

Interactive comment on “Climate change impacts model parameter sensitivity – What does this mean for calibration?” by Lieke Anna Melsen and Björn Guse

Lieke Anna Melsen and Björn Guse

lieke.melsen@wur.nl

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We would like to thank the reviewer for the constructive suggestions to improve our study. Below a point-by-point discussion in response to the review.

1) We chose for a short and concise introduction; the intro is therefore indeed not complete in terms of literature. We will expand the introduction with a section on hydrological climate change impacts in the US and a more extensive citation of studies that relate climate to sensitivity.

2) The parameter ranges might indeed impact the sensitivity analysis. Therefore, we

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used the default ranges for each of the models, so that our study mimics applications of these models as good as possible.

Concerning the impact of catchment physical properties: since we conducted a global sensitivity analysis, the parameters have not been calibrated to the local situation. Only the VIC models contain land-surface information that is usually not calibrated, but we also applied sensitivity analysis to these terms (LAI and rooting depth through a multiplication factor). In HBV, the only catchment physical property that is (obviously) not included in the sensitivity analysis is the elevation, but the effect of elevation is conveyed through the forcing. As such, there might be a small effect of physical properties on sensitivity in VIC (because multiplication factor is applied to the the initial LAI and rooting depth values) but these parameters were found not to be highly sensitive anyways, and we don't expect any effect of physical properties for HBV and SAC, in this context of global sensitivity analysis.

3) This is a useful suggestion. We will add, before presenting the sensitivity results, a short summary of the projected temperature and precipitation changes for the selected basins.

L35: Yes, we will add more relevant literature on the relation between climate and sensitivity.

L75: We selected only one GCM as we see this study as a 'proof of concept', therefore we also talk about 'a plausible climate change rate' rather than an absolute projection. We will elaborate on our choice and also place CCSM in context of other GCM's.

L77: The applied bias correction methods is the bias-correction and spatial disaggregation (BCSD) method of Wood et al. (2004). We will add this to the text.

The selection of 605 catchments compared to the 671 that are available in CAMELS is because at the time of performing these calculations, the other 66 catchments still had some issues with catchment area (two datasets disagreed more than 10% on

catchment area, thereby influencing the spatial averaging of the forcing). We will clarify this in the text.

L118: Agreed, this can indeed cause confusion and will therefore be reformulated.

L158: Agreed, we will add this.

L175: Yes, we meant: 'on top of the snow process,..'. We will think of a way to better formulate this.

L182: It is not completely clear to us what the reviewer refers to here. In this sentence, we write: "From the figure, it can be seen that the patterns relating parameter sensitivity to climate and climate change indicators are weak. The aridity index seems to have most explanatory value, followed by seasonality and fraction precipitation falling as snow, respectively". Does the reviewer mean that the second sentence gives too much attention to a non-existing correlation? Our intention was to make that clear from the preceding sentence, but we will reformulate it.

Fig. 4: Agreed, will be adapted.

Fig. 6: Agreed, labels will be added. It is not completely clear to us what the reviewer means with that the negative correlation is not quite obvious. Does this refer to the left panel? Because the chord diagrams are only showing strong negative correlations (no positive correlations). We will try to reformulate the caption and can perhaps further clarify the figure.

Discussion: Yes, also in response to the other review, we will elaborate on the role of model structure on parameter sensitivity and change in parameter sensitivity in the discussion.

We would like to thank the reviewer for the useful literature suggestions.

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