

## 1 Motivation

- European windstorm loss under climate change remains uncertain [1].
- Seasonal loss clustering cause extensive economic loss [2].

## 2 Significance of study

For the first time :

- EURO-CORDEX was used to study windstorm loss across entirety of Europe.
- We investigate regional differences of seasonal loss clustering across various Global Warming Levels (GWLs).

## 3 Data

Bias corrected (Empirical quantile mapping with ERA5 wind gust) EURO-CORDEX (12.5 km) daily maximum 10m wind gust from Historical period (1975-2005) to future period at GWL+2°C and GWL+3°C.

### Global Climate Model (GCM) :

NorESM1-M (2031 – 2060) (2057 – 2086)  
 EC-EARTH (2026 – 2055) (2051 – 2080)  
 HadGEM2-ES (2016 – 2045) (2037 – 2066)  
 CNRM-CM5, and MPI-ESM-LR (2029 – 2058) (2052 – 2081)

### Regional Climate Model (RCM) :

COSMO-crCLIM-v1-1  
 RACMO22E  
 HadREM3-GA7-05  
 RCA4

## 4 Method

### Loss index (LI) [3]

$$LI = \sum_{i=1}^N \sum_{j=1}^M \left( \frac{v_{ij}}{v_{98ij}} \right)^3 \cdot I(v_{ij}, v_{98ij}) \cdot P_{ij} \cdot L_{ij}$$

$v_{ij}$ : maximum wind gust within 72 hours  
 $v_{98th\ ij}$ : 98<sup>th</sup> percentile of daily maximum wind gust  
 $I(v_{ij}, v_{98th})$ : 0 if  $v_{ij} < v_{98th}$  and 1 if  $v_{ij} > v_{98th}$   
 $P_{ij}$ : population density  
 $L_{ij}$ : 0 if seas and 1 if land

### Loss Clustering [2], if :

$$\frac{OEP}{AEP} \approx 0$$

OEP : Maximum LI in a season  
 AEP : Total LI in a season

## 7 Conclusion

- LI and event frequency decrease over Western Europe, while they generally increase over Eastern Europe.
- Seasonal loss clustering is less common under GWLs in most regions.

### What is seasonal loss clustering ?

Multiple European windstorms in a season (ONDJFM), which cause large cumulative economic losses.

