Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-639-RC1, 2020
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Hydrology and Earth System Sciences Discussions
Open Access

Interactive comment on "A time-varying parameter estimation approach using split-sample calibration based on dynamic programming" *by* Xiaojing Zhang and Pan Liu

Anonymous Referee #1

Received and published: 14 February 2020

General comments: The main objective of this paper is to propose a new method to estimate time-varying parameters. The study is interesting, by considering the combination of the basic concept of split-sample calibration (SSC) and the parameter continuity assumption. And dynamic programming is used to determine the optimal parameter trajectory. Two synthetic experiments were designed to evaluate its applicability and efficiency for time-varying parameter identification. However, the assumption that the response of individual parameter variations to changes in the climatic conditions should be further discussed. Therefore, I think the manuscript requires major revision before publication. I will detail my process here through general comments that the author could use to rework the paper in order to improve it. Special comments: 1. This paper

presents methods to estimate the time-varying parameter based on dynamic programming. The authors attempt to combine multiple methods including SSC and ENKF. However, the highlight of this paper is no very clear, which should be refined. 2. The fundamental assumption that the individual parameters may not response to the catchment dynamics due to the linear or nonlinear correlations between parameters (Bardossy, 2007). The effects of identifiability of parameters on this research are suggested to be investigated. 3. The non-stationary change in catchment characteristics may not be predicted. Lots of uncertainty factors would prevent the estimation of future scenarios in catchments. 4. How to generally estimate the stable period, such as decades, years or months, considering catchment characteristics? It is vital for the method in this study. The impact of sub-period lengths on the performance of SSC-DP is significant. 5. The two lumped models were chosen in this study. The number of parameters is different. The sensitivity analysis was further performed to reduce the dimension of parameters in the Xinanjiang model. Hence, the purpose of choosing two different lumped models should be discussed. 6. The titles cannot show the logic framework of the research. The flowchart is suggested to used to illustrate the framework in this study. The introduction of the manuscript is suggested to present in the appendix. 7. The sensitive hydrograph phases of model performance criteria, i.e., RMSE, R2 and NSE are peaks and discharge dynamics, flood peak, and discharge dynamics (Pfannerstill et al., 2014). Three metrics have strong correlations. The results as shown in Figure 5 needs furthermore discussion. 8. The streamflow, climate and underlying surface conditions in the two study areas were not analyzed in this study. However, it is critical to the estimation of time-varying parameters. 9. In lines 175-176, the assumption that the continuity condition aims to minimize the difference between the estimated parameters for sub-periods i and i+1 unreasonable. The differences between two consecutive sub-periods represent the time-varying changes of the catchment. The continuity conditions for enhancing the model performance should focus on the model structure, such as state variables. 10. Minor comment. The resolution of Figure 5 is low and information is not presented. References: Bardossy, A., 2007. Calibration of

hydrological model parameters for ungauged catchments. Hydrol Earth Syst Sc, 11(2): 703-710. DOI:DOI 10.5194/hess-11-703-2007 Pfannerstill, M., Guse, B., Fohrer, N., 2014. Smart low flow signature metrics for an improved overall performance evaluation of hydrological models. J Hydrol, 510: 447-458. DOI:10.1016/j.jhydrol.2013.12.044

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