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Interactive comment on "Investigating soil moisture-climate interactions with prescribed soil moisture experiments: an assessment with the Community Earth System Model (version 1.2)" *by* Mathias Hauser et al.

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General comments

This paper investigates some of the issues related to the experimental protocol of the "Land Surface, Snow and Soil Moisture Model Intercomparison Project" (LS3MIP). Several methods to prescribe the soil moisture conditions are tested, and the results are analyzed in terms of water balance perturbations. This constitute a new diagnostic that should be quite inspiring for other modelling groups. The study is carefully carried out and well written. And it is highly relevant in the context of the coming LS3MIP

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Discussion paper

exercise. I recommend a publication, although I have some minor comments.

Specific comments

1. p. 4, lines 1-15 (description of the various methods of prescription)

The authors consider the possibility of prescribing either the liquid water content only, or the liquid and ice contents separately. There is (at least) another option in which the total amount of soil moisture (liquid + ice) is prescribed and the partition of ice and water is computed accordingly to the model's proportion of liquid and ice at a given time step (i.e. before the value is prescribed). This what we did in Douville et al. (2016) and we tend to think this method can prevent most of the disturbance in the energy balance you observe with the PRES_LIQ+ICE method. It would have been interesting to test it. But since it was not, it could be worth mentioning.

2. p. 4, lines 4-8

I had a hard time understanding the description of the PRES_LIQ method. Figure 1 definitely clarifies things, but the written explanations should be improved. For example, the text could explicitly mention that the total soil moisture content is converted into liquid water to be prescribed. The authors could also write that below zero, both the liquid water and ice contents are let interactive.

3. p.7, lines 26-27

"Interestingly, the regions with large amounts of net added SM coincide with regions where we find the strongest Txx reduction in Figure 4". Could you give some physical explanations of this finding?

4. p.7, lines 26-27

The reduction of TXx found in southwestern Europe in figure 4.d does not match any perturbation of water balance in figure 5.d. Can you comment on that?

5. p. 7 line 32 to p.8 line 4

Do you have some insights as to why the PRES_LIQ_MEDIAN method leads to a smaller imbalance than the PRES_LIQ_MEAN one? It would help to plot the distribution function of SM, as in figure 2.a, for grid points where the differences between the two methods are the greatest. Let's say in India where large amounts of water are added in PRES_LIQ_MEAN and in Indonesia or Brazil where water is removed.

Technical corrections

1. The figures should be enlarged.

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