

Geosci. Model Dev. Discuss., referee comment RC1  
<https://doi.org/10.5194/gmd-2020-367-RC1>, 2021  
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## Comment on gmd-2020-367

Wouter Knoben (Referee)

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Referee comment on "Understanding each other's models: an introduction and a standard representation of 16 global water models to support intercomparison, improvement, and communication" by Camelia-Eliza Telteu et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-367-RC1>, 2021

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### Summary

The authors have written down the model code that exists in 16 global models using standardized terminology (in the Supporting Information). This facilitates comparison between the models. The authors qualitatively compare the models in great depth and summarize this information in tables in the main manuscript. The manuscript also covers a variety of other topics: "typical" model setups in the Global Hydrologic Modeling, Land Surface Modeling and Dynamic Global Vegetation Modeling communities, a general overview of earth system models and known deficiencies, and lessons learned from the ISIMIP2b model intercomparison project, which the 16 models were part of.

To start, let me say that the work shown in the Supporting Information (SI) is impressive. I know that standardizing model code into a single format is not easy and doing this for 16 models of the complexity typical of Earth System Models is no small feat. I expect that the SI to this manuscript can become a valuable resource for Earth System modelers. Unfortunately, I also need to say that I found this paper difficult to review for two reasons.

First, the discussion of model differences and similarities is based on the standardized description of model code in the SI but it is virtually impossible for any reviewer to factually check this information. There is simply too much of it. Consequently, the reader needs to trust that this information is correct; which they may do if the process used to generate the standardized code is transparent and robust. The description of the method used to standardize the model code is currently limited to section 3.2 (some definitions, a paragraph on the actual process used and a description of which subscripts and superscripts are used) and section 6.1 (more definitions). I think the paper needs to be more descriptive of the methodology used to standardize the models' equation and of the ways in which the authors ensured that the descriptions in the SI match the actual code in the models.

Second, I think this paper may be trying to do too many things at once. As far as I can tell, the paper covers three general themes (with some overlap between them):

- **Introducing a standardized way of writing ESM code**, as evidenced by the manuscript's title, the amount of work spent on creating the SI, section 3.2 and 6.1 (method for standardizing equations), and the lengthy discussion of model similarities and differences in section 5.
- **Providing a general commentary on the state of, and challenges associated with, global hydrologic modelling**, as evidenced by section 2 (typical model use in different modelling communities and confusion about terminology), section 4 (general history and challenges with global hydrologic modelling), section 6.2, Table 11 and its submission as a "review and perspective" paper.
- **Laying the groundwork for a follow-up ISIMIP2b paper by describing the models and process of this MIP**, as evidenced by the introduction, sections 3.1 and 3.3, section 5, and sections 6.3 (lessons learned from the MIP) and 6.4 (future work planned by MIP contributors).

I think any of these themes can be a good contribution to GMD but combining all three into a single paper seems to me to be too much. The manuscript is currently a bit haphazard in its organization, it was sometimes unclear to me how sections related to one another and due to the extremely broad scope I think none of the three themes get the amount of attention and detail they need to be convincing. What I missed for the 1<sup>st</sup> item was a detailed description of how the standardized writing scheme was developed, its strengths and weakness, procedures used to robustly translate model code, applicability to models outside this set of 16, a discussion of the implications of the discovered similarities and differences for ensemble modelling and model intercomparison, etc. What I missed for the 2<sup>nd</sup> item was a discussion of a considerable number of existing commentaries on this topic (some suggestions below) and a discussion of the information presented in Table 11. What I missed for the 3<sup>rd</sup> item is a more in-depth description of the MIP, established procedures, etc. Given that the manuscript is already just a bit shy of 1000 lines of actual text, I doubt there is space to fully cover all three themes. I would therefore strongly recommend clearly defining the scope of the paper and streamlining/modifying the text accordingly.

I have added various comments as annotations to the uploaded .pdf in the hopes that they are helpful to the authors in clarifying the text.

Kind regards,

Wouter Knoben

## Possibly relevant literature

Archfield, S. A., et al. (2015), Accelerating advances in continental domain hydrologic modeling, *Water Resour. Res.*, 51, 10078– 10091, doi:10.1002/2015WR017498.

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Clark, M. P., Bierkens, M. F. P., Samaniego, L., Woods, R. A., Uijlenhoet, R., Bennett, K. E., Pauwels, V. R. N., Cai, X., Wood, A. W., and Peters-Lidard, C. D. (2017): The evolution of process-based hydrologic models: historical challenges and the collective quest for physical realism, *Hydrol. Earth Syst. Sci.*, 21, 3427–3440, <https://doi.org/10.5194/hess-21-3427-2017>

Gleeson, T., Wagener, T., Döll, et al. (in review, 2020) HESS Opinions: Improving the evaluation of groundwater representation in continental to global scale models, *Hydrol. Earth Syst. Sci. Discuss.* [preprint], <https://doi.org/10.5194/hess-2020-378>

Gupta, H. V., M. P. Clark, J. A. Vrugt, G. Abramowitz, and M. Ye (2012), Towards a comprehensive assessment of model structural adequacy, *Water Resour. Res.*, 48, W08301, doi:10.1029/2011WR011044

Please also note the supplement to this comment:

<https://gmd.copernicus.org/preprints/gmd-2020-367/gmd-2020-367-RC1-supplement.pdf>