Hydrology and Earth System Sciences Discussions

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Reply on RC2

Yi Nan et al.

Author 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-AC2, 2021

Response to Reviewer #2:

Comment 1:

The tracer-aided hydrological model was recognized to have value on improving the rationality of model structure and parameter, which was especially important for mountainous catchments. However, the application of tracer-aided model was limited to small and middle scale because of the low availability of isotope data in large scale. The authors developed a procedure to correct the iGCM data and force tracer-aided model in a large basin on the Tibetan Plateau, and had good effect on improving the model behavior. The results open a new window to expand the application of tracer-aided model to larger scales. Meanwhile, the paper is well structured and the language is well written. I recommend its publication on HESS after a moderate revision properly addressing some specific comments.

Response 1:

Thank you very much for your appreciation. We will revise the manuscript thoroughly according to your comments.

Comment 2:

In the multiple-objective calibration methods, the evaluation indexes of different objects are added together directly. I am concerned about the reasonability of this procedure considering that the NSE, RMSE and MAE have different measurement units.

Response 2:

Thanks for your comment. This is indeed an important issue, and the objective function should be carefully determined when developing a general calibration strategy. But this study only aimed to illustrate the benefit from the calibration of isotope, and adding three

objective functions together just meant that good simulation for the three objectives were produced simultaneously. Besides, although the three functions have different units, their values are in the similar order of magnitude (0 to 1) when the model performances were behavioral. Our result showed that when three objectives were all simulated well, the uncertainty of parameter and runoff component contribution was significantly reduced compared to the condition when only one objective was satisfied. Thus the influence of objective function choice was not stressed in this study, and we will clarify this in the revision version.

Comment 3:

Why did the authors interpolate the measured data using the terms longitude and elevation, but correct the isoGSM data only using the term elevation?

Response 3:

Equation (1) was used to interpolate the point-scale measurement data to the whole basin, and the term longitude reflected continental effect. Equation (3) was used to correct the output of isotopic GCM model, which tended to have larger error in the regions with higher elevation, because of the complex regional topography, which cannot be captured well by the coarse spatial resolution of GCM. It seems that no mechanism can make the error of GCM change with longitude, thus it was deprecated in Equation (3). However, the choice of regression term in regression and bias correction will undoubtably have important influence on the modelling result. Consequently, we still need to do lots of works to explore a general way to drive tracer-aided model using isotopic GCM data (e.g., to have a better understanding on the bias characteristic of the iGCM data).

Comment 4:

Is it enough to only use the average measured isotope data to correct isoGSM data? How about the seasonal characteristic of the bias?

Response 4:

Thanks for your comment. This study aims to develop a strategy for establishing a tracer-aided model in large basin, especially in the regions where little measured precipitation isotope data is available. Consequently, we tried to use little information from measurement data as possible to correct the isoGSM data.

Comment 5:

The runoff is divided into rainfall, snowmelt and glacier melt. How did the authors consider about the groundwater?

Response 5:

The hydrological model THREW used in this study quantifies the runoff component in two aspects of definitions. The first definition is the contribution of water sources including rainfall, snowmelt and glacier melt to the total water input into the catchment system. The THREW model focuses on rainfall-runoff, thus the processes of deep groundwater are not

described. The groundwater in our model is fed by the infiltrated rainfall or snowmelt, thus it has been included in the three water sources. The second definition is based on the runoff generation pathways including surface runoff and subsurface flow (baseflow), and the result was not reported in the manuscript. We will report them in the revised manuscript and compare with other studies to verify the result.

Comment 6:

How did the authors determine the isotope composition of snowmelt and glacier melt?

Response 6:

Snowpack and snowmelt were considered similarly as other water storages and fluxes in the model, thus the isotope composition was simulated similarly with the water isotope based on complete mixing assumption.

According many studies, the glacier meltwater usually has depleted isotope composition with a very small variation. Consequently, the isotope composition of glacier melt was assumed to be a constant value, which is lower than the average isotope composition of precipitation.