General comments

The authors have submitted a revised version of 'Towards simplification of hydrologic modeling: identification of dominant processes'. In the manuscript a methodology of identification of influencial parameters and related dominant hydrological processes of the HRU based Precipitation-Runoff Modeling System (PRMS) is presented. Parameter influence on model output was evaluated by parameter senstivity index values originating from global sensitivity analysis with the Fourier Amplitude Sensitivity Test (FAST). The approach aims at reducing the number of calibration parameters helping modelers to focus on relevant processes within the watersheds of the conterminous United States.

The incorporation of necessary improvements in terms of the overall purpose, fundamental assumptions or the presentation quality of the study has been partly accomplished in a reasonable way. Nevertheless, in several parts, the manuscript still shows shortcomings. My concerns mainly relate to the structure and presentation of the concept, including the line of argumentation evolving around the general hypothesis of the study through the different sections. I recommend to revise again a number of specific and technical points to reach publication quality.

Specific comments

Introduction

I am not sure if the introduction is structured appropriately along the main purpose of the study defined as identification of 'sensitive parameters' and 'dominant processes'. I think it partly omits to set the right focus on these two aims which is important to understand the benefit of the methodology.

I like the beginning with the two complexities (input parameters and model output/processes) which nicely sets the focus on the main purpose and should structure the whole chapter, not to say the whole manuscript. Unfortunately, then the focus gets a bit lost and parts of this paragraph seem to be more a general description of methods (global sensitivity analysis, classification) and own findings which doesn't not keep this focus on the two complexities. Specifically, it is not sufficiently linked, first to previous studies, second to the presented study and results:

P3L1: Can you please be a bit more precise here in reference to the literature: What are reasons that parameters cannot be directly measured or transferred to larger scales even if measurements are partly available but at smaller scales (hillslope, plot or lab scale)?

P3L16: Are there any other studies where these two complexities (or one of them) were addressed or reduced?

P3L18: Here a few references (e.g. Sanadhya et al., 2013) to studies where global sensitivity analysis was used to identify parameters or processes might be worth to include.

P3L26-L31: References to these statements are missing - please add. Otherwise it can be regarded as one of your findings and sould be moved to the results or discussion sections. It seems to be an anticipation of your results or general interpretation of them.

P4L6: Could you be more specific here. How was the identification of dominant hydrological processes performed in some of these studies. I recommend to focus in more details on literature that has dealt with the identification of dominant parameters, hence processes. This is actually the purpose of your study and needs to include former efforts to cope with this complex problem. This should be presented to the reader in a form that clarifies the need for ongoing research on this topic, see e.g. Cuntz et al., 2015. Furthermore there might be studies where dominant processes are identified in different ways than with a purely model based approach.

P4L23: What kind of input do you mean (parameters or meteo forcing etc.?), output in which form? Can you please describe the input and output with a few words to be more clear here.

Methods

P4L30: Here it might be worth to mention the modular structure of PRMS first. This was first done in the following section 2.2. but is a property of PRMS.

P5L15: Are there studies where parameter interactions have been analysed.This might be additionally helpful to explain interactions of parameters.

P5L28: I suggest to delete the word 'stream segments' here to avoid confusion and focus on HRUs as fundamental spatial discretization units of PRMS. Stream segments where used to derive HRUs in the case of your study but are not further used for simulation and analysis.

P7L6: Please consider to rename the expression 'Performance measures'. In my view, performance measures are commonly used in hydrological modelling to evaluate the simulation results in comparison to any form of observation, which is not the case in this study. In accordance with B. Guse's comment on the previous manuscript version an expression should be selected that describes the statistical indices more appropriateley. I recommended to use a term like: 'fundamental daily streamflow statistics (FDSS)', 'statistical hydrological indices' or 'statistical response characteristics'.

P7L22: To be more consistent, I propose to move the section about the FAST analysis to the methods section. It is, in combination with the hydrological model and its output, a tool/method you used to identify parameters and processes.

P8L25: Please explain here or above why exactly a number of more than 9000 parameter sets are developped via FAST.

