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Statistical bias correction and localization for RCM-simulated present and future climate in Central Europe

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Raw outputs of regional climate models (RCMs) often suffer from systematic errors which may prevent them from being directly applicable for the analyses of the behavior of the climate system, its eventual changes and their local impacts. In order to lessen the severity of this problem, statistical corrective procedures can be applied. Here, we present and evaluate a postprocessing strategy for preparing datasets with not just reduced systematic errors, but also with horizontal resolution sufficient for impact studies requiring climate data at very fine spatial scales.

The analysis was carried out for the outputs of regional climate models RegCM3 and ALADIN-Climate/CZ, integrated on a 10 km grid and driven either by the ERA-40 reanalysis or by the ECHAM5 (RegCM) and ARPEGE (ALADIN) models. The validation data consisted of daily series of temperature and precipitation, gathered from weather stations in several Central European countries. The RCM outputs were subjected to a corrective procedure based on comparing the matching quantiles of low-parametric fits of the PDFs of simulated and observed data. The technique was generally able to restructure the statistical distribution of the target variables and bring a better correspondence between PDFs of the simulated series and their observed counterparts, but we also show that it lacks the ability to mend some specific types of the systematic errors (e.g., the eventual unrealistic temporal persistence in the simulated time series).

The debiased data were further localized beyond the original horizontal resolution of the RCMs: Several approaches to the conversion of the model-generated fields to subgrid spatial scales were tested and compared, differing in their complexity and type of additional information used for the localization. By combining the corrective and localization procedures, a generalized correction could be created for an arbitrary location (or an arbitrary grid) and then applied to generate an improved version of the data representing future climate.

Aside from validating the results for the present climate, we paid a special attention to the analysis of the effect of the corrective procedure on the temperature and precipitation changes simulated for future climate: It is demonstrated how the postprocessing can sometimes significantly alter the simulated climate response to the increasing concentrations of greenhouse gasses.