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High-resolution downscaling of ERA40 Reanalysis and CMCC-CM 21st century data with nonhydrostatic regional NMMB model

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Dynamical downscaling is widely accepted approach in climate research. In particular, downscaling of the reanalysis has become common practice to verify regional model performance with “perfect” boundary conditions against observed climate over area of interest. On the other side, in recent years horizontal resolution of regional climate models approached non-hydrostatic scales. The need for these high-resolution runs is mainly driven by the idea of a better representation of the small-scale process, such as convective, which can be crucial for better representation of local climate characteristics.

The unified Non-hydrostatic Multi-scale Model on a B grid (NMMB) performance of ERA40 downscaling on two resolutions 14 km and 8 km is verified using standard verification scores over territory of Serbia against data from national meteorological network and two gridded observation datasets E-OBS and CARPATCLIM, for the 1971-2000 period. Results show that model is capable for reproduction of observed climate characteristics and its’ performance is in line with results of other similar experiments performed with the state of the art regional climate models. Comparing 8 km and 14 km integration, high-resolution downscaling experiment integration shows improvement in overall model performance, especially in reduction of negative monthly precipitation bias during summer months in northern part of Serbia, common to many regional climate simulations and known as a summer drying problem. Detailed analysis of daily precipitation distributions revealed that reason for this is convection permitted resolution of model, which enables better representation of summer heavy precipitation episodes. In addition, over some regions of Serbia, in comparison with E-OBS gridded observations, model shows better results in terms of mean annual precipitation accumulation.

Possible future changes in temperature and precipitation are obtained by downscaling results of the global CMCC-CM model and by applying RCP8.5 climate change scenario. Simulation is done for the 1971-2100 period on 8 km resolution.