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An analysis of MM5 sensitivity to different parameterizations for high-resolution climate simulations

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An evaluation of MM5 mesoscale model sensitivity to different parameterizations schemes is presented in terms of temperature and precipitation for high-resolution integrations over Andalusia (South of Spain). As initial and boundary conditions ERA-40 Reanalysis data are used. Two domains were used, a coarse one with dimensions of 55 by 60 grid points with spacing of 30 km and a nested domain of 48 by 72 grid points grid spaced 10 km. Coarse domain fully covers Iberian Peninsula and Andalusia fits loosely in the finer one.
In addition to parameterization tests, two dynamical downscaling techniques have been applied in order to examine the influence of initial conditions on RCM long-term studies. Regional climate studies usually employ continuous integration for the period under survey, initializing atmospheric fields only at the starting point and feeding boundary conditions regularly. An alternative approach is based on frequent re-initialization of atmospheric fields; hence the simulation is divided in several independent integrations.
Altogether, 20 simulations have been performed using varying physics options, of which 4 were fulfilled applying the re-initialization technique. Surface temperature and accumulated precipitation (daily and monthly scale) were analyzed for a 5-year period covering from 1990 to 1994. Results have been compared with daily observational data series from 110 stations for temperature and 95 for precipitation
Both daily and monthly average temperatures are generally well represented by the model. Conversely, daily precipitation results present larger deviations from observational data. However, noticeable accuracy is gained when comparing with monthly precipitation observations. There are some especially conflictive subregions where precipitation is scarcely captured, such as the Southeast of the Iberian Peninsula, mainly due to its extremely convective nature.
Regarding parameterization schemes performance, every set provides very similar results either for temperature or precipitation and no configuration seems to outperform the others both for the whole region and for every season. Nevertheless, some marked differences between areas within the domain appear when analyzing certain physics options, particularly for precipitation. Some of the physics options, such as radiation, have little impact on model performance with respect to precipitation and results do not vary when the scheme is modified. On the other hand, cumulus and boundary layer parameterizations are responsible for most of the differences obtained between configurations.

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Key words: MM5 mesoscale model, parameterizations schemes, temperature and precipitation, South of Spain.