REGIONAL CLIMATE MODEL EXPERIMENT USING REGCM SUBGRIDDING OPTIONS IN THE FRAMEWORK OF MED-CORDEX

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ABSTRACT

Our research group is participating in the Med-CORDEX international initiative of the CORDEX program in the framework of WCRP (World Climate Research Program). The specific aim is to contribute to the complex regional climate modeling database with RegCM experiments with 50 km horizontal resolution using subgridding option in order to take into account subgrid processes. As being part of the Med-CORDEX initiative, our model domain contains the MED-44 CORDEX area covering the Mediterranean region of Europe (Fig. 1 upper panel).

Regional climate model RegCM stems from the National Center for Atmospheric Research/Pennsylvania State University (NCAR/PSU) Mesoscale Model version MM4 (Dickinson et al., 1989; Giorgi, 1989). It is a 3-dimensional, sigma-coordinate, primitive model. It was originally developed by Giorgi et al. (1993a, 1993b) and later modified and improved by Giorgi and Mearns (1999) and Pal et al. (2000). The latest version of this model is RegCM4. Currently, it is available from the ICTP (Abdus Salam International Centre for Theoretical Physics).

We already completed a few experiments (using mainly ERA-Interim data, and HadGEM2 global model outputs as initial and lateral boundary conditions) with 50 km resolution and more experiments are planned (using further HadGEM2, ECHAM5, MPI-ESM global model outputs for driving the regional climate model). Besides the historical runs (covering 1981-2010), new scenario (RCP4.5) is also analyzed for the 21st century. In this poster we are presenting the comparison of ERA- and HadGEM-driven historical experiments for temperature and precipitation, as well, as the preliminary projection results using RCP4.5.

The 50-km resolution RegCM-outputs serve as an input for further downscaling using 10 km as a horizontal resolution for a smaller domain covering Central Europe with special focus on Hungary (Fig. 1 lower panel). These experiments will be the basis of the Hungarian national climate and adaptation strategies by using RegCM results for detailed regional scale climatic projections and specific impact studies.

The 50-km resolution model simulations are compared to the gridded E-OBS (Haylock et al., 2008) database covering the continental parts of Europe with 0.25° horizontal resolution. The 10-km resolution simulation results are compared to the gridded homogenized CarpatClim (Szalai et al., 2013) database covering the Carpathian Region with 0.1° horizontal resolution. The red box indicates both target areas in Fig. 1. Besides the annual and seasonal mean bias maps of temperature and precipitation we evaluate and compare the model simulations using Taylor-diagrams. This complex analysis show how well the measurements are reproduced in a statistical sense in different large regions within Europe (Fig. 2).

After completing the historical runs (1951-2005) we continued the climate simulations taking into account the new RCP4.5 scenario (van Vuuren et al., 2011) for 2005-2100 using RegCM with 50-km horizontal resolution. Here, we are presenting the estimated mean annual and seasonal changes of temperature and precipitation for two future target periods, namely, for 2021-2050 and 2071-2100, using the reference period of 1971-2000.

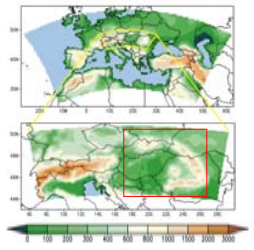


Fig. 1: Topography of the integration domains. (Height is expressed in meters.)

Upper panel: RegCM4.3 simulation at 50 km (Med-CORDEX domain). Lower panel: RegCM4.3 simulation at 10 km resolution.

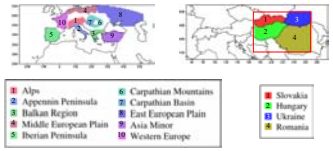
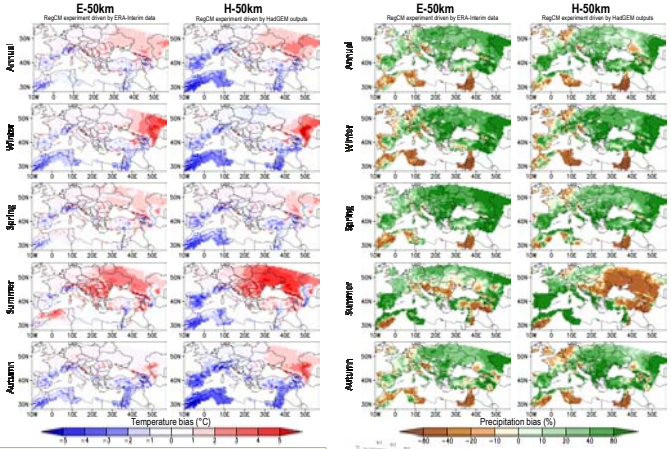
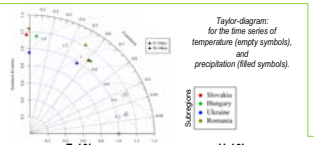


