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Hydrology and Earth System Sciences Discussions

Interactive comment on "A variable streamflow velocity method for global river routing model: model description and preliminary results" *by* T. Ngo-Duc et al.

T. Ngo-Duc et al.

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(From the authors: T. Ngo-Duc, T. Oki, S. Kanae, P. Yeh)

Thank you very much for Dr. Fekete and another anonymous referee for giving us invaluable comments. Please find below our detailed response to your comments:

We agree with Dr. Fekete about his two main comments. The first one is about the coarse resolution of the 1-degree gridded networks we used in the simulation. There are several reasons why we used this resolution. Firstly, the input runoff forcing data that we use are provided by the Global Soil Wetness Project-2 (GSWP-2), which has also 1-degree resolution. Secondly, the 1-degree flow direction map was constructed

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Interactive Discussion

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by our laboratory (Dr Oki, one of the co-authors of this paper) so that we have strong confidence in assuring the quality of the map. Previous studies, for example, Arora and Boer (1999) used a much coarser resolution than 1-degree. The third reason is about the computational expenses. Although several flow direction maps are available nowadays at high resolutions (e.g., Hydro 1k, HydroSheds), it is still not practical to use these maps for global simulation due to computational burdens. Several upscaling methods have been proposed (e.g. Fekete et al., 2001; Arora and Harrison, 2007) and we will consider using those methods in our future study. Following the comments given by Dr. Fekete, in the revised version of this paper we have conducted another simulation using a 0.5-degree resolution, and we will show the sensitivity of river discharges to the grid resolution.

Dr. Fekete has also pointed out that the proposed constant slope is probably as bad as using uniform flow velocity for the region where the river slope is negative. We agree on that, and accordingly we have put special attention in order to overcome this problem. In fact, when we constructed the flow direction map, we had compared the map with the World Atlases and manually corrected the flow direction map at many points over the global continents. That is the reason why occasionally a downstream grid has higher elevation than an upstream one, which causes negative slope. In the revised version, we have added a scheme to further adjust the elevation from the flow direction map. The method of correction is to use the elevations of surrounding upstream, downstream "normal" grids (i.e. where the slope is positive) to adjust the elevation of the "negative" grid. With this method, we will effectively remove the "constant minimum river slope value" and the inconsistency between the elevation and the flow direction map. In the revised version, we will also briefly discuss about the difference between the two methods. Finally, although the limitation imposed by the 1-degree grid resolution has been well recognized by us, it is still worthwhile to emphasize that our proposed approach is a practical step towards successful global-scale river routing. We will elaborate this compromise between the scale of application and the desired grid resolution in the revised manuscript as well.

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Interactive Comment

The anonymous referee #3 also gave us invaluable comments to improve the quality of our paper. In the revised version, we will include the comparison between the Dingman and Sharma (1997) approach and the constant Manning coefficient approach. The technical corrections will be made accordingly to referee #3's instructions. Together with the modifications according to Dr. Fekete's comments, the new revised version will include more additional tests and results as suggested by two reviewers.

While revising our manuscript and waiting for the decision from the Editor, we would like to inform that Dr. Pat Yeh at our institution has joined us as a co-author of the paper because of his important contribution in the revised version of this manuscript.

Once again, many thanks to the Editor and two reviewers. We deeply believe this manuscript has benefited significantly from your instructions.

Reference

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