## 5 Result 1 : Change in windstorm loss

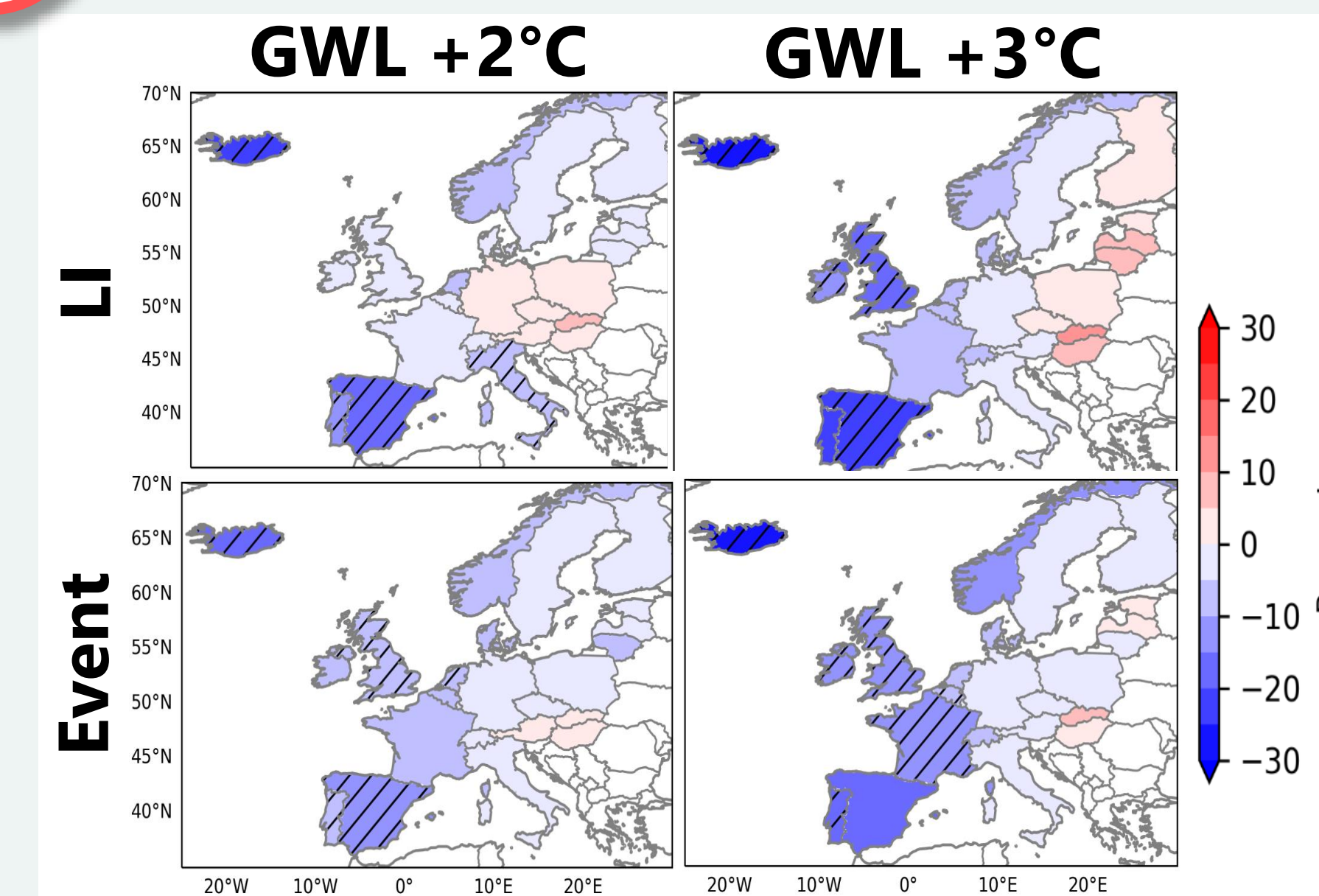


Fig 1. Changes in LI and Event frequency under GWLs. Slash : More than 14 models agree on the sign of change.

- A decrease in LI and event frequency occurs over Western Europe, while an increase is generally observed over Eastern Europe.
- Non-robust changes prevail in most countries.

