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Earth System Dynamics Discussions

Interactive comment on "A trend-preserving bias correction – the ISI-MIP approach" *by* S. Hempel et al.

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Hempel et al. recognise an important problem of quantile mapping and other bias correction methods aiming to correct for misrepresented variance. However, the solution presented by the authors still suffers from the same fundamental mis-application of these methods that actually cause the described problem: quantile mapping cannot downscale - in the sense that quantile mapping does not add small scale variability. Quantile mapping is a deterministic transformation and therefore designed to correct systematic errors, it does not add small scale random variability not explained by the uncorrected numerical model. This problem is exactly the same as that caused by the inflation of (perfect prog) statistical downscaling, which has been described more than 10 years ago (von Storch, 1999). The problems arising when quantile mapping

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is used to downscale have recently been described (Maraun, 2013): because the temporal structure is not that of the local scale but still that of the grid box scale, apart from the inflation of trends, area aggregated extreme events are overrepresented and are aggregated dry days are over-corrected. These problems should remain even after the application of the modified approach presented by Hempel et al. (this should be checked). Imagine downscaling to several stations within a GCM gridbox: in reality, there will always be random variability between these stations, yet since quantile mapping is deterministic, they will always be perfectly correlated. A physical rather than a statistical argument is the following: the aim of downscaling is to add energy on small scales not resolved by the RCM. Yet quantile mapping instead increases the energy on resolved scales and thus causes the problems described (see figure). So my guess is that the method proposed here does not work for precipitation, as it does not tackle the underlying problem. However, it might work for temperature, where small scale variations are often rather systematic than random (e.g., caused by orography).

The easiest way to investigate whether my criticism is correct is to consider area aggregated QQ plots as in Maraun, 2013, and also the length of dry spells of area aggregated precipitation.

Furthermore, a row of relevant papers should be included in the discussion: * Eden et al, 2012, discuss were bias correction directly from a GCM might in principle make sense. Not surprisingly, there are regions where the GCM simulated precipitation is so wrong that it cannot be taken as input for a bias correction. * The authors mention the problem of bias nonstationarities. This has already been investigated by Raisanen and Raty, 2012 and Maraun, 2012, in a pseudo reality. * Much of the discussion in cited Ehret et al., 2012, is based on the review by Maraun et al, 2010. Therefore, the latter paper should be mentioned here, also as it provides a state of the art discussion of bias correction methods.

Eden, Widmann, Grawe and Rast, Skill, correction and downscaling of GCM-simulated precipitation, J Climate, 2012.

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Maraun et al., Precipitation downscaling under climate change. Recent developments to bridge the gap between dynamical models and the end user, Rev. Geophys., 2010.

Maraun, Nonstationarities of regional climate model biases in European seasonal mean temperature and precipitation sums, Geophys. Res. Lett., 2012.

Maraun, Bias correction, quantile mapping and downscaling: revisiting the inflation issue. J. Climate, Online First, 2013.

Raisanen and Raty, Projections of daily mean temperature variability in the future: cross-validation tests with ENSEMBLES regional climate simulations, Clim. Dynam., 2012.

von Storch, On the use of "inflation" in statistical downscaling, J Climate, 1999.

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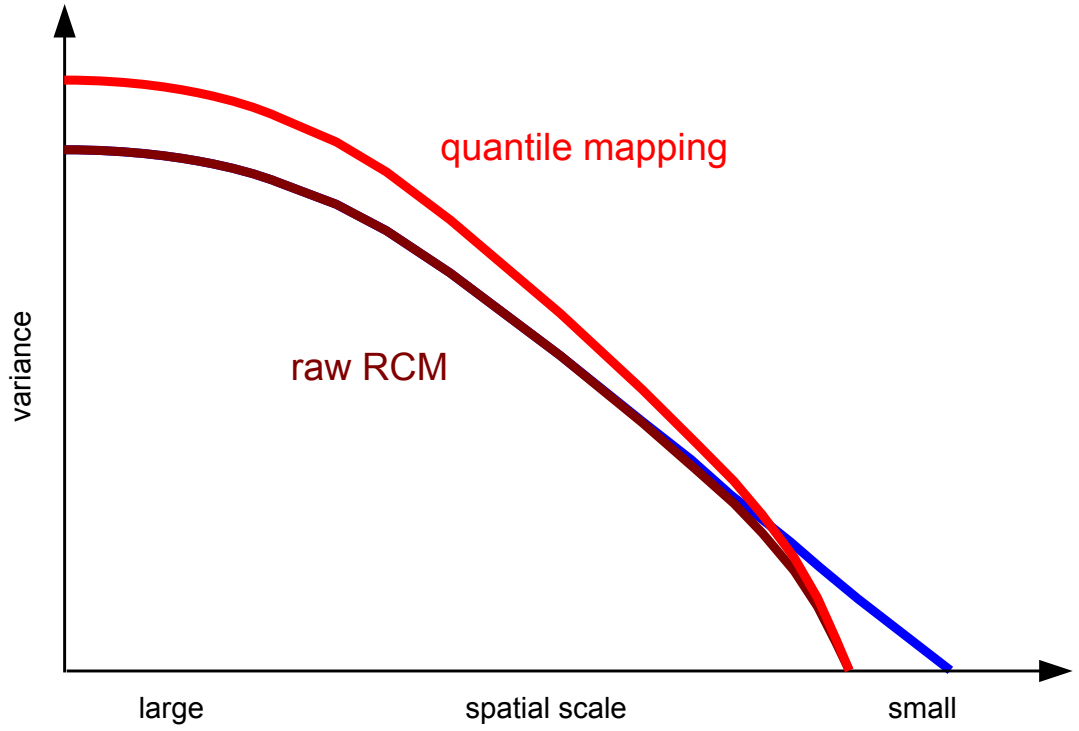

Fig. 1. Dark red: raw RCM, blue: desired correction, red: actual correction

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