Geophysical Research Abstracts,
Vol. 11, EGU2009-10861-2, 2009
EGU General Assembly 2009

Implications of land-atmosphere coupling on the present and projected climate over the Iberian Peninsula

S. Jerez (1), J.P. Montavez (1), P. Jimenez-Guerrero (1), J.J. Gomez-Navarro (1), J.A. Garcia-Valero (2), J. Gonzalez-Rouco (3), and J.M. Jimenez ()

(1) Universidad de Murcia, Physics, Murcia, Spain (montavez@um.es), (2) AEMET, Murcia, Spain, (3) Universidad Complutense de Madrid, Madrid, Spain

Regional Climate Models (RCMs) are widely extended tools to evaluate the global warming impact at regional scales. Some of these models have a wide spectrum of physical options in order to parametrize the implemented processes, such as land-atmosphere interactions. This work assesses the implications of the election of the land-surface model (LSM) within a climate version of the MM5 mesoscale model in the present and future modeling of the climate of the Iberian Peninsula (IP). Often such interactions are modeled by a simple soil model (Simple Five-Layers Soil Model) whose main weakness comes conditioned by the fact that the content of soil moisture is prescribed to fixed seasonal values. Previous works prove that this leads to an underestimation of summer temperatures in regional climate experiments, among other limitations. A more complex soil parametrization (Noah Land-Surface Model) can be coupled to the atmospheric part of MM5. Noah LSM dynamically models the evolution of the soil moisture, allowing the development of some feedback processes between the soil and the atmosphere that otherwise would remain inhibited. Hence, the aim of this work is to characterize the projected warming over the Iberian Peninsula that can be attributed to the new processes taken into account only when this more complex soil model is employed.

First, simulations have been performed for the recent past (1959-2002), using ERA40 data as driven conditions, in order to elucidate the contribution of the more complex LSM to the skill of such simulations to accurately reproduce the observations in the Iberian Peninsula. Focusing on 2-meter temperature outputs, when Noah LSM is employed the main improvements are achieved for summer season and are localized towards the south of the IP. Higher monthly mean values (even more than 3 degrees) and a major temporal variability of the anomalies series (about 30% of increase) are found. Spatially, more realistic patterns are also reproduced since north-south heterogeneities of the IP climate are better captured. Regarding the underlying mechanisms causing these results, the leading is related to the more realistic sensible and latent superficial heat fluxes simulated.

Last, the implications of such detected features when projecting the future warming over the IP have been evaluated. In order to do that, two pairs of identical simulations except for the soil model employed have been performed: a control period (1961-1990) driven by the ERIK1 experiment performed with ECHO-G global climate model, and a future projection (2070-2099) driven by the prolongation of the ERIK1 towards the future under the SRES A2 scenario. Results show a larger projected 2-meter temperature increase for the summer season, almost 2 degrees for some areas, when the complex LSM (Noah) is used. This increase is larger for the maximum temperatures than for the minimum ones showing different spatial patterns. Moreover, not only a displacement of the temperature distribution function is found, but also a change of its shape.

Due to its climatic heterogeneity, the IP results a feasible scenario for this kind of studies. It has been shown that seasons and areas not subjected to hydrological stress phenomena are not notably affected by the use of the more complex (and so, more computationally expensive) soil parametrization. Nevertheless, results indicate more realistic simulations for the South of the IP and for the summer season, where the simplest-scheme simulation fails in both mean values and temporal variability. These current results open a new uncertainty source for temperature projections coming from the uncertainties related to the simulated precipitation.