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Effect of sample size on bias correction performance

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The output of climate models often shows a bias when compared to observed data, so that a preprocessing is necessary before using it as climate forcing in impact modeling (e.g. hydrology, species distribution). A common bias correction method is the quantile matching approach, which adapts the cumulative distribution function of the model output to the one of the observed data by means of a transfer function. Especially for precipitation we expect the bias correction performance to strongly depend on sample size, i.e. the length of the period used for calibration of the transfer function.

We carry out experiments using the precipitation output of ten regional climate model (RCM) hindcast runs from the EU-ENSEMBLES project and the E-OBS observational dataset for the period 1961 to 2000. The 40 years are split into a 30 year calibration period and a 10 year validation period. In the first step, for each RCM transfer functions are set up cell-by-cell, using the complete 30 year calibration period. The derived transfer functions are applied to the validation period of the respective RCM precipitation output and the mean absolute errors in reference to the observational dataset are calculated. These values are treated as “best fit” for the respective RCM. In the next step, this procedure is redone using subperiods out of the 30 year calibration period. The lengths of these subperiods are reduced from 29 years down to a minimum of 1 year, only considering subperiods of consecutive years. This leads to an increasing number of repetitions for smaller sample sizes (e.g. 2 for a length of 29 years). In the last step, the mean absolute errors are statistically tested against the “best fit” of the respective RCM to compare the performances.
In order to analyze if the intensity of the effect of sample size depends on the chosen correction method, four variations of the quantile matching approach (PTF, QUANT/eQM, gQM, GQM) are applied in this study. The experiments are further extended by varying the splitting of the 40 years into calibration and validation period.

The results indicate, that in comparison to the “best fit” a significant decrease in the median performance is on average observed when reducing the length of the calibration period to about half of the “best fit” of 30 years, but the spread between RCMs is quite large. More important than the median performances are however the performances of the repetitions with the largest mean absolute error for each sample size. For these, a significant decrease in performance can already be observed when reducing the length of the calibration period by only a few years. This is caused by the fact that the larger number of repetitions for reduced sample sizes goes along with an increase in the variability of the bias correction performance.