Results

P12L30: Could you better explain the connection of the circles' colors to the percentage values of Table 2 and to processes? (please see also comment on Fig. 4)

P13L24: Can you be a bit more precise here about sensitivity differences and the value for calibration between the two parameters and their order in vertical routing process in reference to the cited literature?

Discussion

P13L28, Section 5.1: In terms of the causes of parameter sensitivity, the discussion here is almost purely led from a model-based perspective without much reference to real world causes for dominant processes. I think it might be worth to structure it by model-based (as you already discussed) and real world causes. I recommend to add here a small pararaph e.g. with an exemple of studies where dominant processes in the real world of the CONUS where identified and then relate it to your model based findings for causes of parameter sensitivity.

P16L1-P17L28, Section 5.3: Concerning the structure of this chapter and its role in the manuscript, in my opinion, parts of this chapter rather belong to the methods and results section. The authors first introduce a new procedure to make most dominant and inferior model based processes visible (P16L2-10) and then show its results in the following paragraphs. I recommend to split this section and move one part to the methods section, one to results and then discuss your findings in details in the section here.

P17L31: Isn't a calibration advise for modelers always one of the last outcomes of a research on hydrological modelling,

e.g. based on a feasible and sophisticated approach of parameter/process identification?

P19L3: ...or HRUs could be defined by dominant process instead of geographic location....

P19L3: 'Perhaps sensitivity analysis could help define this in a more objective way'. This statement seems to me very vague and should be formulated more clearly in relation to the previous sentence (see also comment directly above).

Conclusion

I have the impression that the conclusion is a bit vague and doesn't point at the most important and specific findings of the manuscript to a satisfactorily extent. Moreover, the two aspects of complexity stated in the introduction should be addressed here more specifically to reach a closed line of argumentation based on the main purpose/hypothesis of the study. The authors could also make use of the argumentation built on the two complexities to form the abstract, introduction and methods in a bit more consistent way. This structure should be kept also in order not to loose the readers attention in the different sections.

P19L13: As HRUs can be derived in various ways and their number is not fixed, I recommend to slightly change this sentence to something like: 'A global parameter sensitivity analysis was performed on the calibration parameters for all HRUs derived for the conterminous United States.'

Technical corrections

Please be consistent in the writing: '**dominate**' or '**dominant** process'. Please use the right adjective.

P2L13-L17: Is the order of findings listed here consistent with the order results are presented and discussed in the manuscript? Please check and change if necessary.

Typing errors:

P2L11: I recommend to write: '...identify the (most) dominant process..'

P3L12: effect instead of affect

P5L29: are

Tables and Figures:

Table 1: In terms of the alphabetical sorting of parameters, I think it might be more useful to sort the parameters by PRMS (process) module according to their occurence in the vertical routing process. Additionally, another column showing the used value ranges of the calibration parameters could make sense in relation to the explanation of the FAST procedure on P8L23.

Figure 1: The resolution of the map still seems to be not high enough and labels a bit pixelated. The colors for the different elevation zones are faint and their contrast low.

Figure 3: The caption can be improved by stating that the plots and maps show the results for the different processes seperately. In subplot (j) a vertical line is plotted to the right of the map. Please remove.

Figure 4/P12L30: It might be possible to assign percentage ranges or average percentages to the legend for first place occurences (red circles), in between occurence etc. to account for the degree of parameter influence throughout the CONUS. This would increase the information content of Fig. 4 and better illustrate the connection to Table 2. Furthermore, the figure doesn't

show any connection of the parameters to the processes they are influencing.

References

Cuntz, M., et al. (2015), Computationally inexpensive identification of noninformative model parameters by sequential screening, Water Resour. Res., 51, 64176441, doi:10.1002/2015WR016907.

Sanadhya, P., Giron J., and Arabi, M.: Global sensitivity analysis of hydrologic processes in major snow-dominated mountainous river basins in Colorado, Hydrological Processes, 28, 34043418, doi:10.1002/hyp, 2013.