**Responses to Referee #2:**

We greatly appreciate the reviewer for his/her valuable comments and feedback on our study. We believe these comments will greatly improve this manuscript.

**General Evaluation**

Sensitivity analysis is an effective tool for identifying important uncertainty sources and improving model calibration and predictions. This study used an advanced hierarchical global sensitivity analysis framework to investigate the uncertainty sources of a three-dimensional, process-based hydrologic model in Amazon catchment. Three uncertainty sources are considered including model parameters, model structure and climate scenarios.

I think this research topic is meaningful in hydrology community, especially for a large scale catchment study. This paper is well organized and easy to read. The conclusions are well supported by the results and data. However, some important problems are not clear, which should be addressed before publication. Please see the specific comments.

**Response**

We thank the reviewer for the positive evaluation and constructive comments of the manuscript. We will substantially revise the manuscript following reviewer's comments.

**Comment 1**

Line 55: Please give a brief description to other global sensitivity analysis methods, e.g., the sensitivity analysis based on information entropy.

**Response**

We will add more descriptions and references to other global sensitivity analysis methods in the introduction, for example, screening method, regression-based method, variance-based method, meta-model method, and information-entropy-based method.

**Comment 2**

Line 290: Are the three aquifer models sufficient to investigate the sensitivity of the model output to aquifer thickness? Please justify it.

**Response**

We chose three aquifer models here because (1) the sediments throughout the Amazon Basin are relatively old, so the stratification of soil and aquifer is relatively stable and the thickness does not change much (Do Rosario et. al., 2016); (2) the lack of actual measurements prevents us to determine the boundary between unconfined and confined aquifers (Fan et. al., 2010); (3) these three models represent three typical cases that (i) the unconfined aquifer is very thick, (ii) the thickness of the unconfined aquifer is similar to that of the confined aquifer, and (iii) the confined aquifer is very thick. Based on the above three reasons, we chose these three aquifer situations to investigate the sensitivity of the model output to aquifer thickness. We will add more detailed discussion in the revised manuscript.

**Comment 3**

Line 293: Are these model weights used for model averaging or model combination?

**Response**

We are indeed using these weights for the model averaging process involved in the variance calculations of sensitivity analysis. The hierarchical sensitivity analysis method requires the weight of model $NM_k$ under scenario $CS_l$ satisfying $\sum_k P\left(NM_k \middle| CS_l\right)=1$, and the weight of scenarios satisfying $\sum_l P\left(CS_l\right)=1$. In this study, we assume that different climate scenarios have the same weight. We also assume that the weights of the different models under each climate scenario are the same. In other words, for 6 climate scenarios, the weight of each climate scenario is 1/6; for each of the 3 models under a certain climate scenario, the weight of each model is 1/3. The results from Section 3.1 to Section 3.4 are exhibited under these assumptions. However, we changed the weights for $NM_1$, $CS_1$, and $CS_6$ within the range of (0, 1) in Section 3.5, respectively. If the weight for $NM_1$, $CS_1$, or $CS_6$ is $p$, then the weight of the remaining uncertain factors of the same kind will be assumed as $(1-p)/n$, where $n$ is the number of the remaining same-kind factors.

**Comment 4**

Line 297: Parameters' ranges have influence on the results of sensitivity analysis, please explain the allowable ranges of these parameters in Table 2.

**Response**

We will add explanations to allowable ranges of these parameters in the revised manuscript.

**Comment 5**

Line 346: It is good to investigate the contribution of groundwater system to stream-flow, and this research find that the thickness of an aquifer will greatly influence the water redistribution process in the aquifer. However, I want to see the influences of aquifers' thicknesses on streamflow in more detail, such as, the unconfined aquifer and the confined aquifer, It is expected that the unconfined aquifer has more influence on streamflow, because it has stronger interaction with surface flow.

**Response**

We thank the reviewer for the suggestion. And we think the comparison for the importance of unconfined and confined aquifers is indeed worth to investigate. We will add new results for defining and estimating new sensitivity indices of these two different types of aquifers.

**Comment 6**

Line 383: what's the meaning of prior weights here, will they used for Bayesian model averaging?

**Response**

We understand the confusion of the reviewer. We called this weight prior weight is because it is currently arbitrary value (i.e., we give equal value to every plausible model in this study) and the prior is indeed relative to the posterior model weight considering data in the Bayesian model viewpoint. We used the term "prior" to imply the posterior model weight can also be used in our sensitivity analysis method. However, the estimation of posterior model weight is complex and not the focus of this sensitivity analysis research. And we found out the weight values have little influence on the sensitivity analysis results in this study. The integration of the posterior weight and sensitivity analysis is an important goal for our future research.

**References**

Dai, H., X. Chen, M. Ye, X. Song, and J. M. Zachara: A geostatisticsinformed hierarchical sensitivity analysis method for complex groundwater flow and transport modeling, Water

Resour. Res., 53, doi: 10.1002/2016WR019756, 2017.

Do Rosario, F. F., Custodio, E., & Da Silva, G. C. J.: Hydrogeology of the western amazon aquifer system (waas), Journal of South American earth ences, 72(dec.), 375-386, 2016.

Fan, Y., and Miguez-Macho, G.: Potential groundwater contribution to Amazon evapotranspiration, Hydrol. Earth Syst. Sci., 14, 2039-2056, 10.5194/hess-14-2039-2010, 2010.