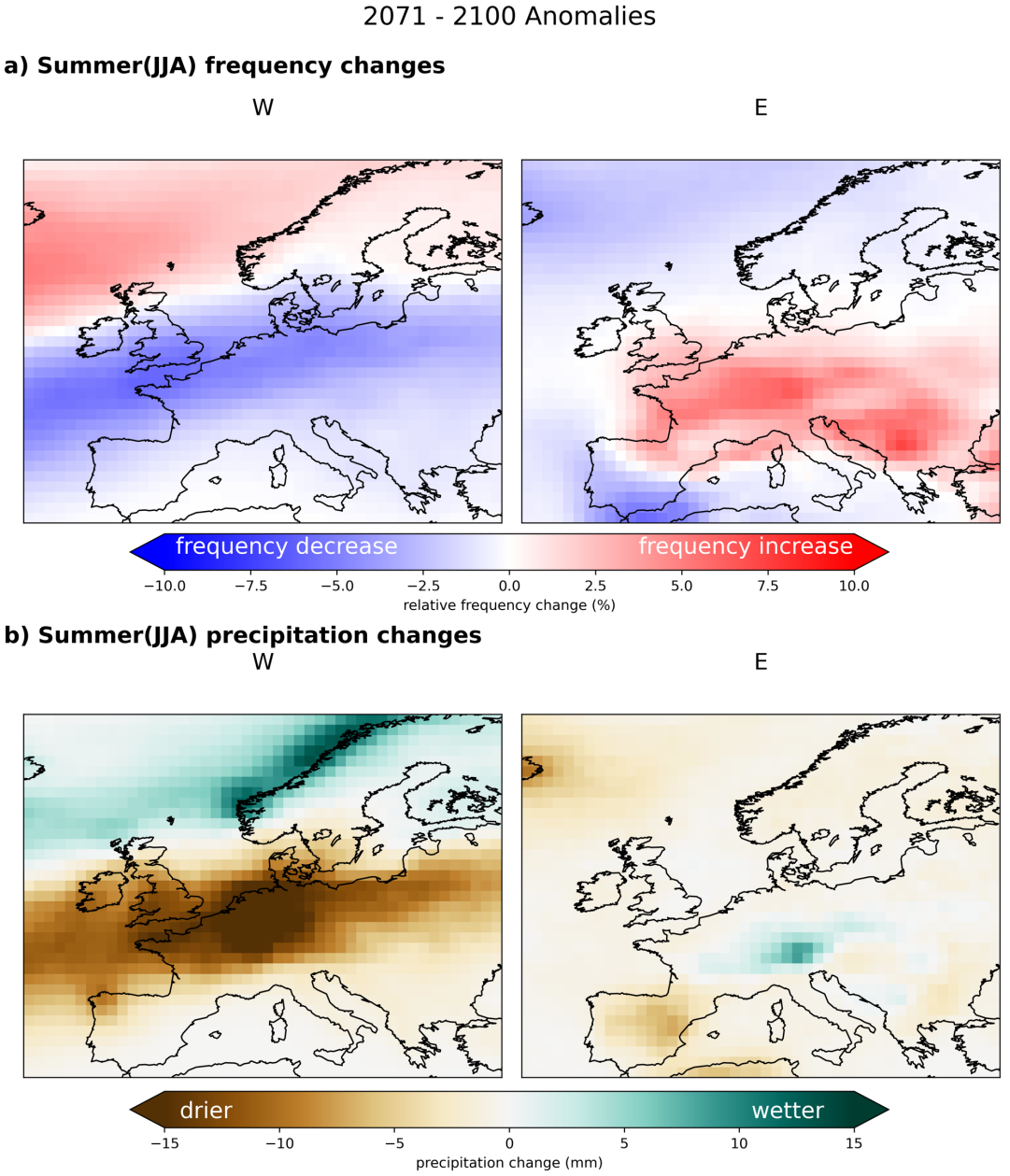
MME: Multi-model Ensemble

••• 80% Model Agreement

Future changes

- Significant decrease in precipitation due to circulation changes

or not?



To conclude:

- Better representation of CTs in GCMs,
- Prevailing biases in reproducing Westerlies,
- Zonal influence on precipitation,
- Likely future changes in zonal types strongly influencing summer precipitation changes.

pedro.herrera-lormendez@ioez.tu-freiberg.de

PedroLormendez

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
The University of Resources. Since 1765.

METEO FRANCE

CAFE
Climate Advanced Forecasting of sub-seasonal Extremes

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 813844