Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-375-RC1, 2018

Hydrology and Earth System Sciences
Discussions
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EGU

Interactive comment on "A comprehensive sensitivity and uncertainty analysis for discharge and nitrate-nitrogen loads involving multiple discrete model inputs under future changing conditions" *by* Christoph Schürz et al.

B. Guse (Referee)

bfguse@gfz-potsdam.de

Received and published: 21 September 2018

In this manuscript by Schürz et al., a detailed analysis of the impact of scenario simulations on hydrological variables is presented. In a sensitivity analysis, the sensitivities of five groups are separated. These groups are three types of scenarios (land use, point source and climate) and two model-specific groups (model set-up, model parameterisation). In the analysis, the impact of the input variables and of the uncertainty of the selection of scenarios or model characteristics is presented.

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Overall, I like the manuscript. However, I see still potential for improvements to increase the understanding of the manuscript.

Major comments:

From my perspective, the readability of the manuscript can be increased by a clear separation in the two major points of the article. First, the impact of the input variables is analysed to show which input variables are more relevant for discharge and nitrate. Second, it is analysed how the selection of a scenario or model characteristic controls the target variables (uncertainty analysis). I think that the article would be easier to understand if these two aspects are clearly separated. This comment is mainly related to abstract, introduction and discussion. In contrast, these two aspects are already clearly separated in the conclusion.

P.11, L: 1: Is it correct that you have identified 43 and 52 behavioural parameter sets out of 100.000 model simulations? If it is true than the number of behavioural parameter sets is rather low. How is than the impact on the sensitivity analysis meaning that most of the parameter sets are unbehavioural?

Figure 4: It is very hard to understand this figure. In my understanding the results from Fig. 3 are shown again and in addition to that the variations evoked by changes in land use or point emissions. Is it maybe better to present this as relative change to the lines in Figure 3? Or only as line and not as coloured area?

Discussion: One idea is to add a table or figure as an overview in the discussion to show which of the five criteria has a dominant impact on discharge and nitrate and which criteria are uncertain. I think that the article would benefit from a clear and easy understandable presentation at the end as a kind of take-home-message. I have in mind a figure which summarize all results in relative values. To understand the overall idea of summary figures see for example Figure 9 in Herman et al., 2013.

Specific comments:

P.1, L. 8: I suggest to modify to: “In impacts studies in two Austrian catchments, . . .

P. 1, L.13: I suggest to write “for each catchments” instead of “for both catchments”.

P.2, L: 17: I suggest to add: “using a set of different climate input data for hydrological models” at the end of this sentence (or a similar statement).

P.2, L.27: The discussion on equifinality is not well motivated. I miss a sentence to relate both paragraphs.

P.3, L. 5: I suggest to add a sentence at the beginning of the paragraph similar to “Sensitivity analysis can be used to derive the impact of different input variables on hydrological target variables” to make clear why you have selected this method.

P. 6, L. 11: fertilizer

P. 8, L. 5: Please avoid one-sentence-paragraphs

P. 9, L: 14: I suggest to write: “applied a GSA on discharge and nitrate. . .”.

Table 3: Is the sensitivity related to discharge or nitrate or both?

P.15, L. 14: You may add that this result could be expected since the model structure is known to be of higher importance for low flows since high flows are strongly driven by the precipitation (observations).

P. 15, L. 31-34: For me, it seems to be that in Fig. 3, spring is the dominant season in the upper left subplot.

Figure 4: The legend needs to be explained in the figure caption.

P. 19, L. 5: Could you add in which subplot you can see this drastic change?

P. 19, L. 11: Have you an explanation for this?

P. 25, L. 3: I suggest to add “The selection of” before “climate scenarios”.

P. 26, section 4.2: You may add a statement similar to “This analysis shows again that

a clear description of the selected scenarios is mandatory for impact studies."

References: Herman, J.D.; Kollat, J.B.; Reed, P.M.; Wagener, T. (2013): From maps to movies: high resolution time-varying sensitivity analysis for spatially distributed watershed models, Hydrol. Earth Syst. Sci., 17, 5109-5125.

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