

Interactive comment on “Two-way coupling between the sub-grid land surface and river networks in Earth system models” by Nathaniel W. Chaney et al.

Anonymous Referee #1

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This manuscript presents a high-resolution land-river coupling strategy in an earth system modeling context. The major conclusions are (I am directly quoting the authors): "1) the implementation of the two-way coupling between the land surface and the river network leads to appreciable differences in the simulated spatial heterogeneity of the surface energy balance; 2) a limited number of tiles (~300 per 0.25-degree cell) are required to approximate the fully distributed simulation adequately; 3) the surface energy balance partitioning is sensitive to the river routing model parameters." The study is properly motivated and overall well written. I do have a couple of major comments for the authors to consider.

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1. The innovations could be better justified. It is intuitive that accounting for land-river two-way coupling will lead to non-negligible difference in the land surface water and energy balance, and high-resolution modeling of that will overall help to better capture spatial heterogeneity. This is not a very new understanding.

2. The benefits of this high-resolution land-river coupling strategy could be more clearly demonstrated. Typically, a new modeling strategy should help either reduce uncertainty or improve prediction. Uncertainty does not seem to be the focus here. Then how about improving prediction? Has it helped to improve the simulation of surface inundation, streamflow, or energy fluxes? In the study area, ARM SGP provides lots of observational data, but the authors did not show any comparison between the model simulations and observations.

3. The impulse response function at the HRU level is constructed in a simplified way, e.g., assuming uniform and constant velocity 0.1m/s. How would this simplification affect the model fidelity? Moreover, the impulse response function or unit hydrograph concept was originally developed at the small catchment scale, and theoretically it is not clear to me whether it can be applied at the HRU level. For instance, is the travel time histogram within a HRU statistically meaningful? Why not just use the kinematic wave routing method at the HRU level?

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