

Interactive comment on “A theoretical approach to assess soil moisture–climate coupling across CMIP5 and GLACE-CMIP5 experiments” by Clemens Schwingshackl et al.

Anonymous Referee #2

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General Comment: This paper is essentially technical. It aims at evaluating the soil-moisture/temperature coupling accross CMIP5 and GLACE-CMIP5 simulations. It compares two ways of estimating the sensitivity of evaporative fraction and daily maximum temperature to soil moisture. The success of the comparison in numerous regions is an indication that the methodology recently described by the same authors in the Journal of Climate (2017) can be used to evaluate the sensitivity of evaporative fraction and temperature to soil moisture variations in a changing climate directly from the CMIP6 outputs. However, since the data from only 4 (out of 6) of the models which contributed to the GLACE-CMIP5 experiment are analysed, it will be interesting to verify that the results are confirmed with the forthcoming LS3MIP data which are part

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of the CMIP6/Deck and should include a larger number of models. From the process analysis point of view the analysis misses a thorough investigation of the discrepancies in the sensitivities; for instance, for Central Europe, the analyis could have brought additional evidence for the non-local processes possibly involved in the SM-temperature coupling, the Sahel would have deserved a more in-depth analysis as well.

Specific comments:

- Which data were missing in the 2 GLACE-CMIP5 models discarded?
- It would help the reader if the various experiments and various "key measures" tested were summarized in a table.
- The sensitivity is evaluated according to the total soil moisture (which is the soil moisture variable used in GLACE-CMIP5) however did the authors try to evaluate the sensitivity to the superficial soil moisture (mrsos in the CMIP5 datasets)? If so, how the sensitivities compare with the sensitivities based on the total soil moisture?
- Could the authors add grid boxes delineating the regions discussed in Figure 6 at least on one maps (may be in figure 2) ?
- p.9 l. 8 What "latitudinal corrected" means?
- Section 4.3. It is not clear to me how figure 1b supports the sentence "This can be explained by 2) the $\{\text{lower tails}\}$ of the soil moisture distribution show a particular strong shift".
- p 12 line 26 In Discussion misture instead of moisture.
- When discussing the impact of the soil moisture on the daily temperature it could be worthwhile to mention that in addition to its impact through the latent heat, it has an impact through the thermal heat transfer via its impact on the soil thermal properties (e.g. Cheruy et al., JAMES 2017).

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