Sensitivity of the seasonal cycle simulated by a RCM to physical parameterizations

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The sensitivity of the MM5 mesoscale modelling system [Grell et al., 1994] to the selection of the wide range of different physical parameterizations provided (including some of the most common schemes also used in global atmospheric models) is analyzed in terms of their ability to reproduce the seasonal cycle of precipitation and surface temperature over the Iberian Peninsula [Fernández et al., 2006].

The experiment was carried out by simulating the 5-year period 1985-1989 by nesting the MM5 model into the NCEP/NCAR Reanalysis [Kalnay et al., 1996] gridded data. The model was set up with two nests to get to 45 km resolution over an Iberian domain through a coarse mother domain covering the Atlantic/Mediterranean area with 135 km resolution. Two-way nesting was applied to allow feedback from the Iberian domain to the mother domain. Grid nudging to the Reanalysis data was applied to the mother domain over the boundary layer to keep the large scale circulation close to the observed one.

We designed 16 experiments by combining the physical parameterizations shown in the table below:

Microphysics	Cumulus	PBL	Radiation
Simple Ice	Grell	MRF	Cloud
Mixed-Phase	Kain-Fritsch	Blackadar	RRTM

where the first row corresponds with parameterizations using simpler assumptions (computationally more efficient) and the second with those using more sophisticated schemes. Details of the different parameterizations can be found in [Grell et al., 1994] and the references therein.

For validation purposes, precipitation (from González-Rouco et al. [2001]) and surface temperature (from the meteorological institutes of Spain and Portugal) station data were used. Other precipita-

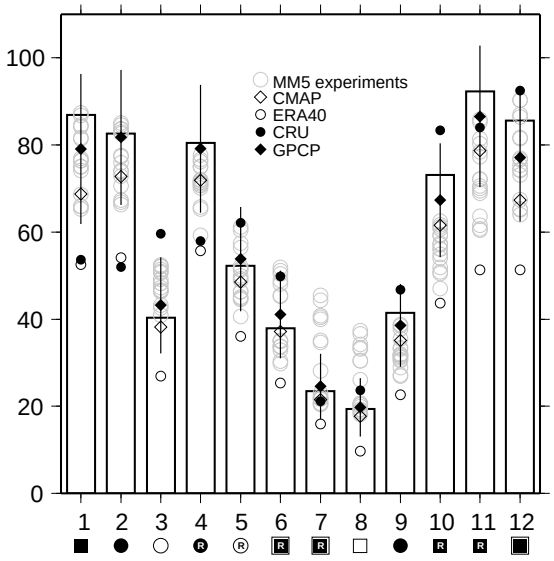

Figure: Area-averaged monthly seasonal cycle of precipitation according to the precipitation stations (bars), the 16 MM5 experiments, CPC Merged Analysis of Precipitation (CMAP), ERA40 precipitation at 2.5 degrees resolution, Global Precipitation Climatology Project (GPCP) which provides error estimates (also shown) and the Climatic Research Unit (CRU) 0.5 gridded data. Every data set is first bilinearly interpolated to the UCM stations and then averaged to avoid errors arising from the different coverage density of the UCM stations.

tion data sets (CMAP, ERA40, CRU and GPCP – see Figure) were used to analize the observational uncertainty.

The overall performance of the model in capturing the area-average annual cycle of precipitation and surface temperature is good, although a bias towards cooler than observed temperatures was found. Particular features of the period selected, such as the strong april and low march precipitation, were well represented. The seasonal cycle in certain areas, however, presents bias. Precipitation is overestimated over the northern Iberian Peninsula and temperatures are underestimated especially in summer over the southeast.

The performance of the individual experiments is influenced by these biases. Experiments yielding higher temperatures perform better due to the cold bias. The experiments producing less rainfall are better in the northern interior Iberian Peninsula, where there is a positive bias. Moreover, no experiment is found to perform better than the others for every place, variable and season. The study, however, provides useful guidance on the selection of parameterizations for smaller subregions and for a specific variable and season.

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References

J. Fernández, J. P. Montávez, J. Sáenz, J. F. González-Rouco, and E. Zorita. Sensitivity of MM5 mesoscale model to physical parameterizations for regional climate studies: Monthly seasonal cycle. *J. Geophys. Res.*, 2006. Submitted.

J. F. González-Rouco, J. L. Jiménez, V. Quesada, and F. Valero. Quality control and homogeneity of precipitation data in the Southwest of Europe. *J. Climate*, 14:964–978, 2001.

G. A. Grell, J. Dudhia, and D. R. Stauffer. A description of the fifth–generation Penn State/NCAR Mesoscale Model (MM5). Technical Report NCAR/TN-398+STR, National Center for Atmospheric Research, 1994.

E. Kalnay, M. Kanamitsu, R. Kistler, W. Collins, D. Deaven, L. Gandin, M. Iredell, S. Saha, G. White, J. Woollen, Y. Zhu, M. Chelliah, W. Ebisuzaki, W. Higgins, J. Janowiak, K. C. Mo, C. Ropelewski, J. Wang, A. Leetmaa, R. Reynolds, R. Jenne, and D. Joseph. The NCEP/NCAR 40–year Reanalysis Project. *Bull. Amer. Meteor. Soc.*, 77:437–471, 1996.