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Non-parametric inferences on climate change of high-resolution spatial patterns of precipitation extremes in Iberia

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Precipitation daily-total data, obtained a multi-model ensemble of Regional Climate Model (RCM) simulations provided by the EU FP6 Integrated Project ENSEMBLES, is analysed at a horizontal spatial resolution of 25 km in the Iberian Peninsula (IP).

ENSEMBLES' RCMs were driven by boundary conditions imposed by General Circulation Models (GCMs) that ran under historic conditions from 1961 to 2000, and under the SRES A1B scenario from 2001 to 2100.

Annual and seasonal indices of precipitation extremes, proposed by the CCI/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI), were derived from the daily precipitation ensemble.

The ensemble of ETCCDI indices is subjected to climate detection methods in order to identify Iberian regions projected to experience higher climate change.

Non-parametric climate change detection methods are applied to each member of the
ETCCDI multi-model ensemble (ETCCDI-MME) and to and to its median (ETCCDI-MMEM). The resulting statistics are used to infer climate change projections and associated uncertainties.

Climate change projections are evaluated from the statistics obtained from the ETCCDI-MMEM, while the uncertainties of those projections are evaluated by a rank-based measure of the spread of these statistics across the ETCCDI-MME.

All methods consist of an estimator whose realization, or estimate, is tested by a non-parametric hypothesis test:
(i) Theil-Sen linear trend, from 1961 to 2100, tested by the Mann-Kendall test;
(ii) differences between the climatologies, estimated by the time median,
of a near-future (2021-2050) and a distant-future (2071-2100) climates
from the climatology of a recent-past reference climate (1961-1990),
tested by the Mann-Whiteney test; and
(iii) difference between the Probability Distributions of the near and distant climates from that of the reference climate, tested by the Kolmogorov-Smirnov test.

IP regions with statistically significant, at 0.05 level, projected climate change, under the A1B scenario, detected by the three methods are identified.

Since these projections have associated uncertainties, estimated by their spread across the MME, we identify which of these regions have projected uncertainties below a chosen threshold value.

In other words, this methodology identifies which IP regions are projected to experience climate significant changes, assuming the A1B scenario, by the majority of the RCM/GCM simulations.

To further minimize the uncertainties of the projections, ETCCDI indices are also computed from the ERA-driven simulations and from the E-OBS dataset provided by the ENSEMBLES project to represent the observed data. Comparison between the two ETCCDI sets is made to validate the climate change projections.

For these regions, the characteristics of such changes are then studied in more detail analysing the changes in the Probability Density Functions of the ETCCDI-MMEM.