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Bias correction of EU-ENSEMBLES precipitation data with focus on the effect of sample size

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The precipitation output of climate models often shows a bias when compared to observed data, so that a bias correction is necessary before using it as climate forcing in impact modeling. We expect the performance of the bias correction to strongly depend on the sample size used for its calibration. This raises the question: how long does a time series need to be to achieve a sufficient bias correction?

We carry out experiments using 40 years of daily precipitation data from 10 regional climate models (RCM) of the EU-ENSEMBLES project, splitting them into a 30 year calibration period and a 10 year validation period. The RCM data are bias corrected using decreasing sample sizes out of the calibration period. By applying skill scores we quantify the critical sample size n_{crit}, at which the quality of the bias correction becomes statistically worse compared to the correction based on 30 years. In order to analyze whether the effect of the sample size depends on the chosen correction method and the calibration period, we applied four variations of the quantile matching (QM) approach and 3 different calibration/validation periods in this study.

The results show that the spread of n_{crit} is large, ranging from 28 years to approximately 10 years. This indicates that even a small decrease in sample size for the calibration can result in a statistical significant degradation of the bias correction. Corrections with sample sizes smaller than 10 years always perform significantly worse than the 'best fit' with 30 years. The chosen QM approach influences n_{crit} in dependence of its degrees of freedom: the higher the degrees of freedom the larger n_{crit}. We also found that the choice of the calibration period affects the n_{crit} values.

In conclusion we recommend to use time series as long as possible for bias correction of precipitation data. However, there is a large transition zone of the critical sample size where shorter time series can perform sufficiently well, depending on the chosen correction method and calibration/validation period. Thus, it is not possible to determine a general minimum sample size.