Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-46-RC2, 2018

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "The effect of input data complexity on the uncertainty in simulated streamflow in a humid, mountainous watershed" *by* Linh Hoang et al.

Anonymous Referee #2

Received and published: 4 April 2018

Review of the manuscript "The effect of input data complexity on the uncertainty in simulated streamflow in a humid, mountainous watershed" by Hoang et al.

In this manuscript, Hoang et al. evaluated the effect of input resolution (digital elevation model) and input complexity (number of soil and land use classes) on model output uncertainty of the SWAT-HS model. Model output uncertainty is evaluated in terms of streamflow, saturated areas and parameter uncertainty. They conclude that uncertainty does not necessarily decrease when increasing input resolution or complexity. However, selecting parameter sets based on the combined information on streamflow and the spatial extend of saturated areas positively affected uncertainty.

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Discussion paper

This is an interesting study and I like the clear and well described concept. The results are illustrated and described in detail for different model outputs and clearly support the conclusions. The main results are well discussed. To further improve the manuscript I have some suggestions listed below. Major comments address the potential calculation of additional streamflow criteria, the calculation of a complementary measure for the saturated areas, or a figure showing simulated hydrographs.

I hope that the comments below will be helpful for the authors to improve their manuscript.

Major comments:

P L4: The model you used in this study is called SWAT-Hillslope. For me the word hillslope implies that one is working at the hillslope scale of an undisturbed catchment. However, you use the model at a much larger scale and for a catchment that is probably highly influenced by human use (urban areas and lots of agricultural area). I think it would be helpful if you shortly reflect on that and give the reader a good reason for using SWAT-HS.

P5 L25-P6L8: It would be interesting to have some more information or numbers about human disturbances within the catchment: are there any major water withdrawals for agricultural use? Is there a reservoir that is used to guarantee the drinking water supply for NY in dry spells? How are these human influences affecting your model assumptions, such as a closed water balance?

P6 chapter 2.2: I am not very familiar with the SWAT model and when reading the second paragraph of chapter 2.2 it was not clear to me how the structure or the combination of subbasins, wetness classes and HRUs look like. Would it be an option to include a schematic of the model structure to visually support what you are writing?

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Discussion paper

P9 L2: I like the idea of using the principle of GLUE the select behavioral parameter sets. However, I am not sure if I would agree in using a Nash-Sutcliffe efficiency of 0.65 as a threshold for good simulations. How do you know that 0.65 is a good model result for your catchment? Nash-Sutcliffe is known to be high in catchments with a high discharge variability and model efficiencies also tend to be better for humid catchments than for dry catchments. Shouldn't good efficiencies for a catchment like yours be around 0.8 (I know this is a bit provocative)? Why did you decide to take a fix efficiency threshold and not just the best 10

P9 L2: Linked to using GLUE: it would be interesting to also see the simulated and observed hydrographs with the confidence intervals.

P9 L5: Your final goal is to make some recommendation about the appropriate model input complexity and resolution based on streamflow, saturated areas and parameter uncertainty. Evaluating the streamflow simulations on a single efficiency measure has therefore a strong impact on your final recommendations. After all the discussion on the use of Nash-Sutcliffe (e.g. Do Nash values have value from Schaefli and Gupta, 2007; Decomposition of the mean squared error and NSE performance criteria: Implications for improving hydrological modelling from Gupta et al., 2009) I would suggest that you calculate one or two additional efficiency criteria for streamflow simulations. This could for example be a criteria representing low flow or discharge volume.

P14 L1: If I understand correctly, you evaluate the model simulations by the percentage of simulated areas that intersect with the observed areas (purple color in Fig. 8). This corresponds to my interpretation to the percentage of correct classifications. To me it seems logical that the DEM30m performs best, because it cannot be too wrong due to its coarse resolution. Therefore, I think that evaluating the percentage area of misclassification (percentage of simulated area that does not intersect with the observation – green color in Fig. 8) would give additional and important information for the evaluation of the various DEM resolutions.

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Discussion paper

P18 L2: In the discussion you provide some good reasons why a relatively coarse DEM resolution (DEM 10) can lead to good/ acceptable results. However, I don't understand why a better resolution does not result in even better results. Could you maybe write a few sentences that elaborate on that?

Table 3 and 4: I agree that the number of parameter sets and the median efficiency values are interesting. However, I would recommend to add the values directly to the corresponding figures to have the information where it is relevant. I think that max and min efficiency values can also be seen/ guessed from the figures and are not that important that they need to be in a table.

Minor comments:

P1 L1: After reading the manuscript I would suggest to adapt the title, because is only addresses part of the actual analysis. I am also not sure if the study catchment can be considered as mountainous. So maybe the title could be adapted to something similar as: Effect of input data resolution and complexity on simulation uncertainty for a simple runoff model.

P1 L11: I would be careful with using the term "water quality" in the very first sentence of the abstract as it suggests that the study is about water quality, which is not the case.

P2 L4: The nine model setups not only had a similar effect on parameter uncertainty, but also on streamflow simulation.

P2 L7: The term spatial input details was a bit confusing to me. I would rather use the same terms as before: input resolution and complexity.

P2 L16-17: Is data used to calibrate the model (e.g. discharge data) included in your list? For me it would be a fourth point called output data uncertainty.

P5 L12-22: I recommend to reorganize this paragraph. Having two listings in a row makes it more difficult to understand what the focus of your study is.

P7 L4: I recommend to mention the concept of “hydrological connectivity”, which is the argument for you lateral surface aquifer.

P7 L20: Please add the reference for the LiDAR data.

P7 L25. I would refer to Figure 4. (“. . .divided into 10 wetness classes (Fig. 4))

P8 L 9: Please add the reference for the solar radiation data.

P8 L21: Using a model with a snow routine I would mention the percentage of precipitation falling as snow in the section where you describe the catchment.

P8 L19: Why do make 10’000 MC runs and not 100’000? Do you think your parameter distributions would look differently with more random parameter sets? Please give some reasons for your choice.

P10 chapter 3.1.1: You could think about moving this chapter to the methods part.

P13 L7: Could you briefly explain what the percentage of saturated areas is? It would then also become clearer what / how many data points the corresponding boxplots (Fig. 7) contain.

Fig. 1: Could you increase the resolution of this figure? Because it is not sharp when printing it out on A4.

Fig. 5 and 10: I recommend to adapt the y axis scales to better use the available space. And I also suggest to use the same style/ content of figure caption for Fig. 5 and Fig. 10.

Fig. 6: Again, I recommend to adapt the y axis scales to better use the available space. Additionally, I would add the information that only the good parameter sets for both streamflow and saturated areas are used in this plot to the figure caption.

Fig. 9 and 11: It is almost impossible to see the distributions of the good parameter sets for both streamflow and saturated areas. Why don't you scale the y axis differently?

Table 1: What is the difference between latA and latB? It is not clear since the definitions are identical.

Generally: I suggest to use the HESS guidelines for making references and also for formatting units.

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