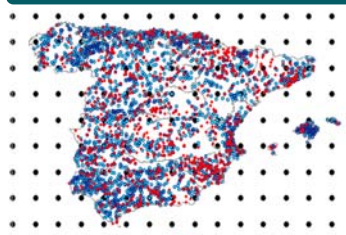


Abstract

The aim of this work is to study and analyze changes in meteorological phenomena and atmospheric circulation during two recent periods of time (1957-1979 and 1980-2002) over mainland Spain and the Balearic Islands. In order to do so, we have performed a joint probabilistic analysis of Weather Types (WTs) and daily observations. WTs are obtained from the ERA-40 Re-analysis data using a modified Self-Organizing Map, which uses the transition probability from one WT to another as ordering criterion. Changes in the frequency of appearance of each WT and their transition probability are analyzed, as well as changes in daily observations and alterations in the frequency of different events.

1. Daily Data



- 888 thermometric stations
- 2788 pluviometric stations
- 1° resolution ERA-40 nodes

Period 1 (P1): 1957-1979
Period 2 (P2): 1980-2002

ERA-40

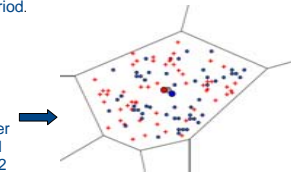
Variables: Z, T, U, V, R
Levels: 1000hPa, 850hPa, 500hPa

2. Cluster Analysis



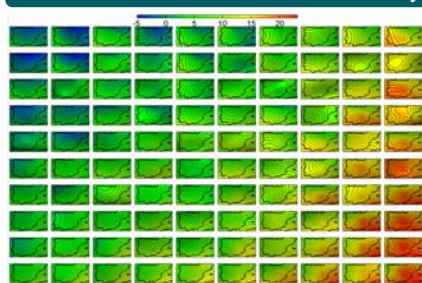
Cluster of 100 WTs, using a k-means algorithm, obtained from the ERA-40 Re-analysis and optimized in the space of the observations (extreme temperatures and precipitation)

In order to compare WTs in both periods we use the general cluster to find two new centers, one for each period, using the atmospheric states that correspond to each period.



Red crosses: P1 atmospheric states
Blue dots: P2 atmospheric states
Grey circle: center of the global cluster
Red circle: center of the cluster for P1
Blue circle: center of the cluster for P2

