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Regional Climate Model sesitivity to different parameterizations schemes with WRF over Spain

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The ability of the Weather Research and Forecasting (WRF) model to simulate the regional climate depends on the selection of an adequate combination of parameterization schemes. This study assesses WRF sensitivity to different parameterizations using six different runs that combined three cumulus, two microphysics and three surface/planetary boundary layer schemes in a topographically complex region such as Spain, for the period 1995-1996. Each of the simulations spanned a period of two years, and were carried out at a spatial resolution of 0.088° over a domain encompassing the Iberian Peninsula and nested in the coarser EURO-CORDEX domain (0.44° resolution). The experiments were driven by Interim ECMWF Re-Analysis (ERA-Interim) data. In addition, two different spectral nudging configurations were also analysed. The simulated precipitation and maximum and minimum temperatures from WRF were compared with Spain02 version 4 observational gridded datasets. The comparison was performed at different time scales with the purpose of evaluating the model capability to capture mean values and high-order statistics. ERA-Interim data was also compared with observations to determine the improvement obtained using dynamical downscaling with respect to the driving data. For this purpose, several parameters were analysed by directly comparing grid-points. On the other hand, the observational gridded data were grouped using a multistep regionalization to facilitate the comparison in term of monthly annual cycle and the percentiles of daily values analysed. The results confirm that no configuration performs best, but some combinations that produce better results could be chosen. Concerning temperatures, WRF provides an improvement over ERA-Interim. Overall, model outputs reduce the biases and the RMSE for monthly-mean maximum and minimum temperatures and are higher correlated with observations than ERA-Interim. The analysis shows that the Yonsei University planetary boundary layer scheme is the most appropriate parameterization in term of temperatures because it better describes monthly minimum temperatures and seems to perform well for maximum temperatures. Regarding precipitation, ERA-Interim time series are slightly higher correlated with observations than WRF, but the bias and the RMSE are largely worse. These results also suggest that CAM V.5.1 2-moment 5-class microphysics schemes should not be used due to the computational cost with no apparent gain with respect to simpler schemes such as WRF single-moment 3-class. For the convection scheme, this study suggests that Betts-Miller-Janjic scheme is an appropriate choice due to its robustness and Kain-Fritsch cumulus scheme should not be used over this region.

KEY WORDS: Regional climate modelling, physics schemes, parameterizations, WRF.

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