

***Interactive comment on* “Impacts of soil-aquifer heat and water fluxes on simulated global climate” by N. Y. Krakauer et al.**

Anonymous Referee #2

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This modeling study investigates the impact of an idealized representation of a soil aquifer on simulated climate. Most land models in CMIP5 generation of Earth System Models do not represent deep ground in their models. Here, the authors complete a simple and straightforward modeling study that investigates how deep ground reservoirs of heat and water can affect climate means and variability. Overall, they find that the impacts on mean climate are negligible, but that the seasonality of surface fluxes and temperatures are affected by the damping of soil temperature and water anomalies that the deep ground provides.

I found this to be a clean and straightforward study that will make a valuable contribution to the literature. The initial parameterization of the aquifer as described here is simple and idealized and not particularly realistic, but we get a good sense of the possible

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impacts, both above and below ground, that the representation of an aquifer can impart. The parameterization is simple enough that similar parameterizations could be applied and tested in other modeling systems to give a more robust indication aquifer-climate interactions.

Overall, the paper is well-written and clear. I find this paper acceptable for publication subject only to the minor revisions that I suggest below.

1. In several places, the authors say that the soil temperature changed in this way or that, but they do not clearly define what they mean. Are they showing soil temperature of the aquifer, the bottom of the original soil column, the surface, or integrated. I suspect integrated, but over what depth?

2. P. 1187, line 28. “The separation . . . is conceptually difficult”. This is a strange way of putting it. I would use something like unrealistic instead of difficult.

3. Validation – There is little mention of validation of the aquifer parameterization. I realize that this may be difficult to impossible, but I think some additional discussion would be useful. You mention GRACE data has been used in other studies to evaluate models with and without aquifers. Why didn't you test against GRACE here? Are there any other datasets, either datasets that already exist or more likely datasets that don't exist at present, but which if collected would help inform modelers about realistic aquifer representations? Soil temperature measurements, for example.

4. Table 3 shows autocorrelations for 1-yr lags. What about shorter lags? The autocorrelations are pretty small at one year, which is common for land models. Bigger impacts might be seen for autocorrelations for monthly or seasonal lags.

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