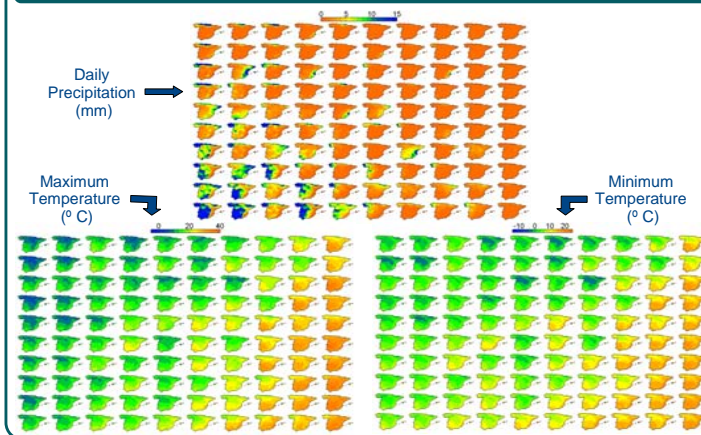
3. Circulation Types



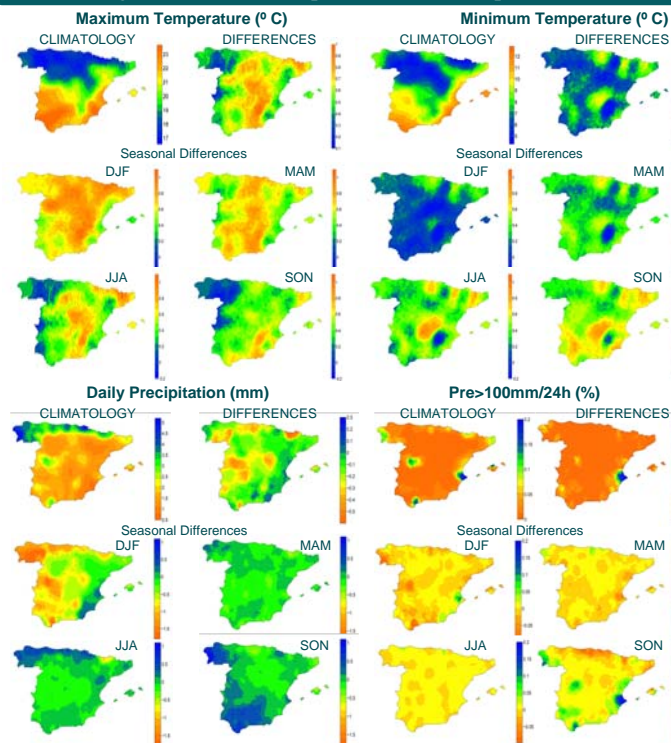
ERA-40
T850: colored
Z500: contoured

The cluster has been ordered by their atmospheric similarities

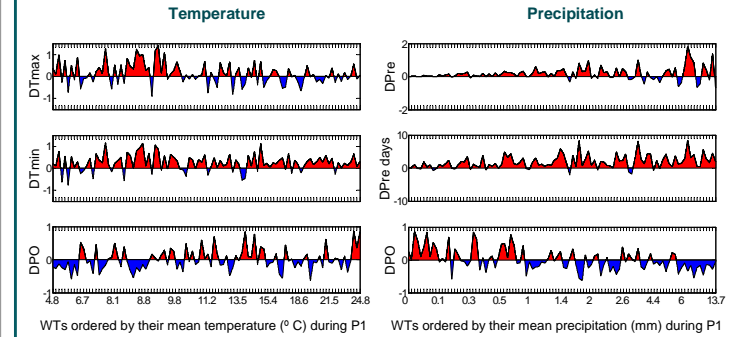
4. Weather Types



5. Changes in Extreme Temperatures and Precipitation (P2-P1)



6. Changes in Weather Types (P2-P1)



DTmax: Differences in Maximum Temperature for each WT (°C)
DTmin: Differences in Minimum Temperature for each WT (°C)
DPre amount: Differences in rainfall amount for each WT (mm)
DPre prob: Differences in rain probability for each WT (%)
DPO: Differences in the occurrence probability of each WT (%)

Notice that changes in the occurrence probability are of the same order of magnitude as those of the occurrence probability of WT.

7. Conclusions

- Changes in extreme temperatures and precipitation were heterogeneous in space, time and distribution of WTs.
- Both extreme temperatures rose since 1980.
- Thermic amplitude in winter was higher during P2 than during P1.
- Almost all the WTs rose their extreme temperatures.
- The warmest WTs were more frequent during P2 and the coldest ones were less frequent.
- Results show a significant decrease in precipitation, mainly during winter.
- Extreme precipitation events (Pre>100mm) were more extreme during autumn since 1980, over some areas of the domain.
- During P2 the atmosphere was warmer and the capacity of WTs to produce precipitation was higher. Thus, WTs increased their rainfall amount and their rain probability during P2. Nevertheless, dryer WTs were more frequent than wetter ones from 1980 on, producing a decrease in the total amount of precipitation over most part of the domain.

8. Future Work

- Detailed study of changes: over different regions of Spain and different WTs.
- Study changes in the transition probability of WTs.
- Study extreme events using WTs.

References

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- M. Bermejo and R. Ance (2009): Statistical analysis of weather types over the Iberian peninsula domain. *Clima en España: Pasado, presente y futuro. Contribución a un informe de Evaluación del Cambio Climático Regional*, Feb. 2009, Madrid
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