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Hydrology and Earth System Sciences Discussions

Interactive comment on "Technical Note: Downscaling RCM precipitation to the station scale using quantile mapping – a comparison of methods" *by* L. Gudmundsson et al.

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We appreciate the very positive verdict of Referee # 2, especially the appraisal of our methodology. In the following we provide short answers to the referees specific questions:

1: Application to future and uncertainty due to correction methods

Within the framework of this study, the application and evaluation of quantile mapping (QM) techniques using an observed time window, it is difficult (if not impossible) to fully quantify the uncertainty imposed by the methods. However, the presented cross validation (see next point) estimates of MAE and $\text{MAE}_{0.1}$, $\text{MAE}_{0.2}$, $\ldots$, $\text{MAE}_{1.0}$ is a reliable indicators of the uncertainty of the methods. Further a new section discussing the impact QM and related methods on the climate change signal will be added.

2: Cross validation

We acknowledge the lack of detail with respect to the cross validation and will extended the manuscript accordingly.

In contrast to bootstrap methods, which resample the data with replacement before fitting statistical methods, CV splits the data into independent subsets which are subsequently used for model training and validation.

3: precipitation thresholds

We did not explicitely check further thresholds. Note however, that the resolution of the precipitation observations used in this study is 0.1 mm day^{-1} which implies a threashold of ≤ 0.1 mm day^{-1}. We will add a note on this to the text.

4: Validity of the results for the entire year.

The different skill scores are estimated for the 1960 to 2000 time interval and do not discriminate between seasons. To increase clarity we will include the time interval in the caption of Figure 2.

We opted not to address seasonal variations in performance as these are dependent on the seasonality of observed and modelled precipitation. This in turn implies that a seasonal evaluation would incorporate an evaluation of RCM performance which is not within the scope of this study.

5: “Remaining” errors

The reported MAE is estimated using cross-validation (see point 2) and thus provides a unbiased estimate of the true uncertainty of the methods. The fact that the errors are not closer to zero reflects the limitations of the methods.

6: Expected error

The CV estimates expected values of skill scores. Thus the reported values of MAE and $\text{MAE}_{0.1}$, $\text{MAE}_{0.2}$, $\ldots$, $\text{MAE}_{1.0}$ are estimates of the expected error.

7: Failure of distribution derived transformations with respect to extremes

As already mentioned in the discussion version of the article (see p. 6193, l. 12 ff of the discussion paper) the parameters of the distributions of observed and modelled values are identified separately. This guarantees the best approximation of the distributions but does not optimise the transformation.

We will reformulate the section slightly to increase clarity.

8: Performance for extremes outside the calibration range

The CV guarantees that performance is also assessed for extremes outside the calibration range. As can be seen in Figure 3 and Figure 4 the performance tends to be worse for the most extreme part of the distribution. Note, however, that the best performing methods lead to a reasonable improvement even for the upper part of the distribution.

9: Restrictions of quantile mapping with respect to temporal structure of the signal

A section on possible limitations of QM will be added.

10: Spatial coherence after bias correction

We did not explicitely analyse spatial coherence of precipitation. As already noted by Referee # 2 in point 9, QM does not alter the temporal sequence of the simulated signal.

Further the scope of the analysis was to assess the performance of the methods with respect to what they have been designed for, i.e.: to adjust the distribution of precipita-

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tion and not any possible (positive or negative) sideffects.

11: page 6188, line 88: remove “for”

there is no line 88 on this page.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 6185, 2012.