

***Interactive comment on* “Practical experience and framework for sensitivity analysis of hydrological models: six methods, three models, three criteria” by Anqi Wang and Dimitri P. Solomatine**

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RC: Providing insight and guidance for users of Global Sensitivity Analysis (GSA) in selecting the appropriate method for their situations is a very current and relevant issue. One thing that has certainly not been sufficiently assessed is how we can combine different approaches in a multi-method approach to GSA (e.g. discussion in Pianosi et al., 2016, EM&S). So, I think that there is some value to the work done here. There is also clearly some more work to be done by these authors as the other reviewers already mentioned and I will not discuss the same again here. Rather I am making some more suggestions for the authors to consider.

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[1] Reduce the content and more clearly focus the study. Certainly, I would avoid presenting a framework. I think that comparing methods in detail and discussing how they can and should be combined is much more valuable. We know they give different results, but how can we use this? See point [4] as well.

REPLY. Indeed, we have not considered the (powerful) idea of combining of methods presented in Pianosi et al 2016, and it was not our intention in this study. We have done some work in the past contributing to the multi-model approaches in hydrological modelling, so fully share the idea of “multi”. Of course methodologically it is a tricky thing, since the methods called SA are doing actually conceptually very different things (but why not - since we do not hesitate to build hybrid environmental models combining different modelling paradigms). We could have included more methods as well, and interpret the results deeper.

[2] Some of the conclusions in model selection are trivial or are not consistent with example studies already in the literature. For example, there are already quite a few GSA studies using variance-based approaches with distributed hydrological or environmental models (in contrast to the authors’ third recommendation) (e.g. van Werkhoven et al., 2008, GRL).

REPLY. Indeed, we have not considered the (powerful) idea of combining of methods presented in Pianosi et al 2016, and it was not our intention in this study. It is also methodologically a tricky thing, since the methods called SA are doing actually conceptually very different things. We could have included more methods as well, and interpret the results deeper, to advance beyond a “trivial comparison”. Concerning the conclusion 2 (re. use of GSA for distributed models), indeed we could have extended it beyond recommending only RSA and LH-OAT, and going deeper, commenting on the possibilities of using of GSA more generally. We are aware of the mentioned approaches, referring in the paper to the paper Tang, Y., Reed, P., Van Werkhoven, K., and Wagener, T.: Advancing the identification and evaluation of distributed rainfall-runoff models using global sensitivity analysis, WRR., 43, 1–14, 2007, and we are

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thankful for the (new for us) reference to van Werkhoven, Wagener, Reed, Tang (2008) Rainfall characteristics define the value of streamflow observations for distributed watershed model identification, GRL 2008. Dealing with distributed models is indeed on our research agenda.

[3] If the focus lies on convergence of these algorithms, then you should really assess this issue in great detail and study for example whether convergence depends on the catchment studies or other things that can be varied between model runs (such as different uncertainties in the input and output data).

REPLY. Indeed, this issue could have been studied in greater detail, and it is planned to do.

[4] Figure 10 is a generic flowchart for GSA and as such more suitable for a review paper or a book chapter. I do not see how this advances on past work and would take it out. Focusing on what you can learn from applying these different methods would be much more valuable and interesting.

REPLY. Indeed, the framework is quite generic, and generally follow a number of frameworks presented earlier. Our intention was, as it can be seen from the title, to present the “practical experience and framework”, and to provide additional orientation for practitioners, who could follow the flowchart and evaluate for their cases what methods to use. We aimed to stress explicitly effectiveness, efficiency, convergence, implementation, etc. as the important criteria for comparison but it seems now we were not convincing enough.

We realise (also taking into account the other referees’ comments) that in the present form the study is not in the form to be presented as a “research paper” in HESS.

We would like to thank Professor Wagener for the time given to review this paper, pointing out deficiencies, and providing the very valuable suggestions.

We will be evaluating our options concerning extension and deepening of this research

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(which requires time and resources), and the target audience of this paper.

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