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Do sub-annual bias corrections improve the quantile mapping results for daily precipitation?

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Quantile mapping (QM) is often routinely applied in climate change impact studies for the bias correction (BC) of daily precipitation data. QM corrects the complete distribution of the data. However, it does not correct for errors in the annual cycle. Thus, QM is often applied separately to temporal subsets of the data, e.g. the data of each calendar month, to take this issue into account. However, the more subsets one uses, the lower is the sample size available for the respective QM calibration. In a previous study, we showed that the performance of QM decreases with decreasing calibration period length, i.e. a decreasing sample size of the calibration data.
Therefore, we analyze whether the potential benefit from applying QM to temporal subsets could be negated by the simultaneous reduction of the respective sample size of the calibration data. To do so, we carry out experiments using 40 years of daily precipitation data of 10 regional climate models (RCM) from the ENSEMBLES project. The data is split into a 30 year calibration period and a 10 year validation period. In the first step, four QM methods are calibrated with the daily data of the 30 year calibration period. Thereby, the QM is done in four alternatives, each with a different number of temporal subsets: annually (no subsets), semi-annually (2 subsets: NDJFMA, MJJASO), seasonally (4 subsets: DJF, MAM, JJA, SON), and monthly (12 subsets). For each alternative, QM is applied separately to each subset. In the second step, the derived transfer functions are applied to the RCM data. In the third step, the bias corrected data sets are evaluated with three different skill scores. Thereby, the skill scores are calculated in the four alternatives used for the QM: annually, semi-annually, seasonally, and monthly. The first results show that the bias correction of the calibration period data continuously improves with increasing number of temporal subsets. However, they also indicate that there is no continuous improvement for the validation period data.