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Hydrology and Earth System Sciences Discussions

Interactive comment on "An integrated model for the assessment of global water resources – Part 1: Input meteorological forcing and natural hydrological cycle modules" *by* N. Hanasaki et al.

N. Hanasaki et al.

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Dear Referee

We are most grateful for your prompt and constructive comments to our HESSD manuscript. We are very glad that you acknowledged our modeling as challenging and commendable. We take your major suggestion into account that our current manuscript is long. However, this manuscript has been polished by seven authors again and again, and we are confident of its good structure and clarity. We have to wait for the final editor's decision, but if requested, we will seek to trim down our manuscript as much as possible. The following are replies to your detailed comments.

1) Clarify who/what will be the biggest beneficiary for the development of such a global water resources management model.

The biggest beneficiaries are the climate change impact assessment community and the earth system modeling community.

A number of global water resources models contributed climate change impact projections to the fourth assessment report of IPCC (AR4; Kundzewicz et al. 2007). Our work will benefit to the next stage of global water resources assessments and climate change impact projections. The global water resources assessments of AR4 largely rely on two indicators, "annual withdrawal over annual renewable water resources" or "per capita annual renewable water resources". These two indicators cannot take seasonality into account explicitly, which is a key factor of water issues in some part of the world. Our model focuses on the seasonality of water resources and withdrawal, and the results are presented in Part 2.

Also, the earth system modeling (coupled atmosphere, ocean, land, carbon model) community are the beneficiaries. They recently started to take anthropogenic activities (such as irrigation and reservoir operation) as an important component of their earth system models. Our methodology and results will benefit their activities, because our model is carefully designed to incorporate with their models.

2) Why is such a development needed in the first place when we have had a number of models to do the same (even though they may not have seen global application)? For example, as the authors rightly mention - VIC, UNH work based on KINEROS, Coe's global model (not mentioned) etc.

Earlier macro scale hydrological models have been mainly focused on the natural hydrological cycles. On the contrary, our model focuses on the

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anthropogenic activities in the global hydrological cycles. What we did is quite different from earlier studies.

We admit that the land surface hydrology module and the river module introduced in Part 1 are not quite new as individual models. However, the description and validation of these modules are indispensable to the final integrated model and assessments.

Our work is based on the two international projects, the International Satellite Land Surface Climatology Project (ISLSCP; provided original input meteorological data) and the Global Soil Wetness Project (GSWP; provided simulation framework). Therefore, our work validated not only our runoff simulation, but also the meteorological forcing of ISLSCP and the simulation framework of GSWP2. Our results will contribute these two leading international projects and the global land surface modeling community.

3) On 2) - the scientific hypothesis/basis needs to be gistly highlighted. We understand that global calibration is almost impossible given the state of availability of calibration data. But many existing models such as VIC could also be implemented using extensive proxy data from ECMWF, FAO, satellite products etc. It seems that the calibration issue alone is a rather weak reason. Whatever the motivation - I suggest that they be itemized in the form of bullets or identifiable writing that draws the readers attention (instead of getting lost in vast amounts of text).

Thank you for your suggestion. Our motivation is already described in the introduction part, but we will emphasize it in the revision.

4) The project is too ambitious - I personally think the anthropogenic module is a difficult one to simulate except for very simple cases. And th reality is that regulated rivers do not have simple water regulation any more (like just withdrawal at some variable rate based on demand). Treaties and transboundary issues have a highly complex effect on

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global water resources management. With so many transboundary basins and lack of basin wide treaties in many places, the effectiveness of a global anthropogenic module is questionnable.

We don't insist that our model can reproduce the real world. What we showed in our two feature manuscripts is how we can incorporate key anthropogenic activities (such as reservoir operations, withdrawals) in the current stage of global hydrological models. Ability and limitation of our anthropogenic modules are discussed in detail in Part 2.

Our current model is still very simple and limited, but we believe this is a first step of a more sophisticated global water resources model with anthropogenic activities. Likewise the first step of global warming simulation was to increase CO2 concentration in a simple one-dimensional atmospheric model.

5) Hap hazard literature review shows up in many places when the authors8217; describe a method/module. I think the review needs to be more organized and appear in the beginning.

Our work is a compilation of wide varieties of earlier global modeling activities. We needed to cite more than 50 literatures in wide varieties of topics. We judged that putting all citations into the Introduction section was not reader-friendly.

6) As a bottom line - the authors really need to market their model in a more focused manner, clearly defining the client base of users for such a model (would UNESCO, ADP or the Mekong Secretariate want to use a model?).

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Currently, we do not intend to market our models (program codes) to practical business users. However, we will market appropriate simulation results to them. Indeed, Japanese government reports often cite our earlier activities to call citizen's attention to global water issues.

Most promising user of our program codes is the earth system modeling community. We started to incorporate our codes to the MIROC earth system model.

7) Provide a flow chart of conceptual linkages (modules) and processes in the model development. This helps the reader understand the work.

The flow chart of our entire model (consists of six modules) is shown in Fig 1 of the Part 2. Because Part 1 discusses only two modules, we think a flow chart is not needed.

8) As for the appropriateness of the paper in HESSD, I am not entirely convinced that it fits completely well within the scope of HESSD. I think there are lots of other avenues out there that focus more on model development than global nature of hydrology where this work could go.

Firstly, we believe HESS is an appropriate journal to submit our paper, because a number of excellent papers on global/continental water resources issues have been published from HESS (Arnell, 2003; Siebert et al., 2005; Haddeland et al. 2007).

Secondly, we are confident that our work is literally a good example of "hydrology and earth system sciences" research. The website of HESS states: *"HESS encourages and supports fundamental and applied research that seeks to understand the interactions between water, earth, ecosystems and man. A multi-disciplinary approach is encouraged that enables*

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a broadening of the hydrologic perspective and the advancement of hydrologic science through the integration with other cognate sciences, and the cross-fertilization across disciplinary boundaries."

1) Our research seeks to understand the interaction between water (land and river module), earth (global model), ecosystems (environmental flow requirement module) and man (withdrawal and reservoir operation module). 2) We took a multi-disciplinary approach. 3) Our work advanced hydrologic modeling through the integration with other cognate sciences (land surface models, agricultural models, and ecological models).

References

Arnell, N. W.: Effects of IPCC SRES emissions scenarios on river runoff: a global perspective, Hydrol. Earth Syst. Sci., 7, 619-641, 2003.

Haddeland, I., Skaugen, T., and Lettenmaier, D. P.: Hydrologic effects of land and water management in North America and Asia: 17008211;1992, Hydrol. Earth Syst. Sci., 11, 1035-1045, 2007.

Kundzewicz, Z. W., Mata, L. J., Arnell, N. W., Döll, P., Kabat, P., Jiménez, B., Miller, K. A., Oki, T., Sen, Z., and Shiklomanov, I. A.: Freshwater resources and their management, in: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Parry, M. L., Canziani, O. F., Palutikof, J. P., van der Linden, P. J., and Hanson, C. E., Cambridge University Press, Cambridge, UK, 173-210, 2007.

Siebert, S., Döll, P., Hoogeveen, J., Faures, J.-M., Frenken, K., and Feick, S.: Development and validation of the global map of irrigation areas, Hydrol. Earth Syst. Sci., 9, 535-547, 2005.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 3535, 2007.