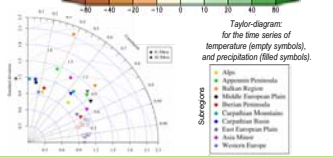
Fig. 2: Subregions within the integration domain defined for regional scale analysis for the 50-km (left) and the 10-km (right) horizontal resolution model runs.

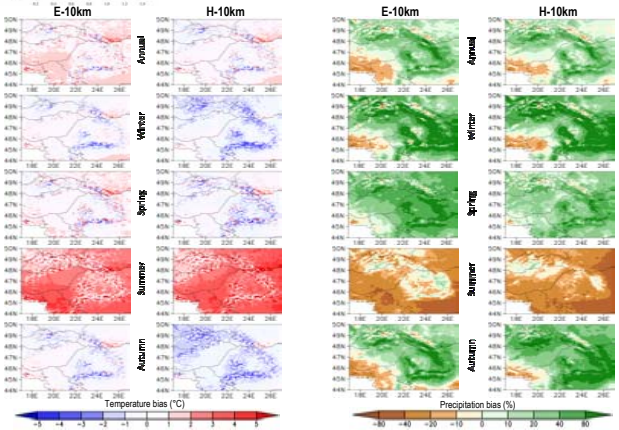
VALIDATION RESULTS (Validation period: 1981-2000)

50-km horizontal resolution RegCM simulations – temperature and precipitation biases





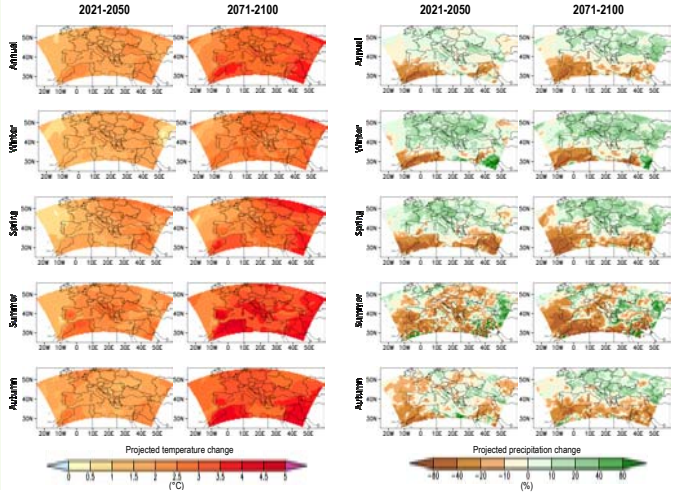




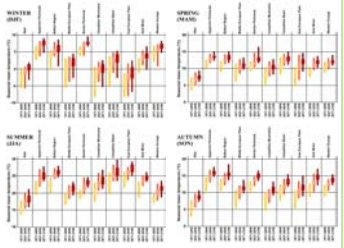
10-km horizontal resolution RegCM simulations – temperature and precipitation biases

PROJECTION RESULTS CONSIDERING RCP4.5 SCENARIO (Reference period: 1971-2000)

50-km horizontal resolution RegCM simulations: estimated changes of temperature and precipitation



Box-Whisker diagrams for regional scale analysis of seasonal mean temperature: 1971-2000, 2021-2050, 2071-2100



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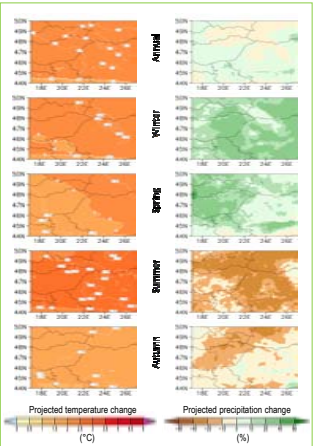

10-km horizontal resolution RegCM simulations, 2021-2050: estimated changes of temperature and precipitation