

Interactive comment on “Using hydroclimatic extremes to guide future hydrologic predictions” by S. K. Oni et al.

P. Willems (Referee)

patrick.willems@bwk.kuleuven.be

Received and published: 13 March 2016

This paper describes interesting research work done by the authors on the sensitivity of model parameter calibration, when this calibration is based on short time periods or based on years which are more wet or more dry than average. The authors furthermore show the impact of climate change based on an ensemble of climate models, and discuss the importance of parameter calibration based on years that are closest to the future climate conditions. The semi-distributed conceptual hydrological model PERSiST was considered, applied on a headwater boreal catchment in Sweden. Hydrological impacts considered are mean monthly flows.

I fully agree with the authors that, prior to any hydrological impact analysis of climate change, the hydrological model need to be tested for their performance to make extrap-

C1

olations beyond the range of historical conditions considered during traditional model calibration and validation. Climate scenarios indeed most often lead to meteorological conditions that are more extreme than the historical ones. Let me propose the paper by Refsgaard et al. (2014), for an extensive discussion on that issue and for an overview of approaches. The authors may consider that paper for their literature review.

The authors, however, do not explicitly show how this can be done. They show the sensitivity of the model parameter calibration to the type of years used for calibration, but I am not convinced that calibration based on either more wet years or more dry years (or years with other conditions), depending on the future projected conditions, is the way to go. Historical periods show strong temporal variability, and, most likely, this will also be the case in the future. The climate scenarios lead to changes, but strong natural temporal variability (with wet and dry years) will continue to happen also in the future. This means that the hydrological impact model needs to be calibrated to long time periods such that it is able to deliver accurate results both for wet and dry years. Separate calibration for dry years only or wet years only does not appear to be useful to me.

Other comments:

The title, abstract and introduction put a high focus on “extremes”, but it is unclear from the paper what exactly is meant by these extremes. I assume that it refers to the dry and wet years considered. These are annual averaged conditions, but the term extremes is often used in the context of shorter duration rainfall and flows (e.g. daily peak flows, low flows). I suggest to clarify this better from the start of the paper. To avoid that the reader is misled by the title, I suggest to omit the term extremes and revise the title accordingly.

Climate model simulations were taken from the EU ENSEMBLES project, which became outdated. This is OK given the methodological focus of this paper, but the paper also concludes on the future climate and flow projections for the study catchment.

C2

Since some years, newer generation (CMIP5 based) RCM runs are available, based on the latest generation of greenhouse gas scenarios (RCP based; the ENSEMBLES RCMs are based on CMIP3 and the more than 15 years old SRES greenhouse gas scenarios). In addition, only one SRES scenario (A1B) was considered by the ENSEMBLES project.

A quantile mapping bias correction method was applied. I assume this was done on a monthly basis, but this is unclear from the text (the reader is referred to the literature). The quantile mapping bias correction method may disturb the temporal sequence (correlations, persistence) of the time series values. It is unclear whether this type of check / validations were performed by the authors.

Lines 144 – 145: “The best parameter sets (top 100) were selected based on highest NS statistics ... and other performance metrics ...”: It would be useful to indicate how this selection was done; how the different metrics were weighted or combined to select the best parameter sets.

Lines 156 – 157: “The ... projected future climate series from ensemble of climate models ... were used to project future extremes using different goodness-of-fit metrics.”: I do not understand how the goodness-of-fit of future extremes can be evaluated.

Line 180: “bias correction helped to reduce the uncertainty”: this is true for the historical period, but it is not necessarily the case for the future period

For the results considering only dry years and only wet years, such as in Figure 2 and Figure 3, I assume these results are shown for all the dry or wet years averaged, but this is unclear from the text.

Results shown in Figure 3: It is unclear whether the “Ensemble mean” result is after or before bias correction.

Regarding the validation of the climate model simulation results for historical conditions (control runs), next to the cumulative distribution function of monthly values (and related

C3

bias correction): given the focus of this study on wet and dry years, it would be useful to validate the performance of the climate model simulation results in describing the wet-dry year variability.

Caption Table 1: change “ENSEMBLE” to “ENSEMBLES”

References: Refsgaard, J.C., Madsen, H., Andréassian, V., Arnbjerg-Nielsen, K., Davidson, T.A., Drews, M., Hamilton, D., Jeppesen, E., Kjellström, E., Olesen, J.E., Sonnenborg, T.O., Trolle, D., Willems, P., Christensen, J.H. (2014), ‘A framework for testing the ability of models to project climate change and its impacts’, *Climatic Change*, 122, 271-282

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-7, 2016.

C4