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Interactive comment on "The multiscale Routing Model mRM v1.0: simple river routing at resolutions from 1 to 50 km" *by* Stephan Thober et al.

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Dear Thomas,

thank you very much for your detailed and insightful review. We see no problem improving our manuscript according to your comments and would like to shortly outline in the following how we intend to do so:

1.) Regarding upscaling using the D8 method: The correct representation of the drainage area at evaluation gauges is crucial for model validation. We did not encounter a large mismatch (>10\%) at the resolution that we investigated in this

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manuscript. However, we would expect these errors to occur in the same way as they did in the work of Yamazaki et al. (2009). In particular in the region east of the Himalaya where three large rivers, the Mekong, the Yangtze, and the Salween, flow almost parrallel to each other over a few hundred kilometers, being less than 1 degree apart from each other (see Fig. 6 in Yamazaki et al. 2009). A mistake in the upscaling of the river network, particularly in this region, will be associated with large errors in any simulation. However, there is no need to run mRM at these coarse resolution of 1 degree. Even if the input to the model is provided at this coarse resolution, the model can be applied at a higher resolution of 0.25 degree where basin area is correctly reproduced. Run times also permit these applications (see comment below). We will put more emphasis on this point in the revised version of our manuscript and also highlight that the flow accumulation area of the upscaled river network is provided as output of the model.

2.) Regarding runtime and parallelization: We are currently parallelizing the routing which is the bottleneck in massive parallel hydrologic modelling at the land-surface, if groundwater is neglected. The parallelization of routing algorithms has to account for the river network because data between grid cells is only exchanged along the river. It is a non-trivial task to minimize communication and prevent idling of individual threads. The parallelization of mRM will be the subject of an upcoming study. It takes about 90 secondes to route 230 000 grid cells for 10 000 timesteps, which corresponds to 13 months simulation with hourly time steps, on a Dual Intel Xeon Platinum 8169 (http://www.fz-juelich.de/ias/jsc/EN/Expertise/Supercomputers/JUWELS/Configuration/Configuration_node.html) compiled with Intel Fortran and O3 optimization without any parallelization. These number does not account for the initialization of the model, which takes a substantial amount of time for 230 000 grid cells (i.e., continental-scale application), in particular the upscaling of the river network. This step, however, only has to be done once because the upscaled river network is saved in a restart file and can be read from it in subsequent applications. We will provide information on these aspects in a revised

version of our manuscript.

References:

D Yamazaki, T Oki, and S Kanae. “Deriving a global river network map and its sub-grid topographic characteristics from a fine-resolution flow direction map.” Hydrol Earth Syst Sci 13(11), 2241-2251, 2009. http://www.hydrol-earth-syst-sci.net/13/2241/2009/

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