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Adaptation of RegCM regional climate model for the Pannonian region – the specific effects of different parameterization schemes

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Climate models with higher resolution result in a better representation of land surface heterogeneity and fine-scale forcing, which are important for simulating the local and regional aspects of climate accurately. The Pannonian Basin is surrounded by the Carpathian Mountains and orographic differences (i.e. hill chains and lowlands) are present within the basin itself. Thus, the heterogeneity of the target region justifies the higher model resolution, which may require different approach and different parameterizations. The current study focuses the newest model versions of RegCM (RegCM4.5 and RegCM4.6) that are used to compare hydrostatic and non-hydrostatic approaches as well as different moisture parameterizations, specifically focusing on the Pannonian Basin. Before climate models can be used for projections, a thorough analysis required whether the model simulations of the past reconstruct the measurements appropriately. Therefore, the main validation goal in this study is to improve the reconstruction of the historical regional precipitation characteristics for the Pannonian region. For this purpose, several model experiments at 10 km horizontal resolution were completed for a one-year-long period (i.e. 1981) using ERA-Interim reanalysis data (with 0.75° horizontal resolution) as initial and boundary conditions. Our simulation matrix consists of hydrostatic and non-hydrostatic runs together with the different treatments of moisture, namely, SUBEX and the new microphysics scheme with different autoconversion parameterizations. In this detailed validation study RegCM outputs (e.g. precipitation, temperature) are compared to the homogenized, gridded CARPATCLIM data (with 0.1° resolution). Variables, which have important roles in the water cycle (e.g. soil moisture, evapotranspiration) also are analysed. On the basis of the results we can conclude that the RegCM4.6 produces substantially wetter and cooler climatic conditions than RegCM4.5, despite that the User's Guide does not mention any major modification in the program code except computational debugging. It should further be clarified and understood what causes these much greater biases in the RegCM4.6 simulations. More specifically, the outputs of the convection permitting simulations with both versions (using non-hydrostatic approach) overestimate the precipitation in the mountainous areas, which is greater than in the simulations using the hydrostatic approach. The simulations with version 4.6 overestimate the precipitation (around 200%), whereas slight underestimations can be found in the southern regions and the Carpathian Mountains.