Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-97

Anonymous Referee #1

Referee comment on "GMD perspective: The quest to improve the evaluation of groundwater representation in continental- to global-scale models" by Tom Gleeson et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-97-RC1, 2021

Authors discussed the value of three strategies for evaluating groundwater representation in global scale groundwater models. The manuscript starts by discussing the importance of groundwater representation in global scale models and then outlines strategies for model evaluation. An important missing piece and challenging issue in between is how to represent groundwater processes at global scale in a computationally efficient manner. Authors discuss some of the current approaches to represent groundwater at global scale (lines 164-207) but this is not complete. I suggest authors to further expand the discussion in this section and provide a summary of various approaches that have been used so far to represent groundwater in global models and discuss potential approaches for improvement.

Authors also discussed challenges in evaluating global groundwater models. For example, the issue of mismatch between the scale of observations and model grid cell exist for any distributed hydrologic model and it is not unique to global groundwater models. The evaluation strategies for global scale models are also similar to any hydrologic models. Therefore, I wonder whether authors could spend more time bringing various view points for model development rather than evaluation as this is the most important challenge in the literature.

It would be useful to bring examples of exisiting global scale groundwater models and discuss their performance to convey the status of science to the readers.

Line 173 – This statement is not very clear. Perhaps add “Explicit” to water storage or hydraulic head since these models consider subsurface storage and distribute estimated average water table depth across the domain based on the topographic wetness index.

Lines 257-271- What about the use of stable and radiogenic isotopes for determining water sources and residence times?

Lines 705-707- Authors discuss the use of estimated recharge or other fluxes from regional scale models to assess global scale groundwater models. However, such flux estimates are not often very accurate and contain large uncertainty. How do authors recommend comparing these uncertain datasets together?

Table 1- Authors list groundwater storage observations at point scale for model evaluation. Could authors further clarify the sources of these data.

Overall this is a very well written paper and authors provide important insights about how to move the community forward. Some of the information throughout the paper could be summarized in tables or conceptual figures to highlight the main points of the paper.