Review of "Exploring how groundwater buffers the influence of heatwaves on vegetation function during multi-year droughts", by Mu et al.

In this study, the authors analyze the influence on groundwater dynamics on land surface conditions during hot-dry compound events using dedicated land surface model simulations. The authors discover that groundwater can help maintain transpiration during the initial phase of a multi-year drought, and thereby dampen canopy temperatures during heatwave condition, but that this effect diminished beyond two years into the drought as the groundwater gets depleted.

The paper uses model simulations to assess an understudied process in land-atmosphere interactions, that is, groundwater-induced dampening of extreme heatwaves. The skill of the GW experiment regarding TWSA is quite impressive, especially since it appears that there has been no tuning. Moreover, the manuscript is well written, and the figures are generally clear. Also, the introduction reads very well.

This study thus overall demonstrates the potential to make a substantial contribution to the scientific literature. However, I have some concerns, which require minor revisions of the manuscript. In general, I could recommend publication of this study if the comments specified below are sufficiently addressed.

General Comments

1. My main concern relates to terminology and definitions: It appears that the paper is using inconsistent variable names, for instance in eq. 2 it uses q_{re} for groundwater recharge while figure 2 uses Qrec for denoting apparently the same term. It is also not clear to me what is meant with 'vertical drainage' in fig. 2 (panel d): is this the vertical downward transport of water from the soil column to the aquifer to the soil column (what would normally be called groundwater recharge)? In that case 'recharge' represents the vertical upward transport of water from the aquifer to the soil column (as suggested in L270)? Overall, I'm confused by the terminology used in this context (recharge is normally used to denote the downward flux from soil to aquifer). Please carefully check throughout and make sure to use consistent and well-defined terms and variables throughout the manuscript and figures. Perhaps a schematic showing these fluxes across a vertical atmosphere+soil+aquifer profile could help as well (potentially with one panel per experiment).

Specific comments

1. L134: Also with the time-evolving meteorological forcing, right?

2. L136: As we currently are in the CMIP6 era, I feel it could be more relevant to comment (also) on the status of groundwater modules in this generation of models.

3. L209: In the case of water fluxes, a conservative remapping would be more appropriate. It's ok to leave it like this now, but please keep this in mind for future research.

4. L123: From the context it appears that the simulations are run at 0.05° spatial resolution and 3h time step, but I suggest mentioning this somewhere explicitly in the method section, for instance in L124-127.

5. Fig3a: the underscore in the right y-axis label can be omitted. How did you define forested area? All pixels in the model domain with 100% tree fraction? Please clarify in the caption.

Textual comments

1. L248, caption figure 2 and elsewhere: replace '(total) evaporation' by 'evapotranspiration', whenever you are referring to the sum of transpiration and soil evaporation. Likewise, replace 'recharge' by 'groundwater recharge' if that is what you mean (though it looks like you mean something like 'soil moisture recharge' with this term, which appears odd to me).

2. L346: 'estimated' > 'estimates'.