### Core Europe

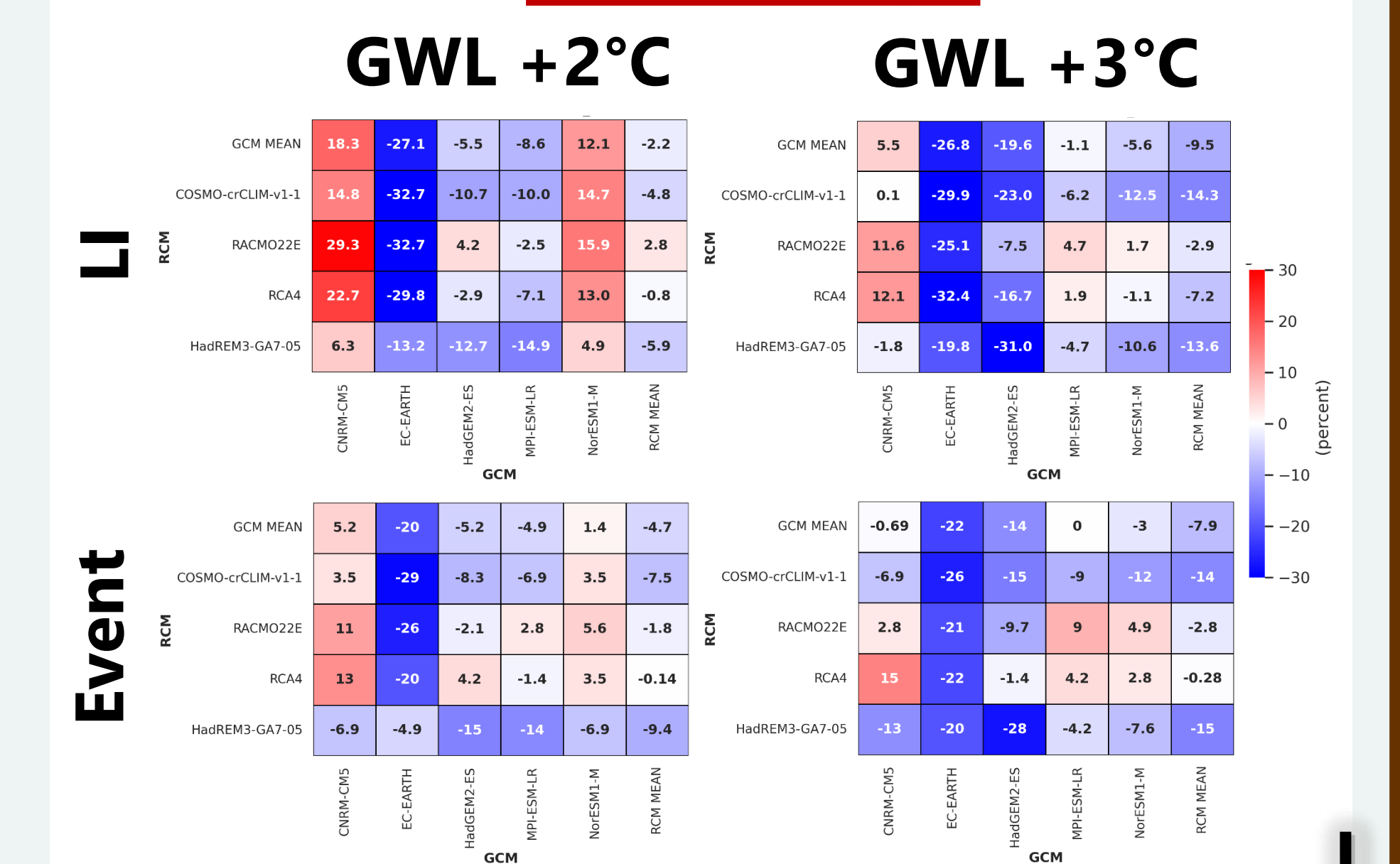


Fig. 2. Same as Fig. 1, but model-to model variation for Core Europe.

- The variations in event frequency and LI are model-dependent.
- CNRM-CM5 predicts higher LI, while EC-EARTH shows lower LI and event frequency.

