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Discussions

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Comment on hess-2021-244

Anonymous Referee #1

Referee comment on "Can we use precipitation isotope outputs of isotopic general circulation models to improve hydrological modeling in large mountainous catchments on the Tibetan Plateau?" by Yi Nan et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-244-RC1, 2021

Interactive comment on "Can we use precipitation isotope outputs of Isotopic General Circulation Models to improve hydrological modeling in large mountainous catchments on the Tibetan Plateau?" by Yi Nan, Zhihua He, Fuqiang Tian, Zhongwang Wei, Lide Tian.

GENERAL COMMENTS:

The authors in this manuscript discussed the potential utility of applying the Isotopic General Circulation Models (iGCM) product isoGSM in assisting large scale hydrological modelling. It was found that spatial isotope data of precipitation from isoGSM can essentially help to reduce modeling uncertainty and improve parameter identifiability in comparison to a calibration method using only discharge and snow cover area fraction without any information of water isotope. The suggested isotopic-tracer-aided hydrological model showed high values for robustly representing runoff processes in large mountainous catchments with sparse observations in high mountain Asia. This topic is closely matched to the journal and the results can be interesting for hydrological modelling community. Additionally, it is well-written, logically organized, and easy to follow. Reviewer would like to point out two main concerns that may be helpful to generalize the results to improve the paper.

(1) the authors claimed that with spatial precipitation isotope derived from the isoGSM data modeling uncertainty and parameter identifiability cam be greatly reduced in the large mountainous catchment. The isotopic data provides additional information to constrain the uncertainty of model parameters controlling water separations into direct runoff, subsurface flow, etc. I think it can be regarded as some kinds of fine tuning without modifying the model structure itself. However, as have been reported in many recent studies, global climate changes are changing streamflow regimes and groundwater storage in cold alpine regions on the TP (e.g., Xu et al., 2019; Lin et al., 2020; Yong et al., 2021). In a warming background, for example, frozen ground on the TP are experiencing significantly degradation, which will modify storage capacity of soil and groundwater and even the flow pathway. Hence, the question is that is it enough to justly constrain parameters, and shall the model structure be simultaneously changed in the study basin?

(2) Results suggested that model driven by the corrected isoGSM data can provide a more reliable ratio in determining the contributions of runoff components, especially the overestimations of glacier melt. The authors have compared the results with other assessments (e.g., Immerzeel et al., 2010). I know that accurate estimation of runoff components in a macro-basin is a tough task due to sparse observations, and thus maybe controversial in high mountain Asia basins. However, the reviewer suggested that more evidences (e.g., isotopic results or sub-basin results or neighboring observed data) besides modelling results should be added and compared to justify their results. And statistical results about glacial retreat in the YTR maybe help as another useful evidence for runoff components determinations. In addition, more physical explanations of adopted assumptions, equations (e.g., equation (1)) should be supplied.

Based on above main considerations, I recommend to accept this manuscript after moderate revisions that are required to address the general and specific comments.

SPECIFIC COMMENTS

P means page, and L means lines

P3L60: one of the reasons limiting tracer-aided model in applying in larger scale catchment lies in the lumped conceptual model structures. So the reviewer suggest that more information about model structures should be added in the section Introduction and methodology. How to delineate a larger scale basin into response units in your model for fully capturing the heterogenous natures of a basin? And how to organize the model structure to consider the strong spatial variability of runoff generations especially in vertical direction.

P3L74-79: As pointed by the authors, runoff in this region is highly vulnerable under climate warming, and hence the land covers, soils and groundwater aquifers. How do they consider these changing environmental factors in hydrological modelling?

P4L89: Could you provide more details about how model parameters be constrained or calibrated in terms of isotopic data?

P5L143-144: does the TPSCE data include glacier in snow cover, or not?

P6L164: As is known precipitation condensing at cooler temperatures tends to be more depleted in the heavier stable isotopes, thus precipitation falling at higher latitudes, at higher elevations, and further inland tends to be isotopically depleted (Yang et al., 2020). So try to explain the physical meaning and extent of the coefficients (e.g., x, y) in Equation (1).

P6L173-175: Isotopic composition of glacier meltwater in this catchment was assumed to be -18.9‰, why a constant value was adopted here. The uncertainty of isotopic data in glacier as well as precipitation for hydrological modelling should be discussed.

P7L195: Equation (3) is similar to Equation (1). However, the equation has deprecated the term longitude here. Why?

P7L214-215: The standard for REW delineation? Why do you sub-divide the whole YTP into 63 units and however 41 in the more smaller catchment KR?

P9L258-260: why NSE threshold is significantly larger in maco-YTR than in smaller scale of KR?

P9L261-273: The authors can refer to some reported contemporaneous isotopic data if possible, add some sporadic-distributed data as additional evidences besides the continuous observations in 2005.

P10L320: in which stations the model performance in YTR was shown in Table 3 and Fig. 5-6?

P10L322-326: why the dual-objective has obtained the best results, while it produced the worst MAE values on another hand? However, the two scenarios adopting isotopic data as supplements for modelling could get better results of runoff components. More details should be revealed why the latter two scenarios calibrate the model at the cost of precision, and in order to obtain more accurate predictions, part of hydrological processes must have been distorted in the dual-objective to compensate other wrong representation in hydrological process simulation.

P10L327-328: provide a spatial distribution map of precipitation isotope.

P11L364-365: why the dual-objective has obtained good results in predicting discharge in the outlet station, while the other two scenarios adopting isotopic data could get better results in internal stations?

P13L410-412: what is the meaning "consistently estimated lower proportions of glacier melt than the dual-objective calibration, which can be attributed to the role of isotope data in regulating the contribution of strong-evaporated surface runoff component fed by glacier melt to streamflow"? And what is the proportion of glacier evaporation in glacier melting?

P13L422-423: The largest differences in the winter season can only explain that isotopic constrain functions. But the predictions have also been improved?

P14L467: The uncertainty of isotopic data for hydrological modelling should be discussed quantitatively and deeply. For instance, the distribution map of precipitation isotope is coarse and vertical effects may be not considered in present scenarios in details.

TECHNICAL CORRECTIONS

P2L26: was first corrected changes as was firstly corrected.

P3L52: Zongxing et al., 2019 changes as Li et al., 2019? The following same below can also be revised.

P3L74-79: Quite a long sentence it is and suggest to adopt short sentence to follow the gist easily.

P11L364: variant changes as scenarios?

P27: keep x-, y-axis in the same scale.

P39: calibration scenarios instead of calibration variant makes sense?

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