

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

### **Anonymous Referee #1**

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#### General comments

This study presents the implementation of a global water demand model into a global hydrological model to simulate water withdrawal and consumptive water use from surface water and groundwater resources. In my view, there is quite some overlap with the previous work of the authors, but the global modelling of water allocation from groundwater and surface water separately is a contribution. Overall the paper is well-written, but I think it would benefit by:

(1) More interpretation (in discussion section) of the advantages of integrating the water use model in a water balance model compared to previous approaches.

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(2) Further explanations of methodology and assumptions made, in particular with regard to allocation of groundwater and surface water resources and calculation of return flows. It would also be good to show the sensitivity of trends in groundwater and surface water withdrawal to these assumptions.

(3) In addition, further explanation of the new irrigation scheme is needed. Please explain why these algorithms were used, and to what extent this approach results in more realistic estimates of irrigation water demand compared to the previous approach.

(4) I would recommend adding more country specific results which are discussed in the text but are not yet presented. For example, Fig 1 is interesting but does not show any results for individual countries that are discussed on P368/L16-19. I would suggest to modify this figure (or add a figure/table) to show the country specific results that you discuss in the text.

#### Specific comments

-P357/L20-27: Please note that H08, MATSIRO and VIC have already been applied on a higher spatial resolution (0.5 deg) and refer to recent studies that applied these models on a global level on higher resolution).

-I would recommend merging section “2.1 Water balance” and “2.2 Snow accumulation and melt” and excluding the “degree day algorithm”, because this is not a new feature of your integrated model. I think you may also assume that the degree day approach is well known.

-“2.3 Irrigation water requirement”: please explain why these algorithms were used to calculate irrigation water requirement and how this affects your results compared to the previous method used.

-“2.4 Other sectoral water demands” P263/L24-25: Can you justify your assumption that daily industrial/energy water demand is kept constant over the year? This seems unrealistic to me and also inconsistent with calculations of water demands for other

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sectors (in with seasonal (daily-time step) variations included).

-“2.6 Water allocation and return flow”: A motivation and further explanations of the assumptions made with regard to allocation of groundwater and surface water resources is needed. How realistic is the assumption that you allocate groundwater predominantly to meet the water demand with remaining water demand met from surface water (except in case of reservoirs) on a worldwide level? I can imagine that in some parts of the world this assumption is realistic and valid (e.g. river basins in India) but not in all regions. Please include a motivation and show the overall impact of this assumption on your results.

-“2.6 Water allocation and return flow”: Explanation of calculation of return flow is missing.

-“2.6 Water allocation and return flow”: For which years did you use country desalination water withdrawal data? Please also include a full link to the desalination water withdrawal data used from WRI Earthtrends and explain how you combined this data with FAO AQUASTAT.

-“4 Result” P368/L3: Please explain how simulated TWS anomalies were calculated and how you compared this with GRACE.

-“4.3 Regional trends of surface water and groundwater withdrawal and consumption”: I am wondering to what extent the rate of change in groundwater and surface water use is affected by the assumptions that you made with regard to allocation of groundwater and surface water? I think it would be good to reflect on this and show the sensitivity of estimated trends in groundwater and surface water to the assumptions you made.

-“5 Discussion and conclusion”: I would suggest to discuss in more detail the advantages of integrating the water use model in a water balance model compared to previous approaches (because this was defined as the overall goal of this study).

-P375/L4-5 “Nevertheless, our simulated....., respectively”: You should add that this is

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presented for a selection of basins which are heavily affected by human impacts (this was not yet shown on a global level).

Technical corrections

-P369/L22 include “.” after “Western USA”

-Fig 2: It would be interesting to show these plots also for more regions (e.g. Asia).

-Fig 3: More explanation is needed of how simulated and observed trends are presented in this figure. I would suggest creating plots with simulated and reported trends over time for different countries in separated figure panels.

-Fig 4/5: Please increase the size of the figure panels to increase the visibility of numbers and trends presented.

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

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