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Geoscientific Model Development Discussions

Interactive comment on "A hydrological model for root zone water storage simulation on a global scale" *by* Ganquan Mao and Junguo Liu

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1. After reading the manuscript, I do not think the results can support the research objective. First, the WAYS is calibrated and the runoff simulation is compared with others after that. Therefore, the better performance of WAYS (let's assume it is better first, and actually I do not think so) could be due to the calibration, not because of the consideration of root zone water storage changes. Second, the NDII data were used as a surrogate of root zone water storage changes. The NDII is just suggested in a river basin in Thailand. However, it is still not clear if it is appropriate to do so on large scales with different climate and hydrological regimes. Therefore, the simulated root zone water storage is not actually verified.

2. I also feel it is not rigorous that without in situ hydrological gauge and flux tower data to verify simulations of ET, runoff, soil moisture etc. Comparison with ISIMIP model runoff simulation is not convincing. The spatial distribution of simulation is also important. Please show the spatial distribution.

3. As shown in Figure 1 and the manuscript descriptions, the soil layer is separated into vadose zone (includes the root zone) and saturated zone, which is similar to many existing models. In addition, in this manuscript, the NDII is not justified to represent root zone water storage changes on large scales with different climate and hydrological regimes. Therefore, the novelty of this manuscript is not enough.

4. Because the soil is separated into different zones, at every grid, each zone must have a certain depth (or a percentage value) at a moment and the depth or percentage will change with rainfall-runoff processes. The manuscript failed to report the changes of the depth of each zone or what percentage of soil is saturated/unsaturated at different time. Please also show the spatial distribution. This is important to see if the simulation is reasonable.

5. I don't think the WAYS is a new hydrological model because it only changed several equations and replaced a few parameters compared to the FLEX model. It is not an improvement of the FLEX model either, because it removed several important components of the original FLEX model and the manuscript failed to prove that the WAYS is better compared to FLEX after doing that.

6. When I saw the root zone water storage, I thought the manuscript would study vegetation. However, I did not find how they deal with vegetation transpiration. Because root zone water storage changes are largely controlled by vegetation transpiration, I don't believe the WAYS can simulate root zone water storage changes properly without considering vegetation transpiration. I share the similar concerns as other reviewers that WAYS has fatal flaws regarding this. In addition, WAYS means 'Water And ecosYstem Simulator' according to the manuscript. Without considering vegetation transpiration,

WAYS cannot represent ecosystem and cannot simulate ecosystem influence on water either. Thus, I believe that the manuscript title, the statement in the manuscript, and the model name are misleading and not suitable.

7. The manuscript failed to report how many parameters the model has, which parameters need to be calibrated, what are the calibrated parameter values, which parameters use default values. The physical meanings of the parameters should be reported. Some parameters have their physical meanings and cannot be calibrated.

In sum, I am not convinced by the methodology and results, and several key issues of the study objective are not solved. I feel that this manuscript should be rejected.

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