

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1  
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## Comment on hess-2022-338

Anonymous Referee #1

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Referee comment on "To what extent does river routing matter in hydrological modeling?"  
by Nicolás Cortés-Salazar et al., Hydrol. Earth Syst. Sci. Discuss.,  
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The authors conducted a very comprehensive sensitivity analyses of the effects of adding an additional river routing model with various schemes to a hydrological model. The publication shows promise as a great reference work for model experiment setup. In general, the publication is well written and the arguments for conducting the study are clear. The decisions made regarding the methods are well-argued (with the exception of 1) and the results are valuable for the hydrologic community. The limitation of this study are well described. It is understandable given the scope of the study and the data requirements that the authors evaluated a single catchment. For future research, I am eager to discover how the results of this study would be different in a more gentle sloping catchment or for various catchment sizes (e.g using CAMELS-CH **Alvarez-Garreton et al., 2018**).

That being said, the publications needs some extra work. The main points that need attention are argumentation for hydrological model aggregation, the structure of text and figures, additional reflection on the meaning of study results, and the archiving of code and data.

### Major comments:

#### *Temporal aggregation of hydrological model results*

In section 3.3 the authors state that for each parameter set the VIC model is run at hourly time-steps and the results are temporally aggregated to various coarser time-steps. In my opinion this is an assumption that there are no non-linear processes in time within the hydrological models. The necessity for this assumption is clear as it results in a clean model experiment. However, the authors should more clearly state this assumption and

reflect on this in section 5.1 (last paragraph) and 5.2. I'm curious to read the authors response.

### *Structure of text*

The authors conducted a lot of analyses which to their credit lead to an abundance of methodology steps and results. This makes section 3.5 difficult to read and therefore it needs restructuring. I suggest to use numbering to make the steps more clear even if this disrupts the flow of the text. What might also help the reader is a model run results matrix in the form of a Table that uses the same numbering. This makes it clearer for the reader what results can be expected for each type of model run configuration.

### *Structure of figures*

There are issues with the presentation of the results in the figures. Overall the image quality (dpi) per figure needs to be higher. The colours used to represent the individual routing schemes are inconsistent, please check all figures.

Figure 1: It is difficult to find the catchment on the left panel (1a). Outlining the catchment in red and using a softer tone for the country would help. The colours for elevation bands in 1b are difficult to distinguish, similar issue with the sub-basins in 1c.

Figure 2: Increase image quality.

Figure 3: Highlighting the horizontal axes in red would help find the period of the zoom boxes.

Figure 5: Colours are difficult to distinguish, suggest using the same colors for each scheme as in Figure 3. The vertical axes of each column varies, ticks for KGE are in steps of 0.2 while those of NSE are 0.4. This makes it nearly impossible to assess the relative differences in objective functions. I suggest using the same tick sizes with the exception of NSElog.

Figure 6: There is almost no reference to the different basin areas that are shown using the horizontal axis. It would make the figure a lot clearer if only the 2770 basin area was shown and the individual schemes were plotted next to each other. I suggest placing the results for the other basin areas in the appendix.

Figure 7: Similar to Figure 6 this figure is difficult to read. The total width of the horizontal axis does not add information, therefore I suggest to make the ticks smaller.

Figure 8: Increase the image quality. I suggest to make a separate table for the objective function results.

### *Reflection on the meaning of study results*

The discussion section 5.1 can be extended by reflecting more on the implications of results. For example, we understand what is happening to the hydrological model in the absence of river routing. Compensation through baseflow and no considerable change in precipitation, evapotranspiration and runoff partitioning. What is missing is, what the implication are for users and why it is important to get these parts right in hydrological model setups. This is also the case for the results in 4.4. In addition, the selection of objective-function is discussed but there is no discussion on multi-objective calibration and how these might affect the results. There is reflection needed on the relevance of the differences in objective-function values. What does a difference of xx KGE mean?

### *Data*

The authors state "The codes used in this study are available from the corresponding authors upon reasonable request". What does reasonable mean?

The Copernicus data policy ([https://publications.copernicus.org/services/data\\_policy.html](https://publications.copernicus.org/services/data_policy.html)) states "In addition, data sets, model code, video supplements, video abstracts, International Geo Sample Numbers, and other digital assets should be linked to the article through DOIs in the assets tab."

In the spirit of open-science I strongly encourage the authors to do so. I leave it up to the editor to determine whether this is a requirement for publication.

### **Minor comments:**

Refrain from using acronyms in figure captions. The style of figure captions is inconsistent,

e.g. use of “:”, or “;”, or “,”

Lines 71-72: SWAT model is missing a reference.

Lines 76 -80: Very long sentence, needs restructuring.

Line 93: remove “apparently”

Lines 251 – 254: This is a bold claim that I would remove as it does not add value to speculate.

Line 349: “MC approach”, change to machine learning approach.

Personal dislike of the use of the word “indeed” throughout the publication.