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Climate change of Precipitation extremes in the Iberian Peninsula: CLIPE project results

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The main aims of the project 'Climate change of Precipitation extreme episodes in the Iberian Peninsula (IP) and its forcing mechanisms - CLIPE' are (i) to diagnose the climate change signal in the Precipitation extremes over the Iberian Peninsula (IP), and (ii) to identify the underlying physical mechanisms. For the first purpose, a multi-model ensemble of 26 Regional Climate Model (RCM) simulations, from the European ENSEMBLES project, is used. These experiments were generated by 11 RCMs, driven by 6 General Circulation Models (GCMs) under both historic conditions (1961-2000) and SRES A1B scenario (2001-2100), and also by ERA data for the recent-past period. In this project, daily precipitation and 500mb geopotential height, for the periods $1961 - 1990$ (recent past), 2021-2050 (recent future), and 2071-2100 (distant future), are used. Using extreme statistics of Precipitation (ETCCDI indices), climate change is presented by high spatial resolution maps of climate-mean differences and trends using a non-parametric approach. A brief discussion between the differences between these results and those obtained by equivalent parametric methods is presented. Note that the non-parametric approach consists of (i) median climatology differences tested by the Mann-Whiteney test, and trends estimated by the Theil-Sen method tested by the Mann-Kendall test. The corresponding parametric approach consists of (i) mean climatology differences, and trends estimated by a least-squares linear regression, both tested by t-Student based tests. Some statistics cannot be displayed in a map, such as Probability Density Functions (PDFs) of time-varying spatial fields. This is case of precipitation over the IP and its derived quantities, which have high spatial gradients. Note that the ENSEMBLES RCMs have approximately 2500 grid-points (each one with a time series) in the IP. Hence, such a large number of PDFs cannot be presented in a short document. Therefore, it is mandatory to reduce the number of degrees of freedom over the IP, i.e. to reduce the number of time series representative of the precipitation time-varying spatial field over the IP. This reduction can be achieved by partitioning the IP into a reasonable number of regions and each region can thereby be represented by a representative precipitation time series. A $k = 6$ cluster analysis of daily precipitation (where the grid points are taken as observations and the daily values are taken as variables) is applied herein. The time series representative of these six IP regions are then subject to further climate change analysis. Particularly, the PDFs estimated for the near and distant future climates of each region are compared to the PDF estimated for the recent-past climate. Kolmogorov-Smirnov tests are applied to assess the statistical difference between future and recent-past PDFs. Regarding the second main objective of the CLIPE project, a $k = 4$ means clustering was applied to the daily 500 hPa geopotential height over the North Atlantic-European (NAE: 90W-30E, 20N-80N) region, yielding four weather circulation regimes (WCRs): Blocking, Zonal or NAO+, Atlantic Ridge, and Greenland Anticyclonic. For each one of the four WCRs, PDFs of each one of the six IP regions are estimated. These results provide climate change projections of precipitation, as well as its derived quantities (such as extreme indices) associated to each WCR and for each IP region. The interpretation of these results helps associating regional climate changes with large-scale circulation changes.

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Keywords

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