## 6 Result 2 : Change in seasonal loss clustering

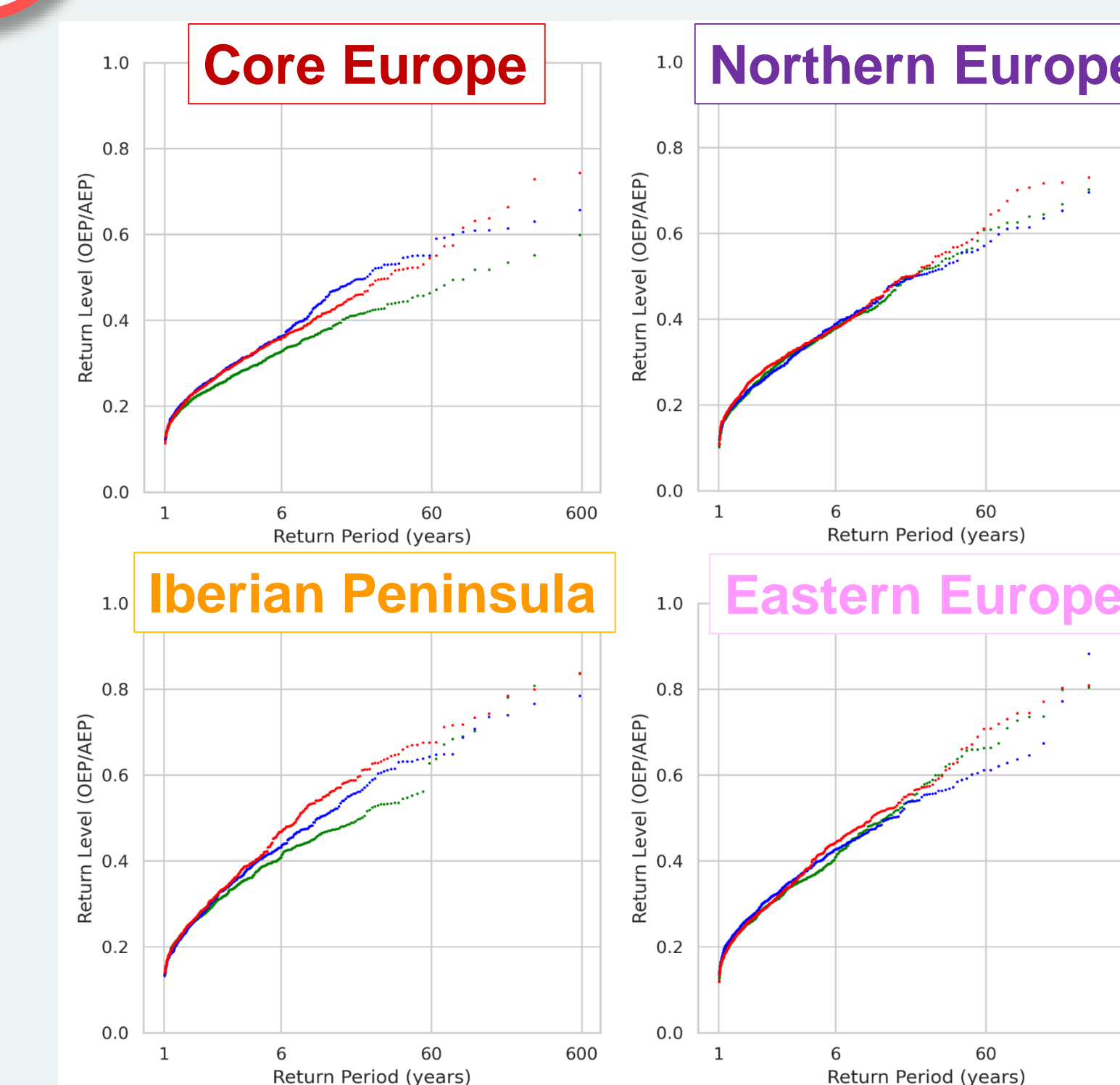
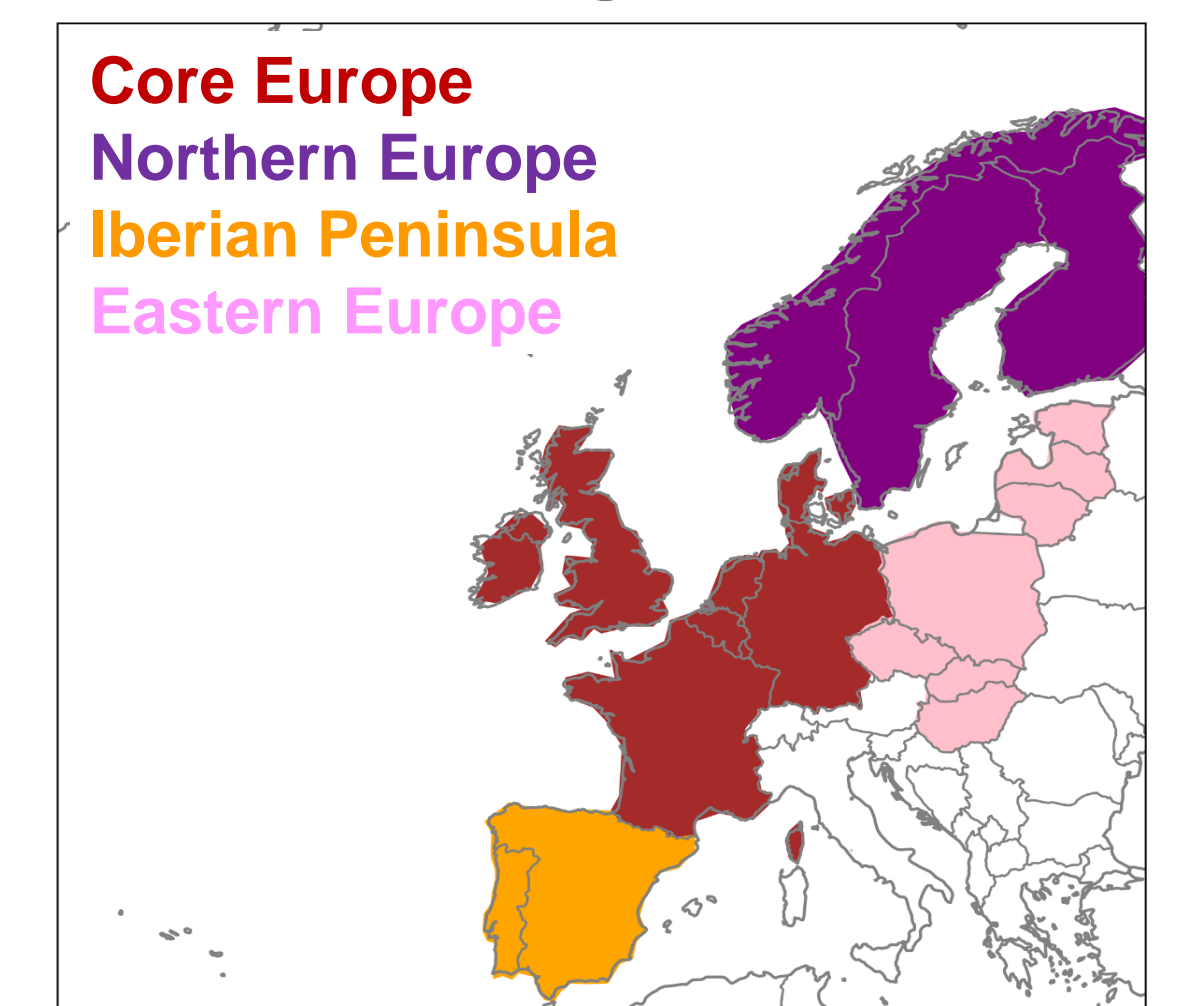


Fig. 3. Empirical Return Period of Loss Clustering under Historical, GWL+2°C, GWL+3°C.

### Legend:



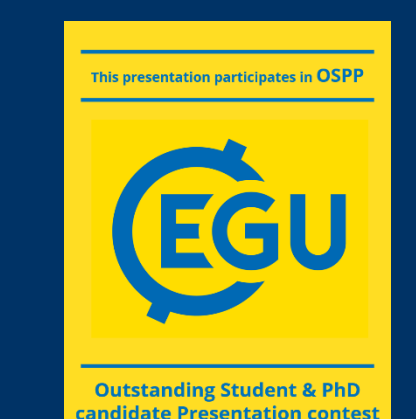
- Northern and Eastern Europe have slight changes.
- Core Europe and the Iberian Peninsula have bigger changes with less frequent clustering under GWLs.

## References

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