Replies to Referee #2

Dear Anonymous Referee #2,

Re: Manuscript # HESS-2019-544 entitled “Dynamics of hydrological model parameters: mechanisms, problems, and solution”.

We are very grateful for the Referee’s comments and encouragement. We have carefully studied and considered all comments in making revision and a point-by-point response is as follows. For clarity, all comments are given in black and responses are given in the blue text. The revised parts in our manuscript are highlighted in red.

Yours sincerely,

Kairong Lin (Ph.D.)
Professor in hydrology
E-mail: linkr@mail.sysu.edu.cn

Title: Dynamics of hydrological model parameters: mechanisms, problems, and solution

Please address the following issues:

1 The introduction should have a paragraph stating the objectives of the paper.

Reply: A paragraph stating the objectives of the paper is *added* in the Introduction section of revision as suggested. The explicit information is as follows:

"This study aims to investigate the underlying causes of poor model performance in hydrological models with dynamic parameters via designing five calibration schemes, and explore the potential reasons for the poor response of the dynamic parameter set to the catchment dynamics are explored."

2 In the methodology, it is unclear what happens with the dynamic parameters during the validation period. Are they set to the same values as in the calibration period? Do they follow the exact same dynamics? Are the values dependent on the calendar day?

Reply: Thanks for the comment and sorry that we failed to state it clear enough in the previous version, and is now clarified. It is feasible that the dynamic parameters during the validation period are set to the same as in the calibration period in this study. The values are dependent on the calendar days. The reasons are as follows. Our previous research (Lan et al., 2018) focused on the reasonable sub-period clustering based on the dynamic catchment characteristics. The hydrological model was calibrated in each sub-period to achieve the dynamics of the parameter set. Namely, the calendar year is clustered into four sub-annual periods based on hydrological similarities. Most importantly, the clustering results are further verified by the hydrological data in the validation period. The study showed that the clustering results of the validation period are almost the same as the results of the calibration period. The reason is given that the selected study areas, which are the sub-basins of the Hanjiang River basin, are located in the monsoon region of the East Asia subtropical zone. The variations of both climate conditions and vegetation density and types are significantly seasonal (Fang et al., 2002). Hence, they are ideal places for studying the sub-period calibrations. The above discussion is supplemented in the *Methodology* section of the revision.

3 Correct the units in Table 1 (fluxes).

Reply: Revised as suggested in Table 1.

4 In the results, the term "model performance" is very generic. Can it be replaced with something more specific?

Reply: Thanks for the Reviewer's suggestion. The more specific explanation for "model performance" is supplemented in the *Results* section of revision. The detailed information is as follows:

"For a concise model evaluation, the model performance is analyzed with multi-metric frameworks with appropriate performance metrics, including five-segment evaluation (5FDC, flow duration curve with root mean square error) (Pfannerstill et al., 2014), Nash-Sutcliffe efficiency index (NSE) (Nash and Sutcliffe, 1970) and the logarithmic transformation (LNSE). For the robustness of model evaluation, the transferability of the optimized parameters between the calibration period and the validation period is considered."

References:

Fang, J. Y., Song, Y. C., Liu, H. Y., and Piao, S. L.: Vegetation-climate relationship and its application in the division of vegetation zone in China, Acta Bot Sin, 44, 1105-1122, 2002.

Lan, T., Lin, K. R., Liu, Z. Y., He, Y. H., Xu, C. Y., Zhang, H. B., and Chen, X. H.: A Clustering Preprocessing Framework for the Subannual Calibration of a Hydrological Model Considering Climate-Land Surface Variations, Water Resources Research, 54, 10,034-010,052, 10.1029/2018wr023160, 2018.

Nash, J. E., and Sutcliffe, J. V.: River flow forecasting through conceptual models part I — A discussion of principles, J Hydrol, 10, 282-290, 10.1016/0022-1694(70)90255-6, 1970.

Pfannerstill, M., Guse, B., and Fohrer, N.: Smart low flow signature metrics for an improved overall performance evaluation of hydrological models, J Hydrol, 510, 447-458, 10.1016/j.jhydrol.2013.12.044, 2014.