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Hydrology and Earth System Sciences
Discussions

Interactive comment on "On inclusion of water resource management in Earth System models – Part 1: Problem definition and representation of water demand" *by* A. Nazemi and H. S. Wheater

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We greatly appreciate Anonymous Reviewer #2 for their positive, constructive and thoughtful comments, which led to substantial improvements in the revised version of our manuscript. In the following, the issues raised are addressed point-by-point in the order they are asked. The reviewer's comments are numbered; our reply to each comment is shown immediately below the comment.

1- I agree with the anonymous referee #1 that it would be nice to have some more explanation with regard to the basic structure of the review (maybe even a schematic

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illustration). It should describe the classification of models into Land-Surface-Schemes (LSS) versus Global Hydrological Models (GHM), irrigative versus non-irrigative demand, top-down versus bottom-up approaches, online representation versus offline representation. In addition to the explanation of terms it could be described why exactly these distinctions are useful. This would fit nicely to the end of section 1 (page 8247).

Many thanks for your comment. Based on your comments, we extensively revised Section 1 (please see the attached draft revisions, lines 42 to 243). We now thoroughly define LSMs and GHMs and differentiate in their application (please see the attached draft revisions, lines 50 to 58, l74 to 76 and 223 to 235, respectively). We further defined irrigative and non-irrigative demands (please see the attached track changed revisions, lines 215 to 218) as well as online and offline representations (please see the attached draft revisions, lines 223 to 235). We also added a schematic illustration to the revised manuscript to show the main components of water resource management and highlight their feedbacks with each other as well as with land-surface and climate processes (Figure 1; please see the attached draft revisions page 66). We also explained the difference between top-down and bottom-up approaches (please see the attached draft revisions, lines 219 to 221, 341 to 344 and 362 to 363). In all these revisions, we try to highlight the relevance of these distinctions describe how they fit within the context of our survey (please see the attached draft revisions, lines 204 to 236).

2- I miss some discussion related to environmental water demand. The authors describe nicely all the anthropogenic impacts on the world's freshwater system and the structures like reservoirs or dams controlling amount and dynamics of the discharge in many rivers or (over)use of groundwater. Shouldn't it also be part of water resources management to ensure basic environmental water requirements when considering that most of the freshwater bodies are controlled or at least impacted by human activities? Or in other words: do we need to manage these requirements actively instead of just

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constraining human water extractions? Should we account for environmental water demand at the demand side (this paper) or at the supply side (the companion paper in HESSD)? It seems that the topic becomes more and more relevant while the implementation in large-scale models remains very weak and simplified. At least in the discussion section I would therefore expect some sentences related to this issue.

Many thanks for your comment. You are absolutely right. Environmental flow needs are an essential part of water resource management. After a careful consideration, we decided to include environmental flow needs at the demand side. Accordingly, we extended our survey and added a brief review on available procedures for estimation of environmental demands at large-scale models. Please see the attached draft revisions (lines 108 to 111 and 487 to 512).

3- Page 8240, lines 23-25: "We argue that current limitations in simulating various human demands and their impact on the Earth System are mainly due to the uncertainties in data support, demand algorithms and large-scale models." => It seems that this is obvious. I don't know any other reason that may contribute to the limitations.

Many thanks for head-up on this. We deleted this sentence in the revised manuscript.

4- Page 8244, lines 23-26: "Although human water use still accounts for a small proportion of total water on and below the surface (see Oki and Kanae, 2006), it currently includes around 26% of terrestrial evaporation and 54% of surface runoff that is geographically and temporally available (Postel et al., 1996)." => 54% of global surface runoff seems to be a lot! Does this include instream uses (e.g. for water power)?

Please note that we mentioned 54% of surface runoff that is accessible by human and this number includes total withdrawals including instream uses and other non-consumptive needs. In fact, Postel et al. (1996) argue that 19% of the global runoff is not accessible. Please see the attached draft revisions (lines 132 to 134).

5- Page 8248, line 13: I miss the reference to Wada et al., 2010 in the list of references.

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The same for Siebert et al., 2010 in line 15. Please check the list of references for completeness.

Many thanks for heads-up on these. We included these references in the revised manuscript and double check the whole list to make sure all the references are included.

6- Page 8264, lines 26-30: "Uncertainty in current data support . . .". I think, another major constraint in data support are inconsistencies across model input data. The models described in this paper require information for many different input variables. Typically, these input data sets are developed independently from each other with different methods resulting in inconsistencies, in particular at pixel level (e.g. soil properties do not fit to land use, humidity does not fit to precipitation, irrigated land in forest areas. . .). Typically, modelers fix these inconsistencies by applying simple rules or assumptions. The impact may be small for global mean values but can be high at the local or regional scale.

Many thanks for your comment. This is definitely the case. We added few sentence to point at this source of uncertainty. Please see the attached draft revisions, lines 765 to 772.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/11/C4871/2014/hessd-11-C4871-2014-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 8239, 2014.