Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2017-28-AC4, 2017

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Identifying the connective strength between model parameters and performance criteria" *by* Björn Guse et al.

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Received and published: 12 May 2017

Comment: The authors have provided the reply to the Referee 2's comment, and are invited to do the same for the Referee 1's comment as well.

Reply: By replying directly to referee#2, we intend to clarify misunderstandings. In the meantime we replied also to the first and the third referee.

C: As an Editor, I have to take a quite "independent view", but I am quite interested in this subject, so decided to write a short comment, and thus to contribute to the discussion.

R: We thank the Editor to take part at this stage of the discussion and clarify these aspects as emphasised below.

C: I would like to mention that - indeed - the paper would benefit if the difference between the presented approach and the more traditionally used sensitivity analysis (SA) and uncertainty analysis (UA) methods is explained clearer.

R: We agree with the Editor and also with the referees that a clearer differentiation of our approach in comparison to a sensitivity or uncertainty analysis would improve the manuscript. This might be a good point for the discussion. In the revised version of the manuscript, we will add this part. Moreover we will relate the core idea of our manuscript to sensitivity analyses in the introduction by representing the state-of-the-art in relation to the objectives of our work.

C: If I understand it correctly, the presented method consists of the following: a) randomly sample parameters (using LHS) and run the model; b) using generated data build a surrogate model (RT) of the response surface (for each perf.crit.); c) estimate "strength" of relationship by looking at the "percentage contribution of each model parameter in explaining the variability in a certain performance criterion".

R: Overall, we agree with this short description of our approach and thank the Editor for this short summary. To a) We like to add that the calculation of ten performance measures for each model run is part of the point. To b) The regression trees are not only built for each performance measure (RTperf, see Fig. 4) but also in a second step for each model parameter using the performance measures as explaining variables (RTpar, see Fig. 5). Thus, we looked at the relationship between model parameters and performance measures from both sides by interpreting the bijective relationship (connective strength). To c) The (connective) strength of the relationship between model parameters and performance measures is described by considering the percentage contribution as described above by the Editor and also vice-versa by estimating the percentage contribution of how a certain performance measure react on changes in the parameter values (see Fig. 6). We will improve this description in the revised version of the manuscript.

C: Both reviewers mention that this can be seen as a variation of SA (and even Monte Carlo based UA) - albeit, in my opinion, with an interesting twist of using a surrogate model and the way "strength" is estimated. However the idea of "propagating" variation (sampling) in parameters through a model, and estimating how much does it influence the output (or performance) can be seen by many readers as similar to SA and UA. So, again, the difference could be perhaps presented more convincingly.

R: We agree that our manuscript would benefit from relating our method to sensitivity and uncertainty analysis and will incorporate the suggested differentiation in the revised version of the article. We like to highlight that a major part of our study is the analysis of the bijective relationship between model parameters and performance criteria. Thus, we do not only investigate how variations are propagated in the model up to the output but also by looking which outputs (i.e. performance criteria) are impacted by a certain model parameter.

C: A comment on RT: it is known that it is not the most accurate machine learning model: in its canonical form, its output in each leave is a zero-order regression model (i.e. a constant), whereas e.g. M5 model tree (Quinlan 1986) generates the 1-order (linear) regression model (unless R code of RT does this differently). (However RT has an advantage that is is simple.) Of course there are also many other methods like ANN. Would be useful to compare if (how) results using RT differ from the results if another type of the surrogate (approximating) model is used.

R: We agree that also other approaches than RTs are possible. However as raised in this comment, RT is a simple approach which can be relatively easily applied and understood. Since the suggested approach is not common we do not want to make it even more complicated. Our main focus was to emphasise the bijective strength between model parameters and performance measures. Thus, we think that the selection of RT is justified. Moreover, we do not expect that the results will significantly differ through the application of one of the mentioned approaches. Our results of parameter relevance for different hydrological conditions coincide with the results of sensitivity

analysis in former studies. Thus, we want to keep the current focus of the manuscript.

C: I hope this comment can be also taken on board.

R: We will certainly also consider these comments while revising the manuscript.

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