Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., author comment AC1
https://doi.org/10.5194/hess-2021-382-AC1, 2021

Reply on RC1

Zhihong Song et al.

Author comment on "Regionalization of hydrological model parameters using gradient boosting machine" by Zhihong Song et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-382-AC1, 2021

Dear Anonymous Referee #1,

We sincerely appreciate the referee's positive comments on the manuscript. Please see our response to the reviewer's concern on regionalizing the model parameters:

Hydrologic models often rely on regionalization approaches to transfer information from small to large spatial scale (e.g., from gridcell to subbasin, watershed, and regional scale) (Beck et al., 2020; Mizukami et al., 2017), and from gauged to ungauged catchments (He et al., 2011; Hrachowitz et al., 2013; Pagliero et al., 2019; Parajka et al., 2013).

In this study, though parameters were calibrated and available at each gridcell, the parameter values at around 450 gridcells were not reliable owning to poor model performance (i.e., KEG < 0) (Knoben et al., 2018; Koskinen et al., 2017; Sutanudjaja et al., 2018). Therefore, we only used the calibrated parameters with KGE ≥ 0 (i.e., representing better model performance) for regionalization of parameters. The model performance for 53% of these gridcells (with KGE < 0 prior to regionalization) were improved when we re-ran the model with regionalized parameters. Particularly, the KGE values in 37% of the gridcells (with KGE < 0 prior to regionalization) became positive, indicating a substantive improvement of the modeling performance.

Even though the parameters were well calibrated and available at each gridcell, one might think whether and which topographic and edaphic properties mediate these hydrological parameters. Our machine learning (i.e., gradient boosting machine) based regionalization of parameters enables to estimate six key hydrological parameters using site-specific characteristics. Following the regionalization of parameters, our results of variable importance quantitatively indicate that the runoff generation parameters are majorly controlled by slope, saturated soil moisture content, and elevation. Moreover, the terrain attributes significantly regulate the runoff processes in relatively humid regions, while the saturated soil moisture content becomes a limiting factor in arid areas. The regionalization of parameters will improve our mechanistic understanding of the runoff generation processes and associated key hydrological parameters under different topographic and edaphic conditions.

Thank you again for your comments.

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