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Hydrology and Earth System Sciences
Discussions

Interactive comment on "How does bias correction of RCM precipitation affect modelled runoff?" *by* J. Teng et al.

Anonymous Referee #1

Received and published: 22 October 2014

Overview

The paper explores various bias correction techniques applied to 'correct' climate model precipitation to facilitate their propagation through hydrological models. More specifically, a number of distribution mapping techniques are applied using a split sample approach to explore the performance of each approach and the influence it has on the resulting change signal.

General Comments

The paper is focussed upon an important topic related to the application of climate models in impact studies, more specifically their use in exploring the potential impacts of climate change on precipitation and discharge. I found the paper to be relatively

well-written, although a further read through to check grammar is needed. I agree with the authors that as RCMs continue to improve they will become more readily applied in hydrological impact studies. Significant biases currently exist however and are unlikely to be completely overcome in the near future. Clearly improving the applicability of climate models in hydrological impact studies is a challenging problem with obvious significance. The paper is therefore relevant, exploring how the choice of bias correction approach may impact the resulting projections.

The manuscript primarily focusses on these differences. It also reaches some important conclusions regarding the overall effectiveness of bias correction techniques and how they should be applied in impact studies.

However, many of the results are largely unsurprising given the relative similarities in the methods applied. Nevertheless there are some important discussions that emerge from the results that have largely been over looked. Some further clarity to the methods and data applied are also required. I therefore recommend publication after minor revision to address the following points:

1) The paper is missing an important discussion around the role of bas correction in impact studies and should be more specific in its recommendations. The paper itself identifies that even when there is a 'perfect' distribution bias correction as is the case with QM method, the limitations of the RCMs cannot be overcome. This raises important questions as to the application of RCMs in climate impact studies. Should we even be using RCMs in impact studies? Particularly for extremes. Some comments around this would be welcome.

2) A broader view of the application of RCMs in impact studies is needed. Bias correction isn't the only way in which climate models are applied in impact studies. For example Smith et al.(2014) used multiple application techniques. There is a rich literature around these alternative methods that should be included.

3) The authors should review and include a paper by Cloke et al. (2013), which ex-

plored the significance of MOS on flood projection in the UK. The paper strongly recommended that bias correction techniques should not be used alone, owing to their unknown effects. How do the conclusions drawn here compare?

4) More generally, the paper focusses upon the correction of various precipitation metrics but fails to make the connection between what these metrics mean in terms of potential impacts. For example, the paper states that at 'high' precipitation quantiles, the uncertainties introduced as a result of different bias correction techniques are amplified. Some comments as to what the implications are for flood impact studies, for example, would be welcome. i.e. Should flood impact studies use multiple bias correction techniques?

5) Further description of the hydrological modelling procedure is needed. The paper states that the hydrological model uncertainty is relatively small. Yet there is no description as to how hydrological modelling uncertainty was handled. Was the model calibrated under an uncertainty framework? Figures 4 and 5 appear to suggest that for some seasons, the hydrological model (HM calib) bias is actually comparatively large. Some clarity here would be welcome.

Specific Comments/Technical corrections (P:Page L:Line)

P10684 L14, 'limitation of RCM'. Doesn't make sense.

P10685 L5, Specifically hydrological impact studies.

P10686 L11, 'Precipitation'? should be modelled?

P10688 L17, A little more as to how the observed precipitation data was aggregated up to the RCM resolution is needed.

P10690 L15, Smith et al.,(2014) used a combination of gamma and GEV distributions. This may lead to some improvements in correcting extremes.

P10694 L25, The RCMs appear to be particularly poor during winter (JJA). Are there

any specific mechanisms causing this?

P10693 L18, Revise sentence.

P10695 L18, QM? abbreviation. First time this appears, should be QM next to 'empirical quartile mapping'?

P10700 L19, However figure 11 appears to show that the raw RCM output performs better than both QM and DM2G at high precipitation quantiles. What are the implications of this?

Figures: Some of the figures are a little hard to read. May need to adjust some the scales to make box plots clearer.

Figure 11. State that observed precipitation is hidden by QM.

Refs

Cloke, H. L., Wetterhall, F., He, Y., Freer, J. E. Pappenberger, F. 2013. Modelling climate impact on floods with ensemble climate projections. Quarterly Journal of the Royal Meteorological Society, 139, 282-297.

Smith, A., Freer, J., Bates, P. Sampson, C. 2014. Comparing ensemble projections of flooding against flood estimation by continuous simulation. Journal of Hydrology.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 10683, 2014.