Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., author comment AC2
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Reply on RC1 - complement

Emmanuel Dubois et al.

Author comment on "Simulation of long-term spatiotemporal variations in regional-scale groundwater recharge: contributions of a water budget approach in cold and humid climates" by Emmanuel Dubois et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-71-AC2, 2021

Dear Referee,

As a complement to our previous response, we would like to share here the results of the sensitivity analysis performed on the eight group of gauging stations. We have used the method initially presented for W6 on all the watersheds in the study area. We obtained the following ranking (Figure 1 will be added to our revised manuscript), with the relative sensitivity of simulated river flows to parameters changes presented on the left panel (a) and the sensitivity of simulated potential GWR on the right panel (b).

L220-230 will be rephrased as follows: "The model sensitivity to its parameters for the eight groups of gauging stations was obtained with 60 repetitions of the design (540 model runs). The relative sensitivity of the model to some parameters varied markedly between the groups of gauging stations for the simulated river flow (Figure 1a) but appears to be more constant for the simulated potential GWR (Figure 1b). River flow simulation was mostly sensitive to the snow-related parameters (T_M and C_M), except for the western watersheds where the f_{runoff} was more important. The simulated flow rates were less sensitive to the other parameters. The simulated potential GWR was most sensitive to f_{runoff} and least sensitive to snowmelt parameters (T_M and C_M) for all the watersheds. The ranking from the second to the fifth highest sensitivity of potential GWR varied from a group of gauging stations to another but was relatively similar. Although the model clearly showed limited sensitivity to the soil freezing time (F_T) for the two simulated variables, they seemed slightly more important for the eastern watersheds W7 and W8. Overall, the potential GWR was more sensitive to parameter variations than river flow since all the μ^* for the river flow were lower by a factor 2 to 10 than for the potential GWR (values not presented here)."

As well, L445-450 will be modified as follows: "The impact of long and cold winters was included in HB through the widely used degree-days method that represents snowpack evolution (Massmann, 2019), and through the representation of freezing soil conditions

with a threshold temperature and a duration of the threshold temperature to freeze the soil (TT_F and F_T respectively). The sensitivity analysis shows that the simulated potential GWR is sensitive to *TTF*, while both flow rates and potential GWR have limited sensitivity to *FT* (Figure 1). The colder watersheds seemed more sensitive to these parameters while the simulation of river flow in the warmer watersheds were less sensitive to the snow-related parameters. This result underlines the importance of including soil freezing in GWR modeling for cold regions. Specific studies on winter recharge would allow to deepen the processes involved and to propose more elaborate representations of this phenomenon."

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2021-71/hess-2021-71-AC2-supplement.pdf