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CLIVAR-SPAIN contributions: Evaluation of WRF ability to reproduce mean and extreme precipitation over Spain.

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In this study, the WRF ability to reproduce the precipitation over Spain is addressed in terms of means and higher-order statistics. The Iberian Peninsula is of particular interest considering its complex topography and its location in the mid- latitudes, which implies a large variability across the region. Furthermore, the Mediterranean area is predicted to be strongly affected by a decrease in precipitation due to global warming and thus an appropriate evaluation of the model will permit to create reliable high-resolution projections of climate change scenarios. Three different simulations at 10-km resolution over the Iberian Peninsula have been completed spanning a 30-year period (1970-1999) and compared with the Spain02 dataset, a daily precipitation observational grid. The ERA40 reanalysis has been employed as 'perfect boundary conditions' in order to reduce lateral boundaries uncertainties and focus on the model performance. Additionally, the General Circulation Models CCSM 3.0 and ECHAM5/MPI have also been selected to specify the boundary conditions and explore their suitability for climate studies over the Iberian Peninsula. The model performance has been evaluated with regard to annual, seasonal and monthly precipitation. Additionally, several statistic parameters have been calculated to assess WRF capabilities to accurately capture the frequency of heavy rainfall, the occurrence and duration of dry spells, and the precipitation Probability Distribution Function (PDF) over Spain. The WRF model is able to reproduce the main Southeast to Northwest precipitation gradient that the GCMs roughly describe. But furthermore, it provides valuable information of precipitation amount and distribution throughout Spain, enhancing the effect of orographic features that GCMs cannot be expected to capture. An evident repercussion of the boundary conditions on the results can be observed, since the simulation driven by reanalysis data shows a good agreement with observations at all timescales. Nonetheless, substantial biases in the monthly precipitation have been found for both the GCMs with very similar spatial patterns, but mainly positive in the case of ECHAM5 and negative for CCSM. Major deviations are obtained for the Northwest and the Mediterranean coast. Despite these biases in monthly means, the different extreme indices and the precipitationPDF that have been calculated for the regional model compare remarkably well with those obtained for Spain02. Therefore, the WRF model constitutes a particularly useful tool to provide climate information with respect to precipitation at scales that are crucial for both the population and the ecosystems. Acknowledgements: the Spanish Ministry of Science and Innovation, with additional support from the European Community Funds (FEDER), project CGL2010-21188/CLI has financed this study.