

Earth Syst. Dynam. Discuss., referee comment RC1  
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## **Comment on esd-2021-31**

Anonymous Referee #1

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Referee comment on "Exploring how groundwater buffers the influence of heatwaves on vegetation function during multi-year droughts" by Mengyuan Mu et al., Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2021-31-RC1>, 2021

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### **General comments**

This paper demonstrates the effect that modelling groundwater in the CABLE land-surface model has on droughts and heatwaves, using two droughts and multiple heatwaves in South East Australia as case studies. This is a very important and topical issue, and well within the ESD remit. The analysis is thorough and well-designed, and described in sufficient detail to allow reproduction. Particular attention is paid to understanding the mechanisms behind the results, which considerably strengthens the conclusions. The relevance to climate model projections is particularly well put, clearly stating the important implications of this study whilst carefully outlining uncertainties and avoiding over-generalisation.

All of the plots in both the main manuscript and the supplementary material are important for the arguments presented, and of a high production standard. The prose is well written, the structure is good, and there is a high attention to detail.

Overall, this is a very strong manuscript, which will make an important contribution to the field.

### **Specific comments**

Section 3.1: This section shows that CABLE-GW has a very good agreement with GRACE total water storage, and that the GW run has a better agreement with GRACE than the FD run. However, I'm not completely convinced by the conclusion that the underestimation of TWSA in the FD run is because of the lack of groundwater representation. (i.e. I don't think that other model deficiencies with the potential to reduce E have been ruled out).

This is particularly the case as the accumulated P-E in GW run is still substantially different to GLEAM, showing that there is still an issue with the model even with groundwater included. To address this I would suggest (a) being a bit more cautious in the phrasing so that the text doesn't imply that including ground water is the only way to make the model match more closely to the observations and (b) including some text discussing possible reasons why the GW and GLEAM lines do not agree in figure 1b.

Line 229: "FD underestimates the magnitude of monthly TWSA variance (standard deviation, SD = 37.18 mm) compared to GRACE (47.74 229 mm) or GW (47.67 mm)": consider showing this explicitly in a plot, as it's an important result, which is difficult to read off Figure 1a.

Line 351: elaborate on why MODIS LST is lower than all the model lines in Figure 6h, even DR.

Line 369: "first ~two years of a multi-year drought": link this explicitly to plots (as far as I could see, this is the first time this was mentioned, but it's picked out as one of the main points of the study in both the abstract and the conclusion).

Line 398-9 "Our regional based results support this hypothesis and in particular highlight the importance of groundwater for explaining the amplitude of fluxes in wet regions (Figure 1)" Elaborate on how Figure 1 shows this.

### **Technical corrections**

Line 434-436: This sentence doesn't read well. Is it missing a "that" or an "and"?

