

Interactive comment on “Uncertainty of simulated groundwater recharge at different global warming levels: A global-scale multi-model ensemble study” by Robert Reinecke et al.

Anonymous Referee #3

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Reinecke et al. study the influence of different global warming levels on groundwater recharge using a suite of hydrological models at the global scale. They report that uncertainty in the GWR estimates is large, and may be possible with confidence in specific regions.

I do appreciate the tremendous amount of work the authors put into the study and already apologize for not being able to be more positive. The study has a flaw in that it assumes/postulates that GHMs are able to simulate groundwater recharge processes (line 61). This remains to be shown (see specific comment below). The authors also compare to Mohan et al. (2018), a data set, which is also highly uncertainty itself,

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and show that all models essentially have no skill. Thus, the study is hypothetical and should be seen as a model sensitivity study, which does not necessarily reflect reality. The large uncertainty in the results supports that notion. The authors discuss the limitations in detail and come to the conclusion (line 538) “Despite the uncertainties, this study shows that climate change will impact groundwater availability in many regions of the world.” Yes, that’s probably true. But it’s sad that due to the large uncertainty, no additional concrete conclusions can be drawn from the results.

Because the detailed analyses and numbers have very low confidence, I am not able to comment on the simulation results.

In summary, I find that GHMs have not been tested comprehensively especially with regard to complex processes such as groundwater recharge. Thus, in my opinion, the study is too early (first testing, then analyses). Looking at the description of the models, I would not even call the estimated flux groundwater recharge. If GHMs are applied I suggest to study the major fluxes of the water balance including their impact on the residuals of the balance equation in the models. In a way that’s what the authors are doing, yet the presentation does not show these results.

Only a couple specific comments Abstract: The reported percent increases/decreases of GWR suggest an accuracy that is simply not there; especially given the huge uncertainty in the results. Thus, the abstract sends the wrong message, especially to water managers and decision makers.

54: One of the most important factors is missing: Depth and dynamics of the free water table.

61: This is true, but has never been tested. I suggest to compare the GHMs against fully integrated hydrologic models, such as Cathy, Hydrogeosphere, OpenGeosys, ParFlow, etc. in order to test the ability of GHMs to simulate recharge processes. This is one of many tests that GHMs should undergo in my opinion.

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Section 2.2: Porbably I missed these details: what's the time step, the spatial resolution, etc?

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