Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2017-442-RC1, 2017

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Regional analysis of parameter sensitivity for simulation of streamflow and hydrological fingerprints" *by* Simon Höllering et al.

B. Guse (Referee)

bguse@hydrology.uni-kiel.de

Received and published: 9 August 2017

Review of the manuscript "Regional analysis of parameter sensitivity for simulation of streamflow and hydrological fingerprints" by Höllering et al.

In this manuscript, hydrological fingerprints are introduced as target variable for a sensitivity analysis and compared with a classical approach using streamflow data for a temporally resolved sensitivity analysis. The joint benefit of both approaches is presented for several headwater catchments.

As a reviewer of the first submission of this study to Hydrol. Earth Syst. Sci., I highly

Printer-friendly version

Discussion paper

appreciate the large effort of the authors. The manuscript is now clearer in its objective and I have only minor comments before publication. In most of the cases, my comments are suggestions. I hope that my comments help the authors to improve the manuscript.

P.3, L. 12-18: Even though that it is mentioned here and also at several other places, the manuscript could benefit from mentioning your contribution to the different options in selecting target variables for a sensitivity analysis in hydrology. These are: (i) Modelled discharge, (ii) Different objective functions (Van Werkhoven et al., 2008, Yilmaz et al., 2008, Herman et al. 2013), (iii) Different hydrological variables (Massmann and Holzmann, 2015; Guse et al., 2016), (iv) Different hydrological fingerprints (this manuscript). The use of fingerprint metrics as target variables for a sensitivity analysis is the novel contribution of this manuscript in my opinion. A clear listing could help in distributing this concept in the hydrological community.

P.5., L.7: I recommend to add some references that these metrics are often used in hydrology, since the approach depend on a reasonable selection of the fingerprint metrics. Probably it is sufficient to use studies which are already included in the reference list.

P.5., L.30: In the study of Van Griensven, FAST is listed as a type of sensitivity analyses, but I think that no FAST application is shown in this paper. This recommended to focus the referencing on the paper with FAST results.

P.6, L.9: The referencing of seven paper for mHm seems to be a high. Are they all required to justify the selection of model parameters and their ranges?

P.8, L.28: You may add that 2002 was a wet year and 2003 a dry year to show that you have consider different hydrological situations in the model calibration.

P.11, L.1-8: These results show clearly that the runoff ratio is a fingerprint metrics complementary to most of the others, while Fig.5 show similar results for several fingerprint

Printer-friendly version

Discussion paper

metrics. The study might benefit from a discussion of redundant and complementary fingerprint metrics. Based on this, it is probably possible to give some recommendations about an appropriate selection of a set of fingerprint metrics as target variables in sensitivity analyses.

P.12, L.5-12: Could you explain (based on its role in the model structure) why a soil moisture parameter is relevant both for high and low flows (but not for mid flow)? What about surface runoff or groundwater flow related parameter?

P.12, L.5-12: If it helps, you might add that the result that evapotranspiration parameters are sensitive in mid flows coincides with former sensitivity studies with other hydrological models.

P.12, L.28: I would recommend to emphasise this statement even more. You could discuss how this result helps for model calibration in terms of parameter constraining, reduction of parameter space and appropriate target variables.

P.13, L.1-5: Is ACT maybe less appropriate as fingerprint metric in sensitivity analysis? Also, at this point, it might be interesting to give some comments on the suitability on different fingerprint metrics.

P.13, L.12-13: At this point, I like to remark that Ksconst control both high and low flows. Thus, it would be interesting to see how precisely this parameter can be identified. I expect also conflicting results in model calibration studies. Even though that this study is not related to model calibration, your study give insights that this conflict might occur in the calibration.

References: The latter "a“ is shown in smaller letters in the author list such as in P. 18, L. 28; P.20, L. 35; P. 21, L. 3.

Fig. 2: The information content of this figure is relatively low. I still see a reason for including it in the manuscript. However, in the case that you have to shorten the manuscript, you may think about removing this figure.

Printer-friendly version

Discussion paper

Fig. 3: For a better visualization, I recommend to show three subplots of sensitivity time series. It is very difficult to distinguish four lines in one subplot. Moreover, the blue colours are very similar. Maybe you can include the legend in the subplot (and increase the y-axis to 0.8).

Fig. 4: I recommend to move the last sentence from the figure caption to the main text. An interpretation of the results belongs to the main text and not to the figure caption.

Fig. 5: This figure clearly shows that a precisely definet target variable helps to disentangle the relevance of model parameters such as in this case for AspectcorrPET. This is an important result which could be more emphasised. It is clearly shown that separate target variables are beneficial for sensitivity analyses. These could be as denoted above: Different objective functions, different hydrological variables or such as in your study different fingerprint metrics.

Fig. 6: It seems to be that due to the high differences in sensitivity it is enough to select 4-6 parameters to control the hydrological behaviour in your case. Is this a typical number of relevant model parameters using mHm (model-inherent) or a case-specific result?

Tab. 2: I recommend to add the meaning of "Sensitivity range“ and "Sensitivity mean“ to a table caption.

References:

Guse, B., M. Pfannerstill, A. Gafurov, N. Fohrer, and H. Gupta (2016): Demasking the integrated information of discharge: Advancing sensitivity analysis to consider different hydrological components and their rates of change. Water Resources Research 52, 8724-8743, doi: 10.1002/2016WR018894

Herman, J. D., P. M. Reed, and T. Wagener (2013): Time-varying sensitivity analysis clarifies the effects of watershed model formulation on model behavior, Water Resour. Res., 49, 1400–1414, doi:10.1002/wrcr.20124.

Massmann, C., and H. Holzmann (2015): Analysing the sub-processes of a conceptual rainfall-runoff model using information about the parameter sensitivity and variance, Environ. Model. Assess., 20, 41–53, doi:10.1007/s10666-014-9414-6.

van Werkhoven, K., T. Wagener, P. Reed, and Y. Tang (2008): Characterization of watershed model behavior across a hydroclimatic gradient, Water Resour. Res., 44, W01429, doi:10.1029/2007WR006271.

Yilmaz, K. K., H. Gupta, and T. Wagener (2008): A process-based diagnostic approach to model evaluation: Application to the NWS distributed hydrologic model, Water Resour. Res., 44, W09417, doi:10.1029/2007WR006716.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2017-442, 2017.

Printer-friendly version

Discussion paper