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Bias correction of climate projections including the scale gap between grid to point data with respect to extremes in precipitation

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Often detailed point information from future climate projections is needed for hydrological and other impact models. Therefore, two problems must be solved, first the bias correction is needed for the unbiased application of projected data and second the general scale gap between gridded model data and pointwise observation data has to be taken into account. The latter is often ignored, but contributes systematically to the model bias as model output is often referring to mean values or budget closing on grid level, while measurements are typically point measurements by nature.

We present an approach, which solves the aforementioned problems by applying a parametric quantile mapping (QM) with a special focus on extremes in precipitation. We selected 16 model combinations of the multi-model ensemble matrix of the projects Euro-Cordex (Coordinated Downscaling Experiment – European Domain) and ReKliEs-De (Regional climate projections ensemble for Germany) as climate projections. Since the study area is the Free State of Saxony in Germany, 17 observation stations from the reference dataset by ReKIS (Referenzdatensatz V1.0 (10/2017), Regional climate information system – www.rekis.org) are used as the observation dataset.

We fitted two parametric distribution functions with the maximum likelihood method to datasets of various situations (i.e. seasons, stations and model combinations). First, the often used Gamma distribution is fitted to the datasets. Second, a dynamical mixed Gamma and generalized Pareto distribution is fitted, to be able to describe the extremes more in detail.

The different correction functions are generated to correct the bias between gridded model data and pointwise observation data. A cross-validation is carried out to evaluate the performance of the different fitted distributions. Therefore, 10 years from 1971-2015 are picked randomly as validation period and the remaining years are used for the calibration of the fitting process. This procedure is repeated 30 times for each single situation. Subsequently, the Akaike information criterion (AIC) and the Cramér-von Mises criterion (CvM) are calculated as skill scores to select the most appropriate distribution for each situation.

However, the analysis of the skill scores shows different pattern of the chosen distributions, the AIC and CvM often suggest different distributions. Hence, to analyse which skill score delivers the better bias corrected model data, both skill score decisions are used to correct the model dataset for each situation to generate two corrected model datasets for the period 1971-2015. The final evaluation is performed by a comparison of quantile-quantile plots of the two corrected model datasets with respect to the observation data. The analysis shows that both distributions have their entitlement and that more reliable results can be generated, if not only one distribution is prescribed for each situation.