Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2022-16

Anonymous Referee #2

Referee comment on "Evaluating a reservoir parametrization in the vector-based global routing model mizuRoute (v2.0.1) for Earth system model coupling" by Inne Vanderkelen et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-16-RC2, 2022

As a disclaimer, I have 10+ years of experience in groundwater modeling, including parameter estimation and uncertainty quantification, but no experience in global hydrologic modeling or the simulation of reservoirs within river networks at large scales.

This paper describes an implementation of a "widely used" reservoir parameterization in the global river routing model mizuRoute, with the goal of improving simulation of reservoirs (and downstream flows), by including reservoir operation as a process. Specifically, the motivation seems to be poor representation of reservoir processes in existing global-scale hydrologic models. An approach was developed to estimate irrigation demand on water supply reservoirs, based on downstream proximity and elevation. The approach was tested first with local mizuRoute simulations at 26 sites, and found to have value vs. a simple natural lake scheme. Then the approach was tested in a global scale mizuRoute simluation. The results here were modest at best, showing little improvement from the newly developed "DAM" scheme, vs the generic natural lake ("NAT") scheme (figure 8). There appear to be a lot of confounding factors with modeling at this scale, including a low resolution and important processes such as mountain snowpacks not being considered, as well as potential shortcomings in the Community Land Model formulation. I therefore agree with the other reviewer that the purely scientific contribution of this work is modest. However, it is clear that advancing the types of models and techniques discussed here is necessarily a community effort, so there is value in publishing an attempt to address the motivating problem of reservoir simulation, even if the results are not yet satisfying enough to signify a major advance. The authors seem to acknowledge this in their discussion of potential future work.

I agree with the other reviewer that the motivation part of the paper could be strengthened. As someone who does not do global hydrologic modeling, it is a little difficult to see the importance of the work, especially given the numerous deficiencies of the global scale models that are discussed in the paper.

I also agree that the paper is very well written for the most part.

Kudos to the authors for making their workflow available on GitHub, in what appears to be a very straightforward series of Jupyter Notebooks.

Specific comments

472 The coupling of mizuRoute to CLM and CESM, which is currently ongoing, will enable routing runoff from the land to the ocean with a network-based routing mode, thereby permitting streamflow alteration by dam operations through the reservoir parametrisations.

Is section 6.4 intended to be proposal to couple the two models, or is this supposed to describe ongoing or future work? I get the sense that this is future work. With the current wording, the purpose of this section is a little unclear. I suggest including "future work" in the section heading, and maybe also restructuring the text to more clearly communicate 1) the key shortcomings of the model workflow described in this paper (ok to reiterate them for clarity, and 2) the future work that could address each of these shortcomings and how. In that sense, this section may be more useful as a "Limitations and Future Work" section.

The irrigation module in CLM is calibrated with one free parameter based on global observed irrigation water withdrawals 425 from AQUASTAT (Thiery et al., 2017, 2020).

Really? Maybe CLM is part of the reason for poor predictive skill? A single parameter implies that there are many uncertain aspects of the irrigation model that are being relegated to the model structure, where they can't be improved by data assimilation and hence are likely to contribute to model error.

Figures

Many of the outflow plots in figure A2 are hard to read (for example, the Trinity location). You might consider a logarithmic scale on the y-axis to better illustrate how the flows compare across the full range of values.

I like the way that you present multiple time series spatially in Figure 7, although the runoff comparisons don't look very good.

Technical

79 Consider changing to:

which will enable investigation of climate change impacts on human water management and the potential of water management strategies to mitigate climate change impacts on water resources.

92 Consider changing to:

This approach allows the lake and reservoir water balance to be modeled using data on precipitation and evaporation from the water surface, in combination with parametrisations providing information on the releases, including both natural outflows and regulated discharge.

194 We conducted a global land-only simulation

233 Comparing this simulation to the DAM simulation allows us to assess

435 Consider changing to:

Here, we use the HDMA river network topology and determine the HRUs contributing to reservior water demand, using simple rules based on distance and bottom elevation of river segments.

437 Consider changing to:

However, more detailed river networks, like MERIT-Hydro (Yamazaki et al., 2019) would allow for refinement of the criteria. For example, additional topological details like the Height Above Nearest Drainage index (Nobre et al., 2011; Gharari et al., 2011) could be included.

Code and data availability

The pre-print PDF appears to be missing the link to the mizuRoute code