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Statistical bias correction for daily precipitation fields from COSMO-CLM over the Nahe catchment area

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Simulated precipitation by climate models deviates from observations due to numerous reasons such as insufficient representation of precipitation processes, resolution of orography, and errors caused by numerics and parameterizations. Deviations affect the whole intensity distribution. As precipitation is a key variable in many impact models especially in hydrological catchment modeling, a correction method needs to be applied.

Aggregated daily precipitation fields simulated by the regional climate model COSMO-CLM are bias corrected using a quantile matching method. This yields internal consistent precipitation fields, which have the same statistical intensity distribution as observations. The study region is the Nahe catchment area in Rhineland Palatinate (Germany). The bias correction is calculated using data from the COSMO-CLM runs of the LandCare2020 project with a resolution of 5km for two time periods 1988-1997 (C20) and 2015-2024 (A1B). As observational data 51 stations (with no missing values) of the German Weather Service (DWD) and the Landesamt für Umwelt, Wasserwirtschaft und Gewerbeaufsicht (LUWG, Rhineland Palatinate) are used. To account for grid boxes where no observations are available, the quantile matching method is combined with an inverse distance weighting interpolation. The quantile matching method calculates a transfer function which transforms precipitation intensities of the COSMO-CLM into corrected intensities via a quantile function. This transfer function is constructed with the C20 data and afterwards used under the assumption of stationarity to correct the A1B data.

Evaluation of the results is done by Kolmogorov Smirnov and Cramér-von Mises tests at a 95%-significance level. To verify the results of grid boxes with no observations a cross-validation is carried out beforehand. The results show a very good correction performance for grid boxes with observational data and a satisfying performance with interpolation. In the case of the cross-validation the statistical tests reject the hypothesis that the interpolated intensity distribution is identical with the observed distribution at the chosen significance level. However, there is a substantial improvement compared to the simulated precipitation without correction.