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How does the choice of the bias-correction method affect the hydrological simulations driven by climate model outputs?

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Climate change may induce several consequent problems in various sectors like hydrology (that is our main focus here), agriculture, tourism or energy production. Therefore, the impacts of climate change should be thoroughly analysed on the basis of available climatic projections. In order to successfully adapt to the potential weather-related future hazards, the development of appropriate adaptation and mitigation strategies is strongly advisable, for which it is necessary to provide as reliable climate simulations as possible, so impact models are able to use realistic climatic information as input.
For future estimations it is inevitable to use climate model simulation outputs. Unfortunately, the simulations usually over- or underestimate climatic conditions in the historical time period. Therefore, in order to eliminate the systematic errors in the climatic information, bias correction methods can be applied to the raw simulation outputs. The choice of the bias correction method is very important, as it can be responsible for a substantial part of uncertainty in the final specific projections. The main aim of this study is to determine which bias correction method is the most suitable for the raw outputs of regional climate model (RCM) simulation that will drive a hydrological model. For the present analysis, we used the CARPATCLIM database as a reference (since it consists of reliable homogenised, interpolated datasets, which are based on standard meteorological station measurements), the RegCM4 regional climate model simulation (with historical and scenario runs) and the physically-based DIWA (Distributed Watershed) hydrological model. DIWA-simulations were driven by the raw and bias-corrected RegCM4 simulation outputs. We tested the percentile-based bias correction (also known as quantile mapping), the delta-method (using simply the differences of mean and standard deviation values) and a weather-generator driven Monte-Carlo simulation based method. The distributions of yearly runoff values (resulted from the different meteorological time-series driven DIWA simulations) are compared to the reference in order to decide, which method is the most appropriate for a hydrological impact study in a target area, i.e. a small catchment in the Carpathian Basin.