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Earth System Dynamics Discussions

Interactive comment on "Global modeling of withdrawal, allocation and consumptive use of surface water and groundwater resources" *by* Y. Wada et al.

Anonymous Referee #2

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This manuscript deals with modeling global water withdrawal from groundwater and surface water sources. I found overall that the manuscript is well written and the results presented are interesting. However, as noted by the authors, I also found that the paper is built upon the authors' earlier modeling works, and it appears to me that there is some overlapping in terms of model development and also the results published in the earlier works. There are also shortcomings in the introduction and methodology sections because the authors mostly describe what had been done in the pervious works and the model updates are overshadowed, so the readers may find difficultly in finding what is new and what is the major goal of the paper. Nevertheless, the manuscript also contains new results for water use from different sources using differ-

ent forcing datasets, and also provides new analysis using GRACE satellite observations. Therefore, I believe that the manuscript provides some new insights on modeling human water use at the global scale and is worth publishing after necessary revisions. So, my overall suggestion is that the authors make some efforts to clearly outline the main goal of this paper, provide clear overview of the major improvements in the model compared to the pervious version, and also highlight the major and new findings. My specific comments are as follows:

1. P356, L8 and P358, L13: It confuses me when you say 'we integrate' Wada et al. (2011a,b) and Wada et al. (2010). It seems that all these previous studies are based on the land model PCR-GLOBWB; you might have implemented some components of one into the other. Please clarify.

2. P358, L2: References seem to be missing.

3. P358, L22: Please specifically mention what is the major goal of this study. For example, evaluate the performance of the model in terms of what? In short, please make clear what are the key differences and major advancements over your previous works.

4. P359, L20-26: How are these groundwater related parameters and co-efficients determined? Is the model validated for river discharge after implementing the new groundwater scheme? I think readers would be interested to see how river discharge is affected even though the main focus of this paper is water withdrawal.

5. P361, Section 2.3: How is the '∼20 days' before harvest determined? Also, why do you assume no direct runoff from paddy field? I would assume significant direct runoff occurs when there is rainfall over flooded paddy fields in humid regions such as eastern China and south-east Asia. Overall, I would suggest further elaborating this section with clear explanation on how these formulations can be justified.

6. P363, L1: Does 'critical level' here mean 'wilting point'?

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7. Section 2.6: What are the water allocation strategies? In other words, at what proportions are different demands fulfilled from different sources? P366-L19: Why is groundwater taken first rather than surface water? Wouldn't humans tap surface water first as it is easily accessible? I assume changing the allocation strategies and withdrawal order will affect the estimated groundwater use. 7. Please explain this clearly in the manuscript.

8. P366-L15: In most depleted groundwater systems (in semi-arid to arid regions), there could be very little baseflow as the water table is too deep but there could be still potential to withdraw groundwater. Please clarify the reason behind this assumption that base flow can used as a proxy to infer groundwater availability.

9. P374, L10: Please compare the groundwater withdrawal of 1200 km3/yr with the other estimates; I believe there are several estimates of global groundwater withdrawals including some cited in the manuscript.

10. Section 4.4: Impact of reservoir operation on water storage change has not been discussed at all. Storage on reservoirs should affect TWS much more than irrigation does in highly regulated basins. Some recent studies (e.g.: Wang et al., 2011. Water Resource Research, Vol 47, W12502) have shown that in highly regulated rivers the impact of reservoirs could be large. Please add discussion. For example, for Colorado river basin, the changes in TWS could be mainly due to reservoir regulation.

11. Table 1: I could not confirm some numbers such as 2380 in Hanasaki et al.

12. Figure 6: Why are these particular basins selected?

13. Figure 6 caption: Please confirm the units. Storages should be in m or mm.

Interactive comment on Earth Syst. Dynam. Discuss., 4, 355, 2013.