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A physics ensemble of regional climate change projections over the Iberian Peninsula

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Some of the most widely used Regional Climate Models (RCMs) contain large numbers of parameterizations which are known, individually, to have a significant impact on simulated climate. Up to date, considerable uncertainties exist in the the extent to which different choices of parameter-settings or schemes may influence present climate simulations and different projections for the future climate. The most thorough way to investigate this uncertainty is to run ensemble experiments in which relevant parameter combination is investigated. The use of ensemble techniques in regional climate modeling has been shown in several studies (such as the PRUDENCE, ENSEMBLES projects) as feasible for obtaining projections of climate change and to study the capacity of RCMs to reproduce the observed climatology.

This work explores the sensitivity of different physical parameterizations within a regional climate version of the MM5 model when applied in a complex an heterogeneous area such as the Iberian Peninsula (IP). To do that, a multi-physics ensemble of eight climate change projections (2070-2099 vs. 1970-1999) have been performed driven by ECHAM5 global climate model outputs, forced by the SRES A2 scenario GHGs concentrations for the future period. This ensemble is the result of combination two of the available options for cumulus (Grell and Kain-Fritsch), microphysics (Simple Ice and Mixed Phase) and PBL (Eta and MRF) parametrizations. The analysis focuses on two variables: 2-m temperature and precipitation.

The results indicate that for 2-m temperature the spread is caused by changes in the PBL scheme (being negligible the changes in other parameterizations). Overall, the MRF scheme for the PBL provokes the highest temperature increase (and also the highest absolute values), meanwhile the Eta scheme leads to the minimum variation and values. The average rise in the temperature is about 2.5 degrees for wintertime and 6 degrees during the summertime in the Iberian Peninsula; however, it should be highlighted that the spread of these results is up to 50% of the estimated warming. If precipitation is analyzed, the spread is caused both by the selection of the PBL scheme and the cumulus parameterization, specially during the August-October period. The most important increase in precipitation takes place in the eastern IP (around 40 mm/month), where convective precipitation dominates. The spread in the simulated data with the different schemes may achieve 100% in the aforementioned area. For precipitation, no experiment is found to cause a dominant increase or decrease in the IP.