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

Anonymous Referee #2

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A correct representation of root zone water storage is important for a robust hydrological modeling. However, in reality, obtaining reliable soil water information is difficult. In many previous studies, the root zone water storage has been quantified as the soil moisture in a certain depth rather than the water stored in the entire rooting system. This leads to an under- or over- estimation of root zone water storage depending on individual site conditions, including the types of vegetation covers on the land surface. The aim of the paper by Mao and Liu is to develop a hydrological model, WAYS, that is capable for simulating root zone water storage on a global scale, without constraining the quantification to a certain depth. Overall, I think the development of such a model is valuable to the hydrological community and can largely advance the eco-hydrological studies which tackle the interactions between the hydrological cycle

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and vegetation dynamics on the land surface. I personally also think with the further development and improvement, WAYS has the potential to be applied in the investigation of land-vegetation-climate-water integrations which is very important for the global change impact assessments. Below I give some comments on the paper and hope the authors can address them in the revision. General comments 1. The model structure of WAYS is the core of this paper (Figure 1). Its scientific clarity is essential for others to understand the processes and also is important for possible future wider applications of the model beyond the authors' group. In the current version, the variables in the flow chat depicted in the small window and the ones in the schematic are not all matched. E.g., in the small window, Si, Pe, Rr, Sf, and Ss are used, but they are not indicated in the schematic. Even if their meanings are clear (some are not clear to me), the authors still need to denote them properly in the schematic. In addition, given the central role of Figure 1 in the entire paper, I suggest the authors to add some text elaborating the flow of the figure. This is different from the following sections describing individual processes in the model. 2. Table 1 gives all the equations concerning the water balance in WAYS. This is very useful for examining the processes and evaluating the robustness of the model. As all the equations are from the relevant literature (the authors give the references in the text), it would be good to provide the major references in the last column of Table 1. 3. Are there any other values used for Rx,max rather than 7, 4.5 and 2.5 for sandy soil, loamy soil and clayey soil? May be worth a checking for uncertainties stemmed from the use of Rx,max values for the mentioned soils. 4. In the captions of Figures 4 and 5, the ERA-Interim/Land represents the reference data. I think it is better to directly use ERA-Interim/Land here, because in the Figures, the ERA is used and no reference data is indicated. Also in Figure 4, WAYS-CHIRPS is not visible. Need to give a note for it, e.g., covered by .... The scale for Y axis for Murray Darling should be enlarged to show the simulated runoff more clearly. 5. The authors demonstrated the good performance of WAYS compared to ISIMIP2a models. However, no direct reasons are given to explain the better performances. I assume that the authors want to say that this is because of the better representation of the root zoon

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water storage in WAYS. The authors should make this point clear. It justifies the effort for developing WAYS in this paper. Also, it seems to me not very convincing to state that the better performance is really from the better representation of the root zoon water storage. Could some other processes in the WAYS model be also influential for the better performance compared with the results from the models in ISIMIP2a? 6. In Figure 4, the authors stated that in the Murray Darling basin, WAYS performed very well in comparison to the ERA data for runoff. In Figure 7, the difference between simulated root zone water storage and the NDII values is quite large. The similar situation is also seen in Mississippi, Amazon and Yangtze. The correlation values provided in Table 2 are rather low for these river basins. The authors stated that this could be caused by either the uncertainty of WAYS or the problem of using NDII as a proxy of root zone water storage in the specific river basin. In general, I think this is reasonable. However, I still feel that some specific reasons should be highlighted with convincing evidence, instead of just saying this is either due to the problem of WAYS or the use of NDII. Besides, in the discussion, it would be good if the authors can give some suggestions on validation of root zone water storage simulations when the validity of using NDII for validation is not so suitable as shown in the above mentioned river basins. 7. Page 21, last paragraph. It is stated that 'this added value feature could benefit for many applications related to the root zone processes.' The authors should specify some of the potential benefits here. 8. The aim of the paper is to develop WAYS which is capable of simulating root zone water storage. In the model evaluation section, much text is about the validation of runoff. The elaboration of the importance to correctly represent root zone water storage and the good performance of WAYS in realizing this goal is relatively brief. It would be good if the authors can strengthen this part of the text to highlight the accomplishment of the paper. 9. I like the philosophy stated in the end of the paper, 'get the right answers for the right reasons rather than simply to get the right answers'. In this paper, I feel that the right results are clearly shown. But the right reasons, to me, are relatively weak. The good performance in runoff and root zone water storage simulations could be good results, but reasons for the good results

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needs to be more clearly and explicitly explained and supported by evidence. Specific comments 10. The window in Figure 1 should be enlarged, as it is important to show components and their connections clearly. Anyway, there is space in Figure to accommodate the enlargement. 11. The manuscript contains many typos and grammatical mistakes. A professional editing of the manuscript is necessary, particularly because I think the paper has the potential to be an important paper in the field and could receive a high citation in the coming years.

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