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Hydrology and Earth System Sciences
Discussions

Interactive comment on "SMOS brightness temperature assimilation into the Community Land Model" *by* Dominik Rains et al.

Anonymous Referee #3

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This study investigated the benefit of integrating SMOS brightness temperature and the Community Land Model over Australia. Three different scenarios were performed to update different layers of soil moisture by the LETKF method. The results were evaluated using ground soil moisture measurements. Personally, I think this paper was well written. The organization was reasonable and the experimental design was clear. However, there were still some major issues need to be addressed before it can be considered for publication. A more systematic literature review on remote sensing data-land surface model assimilation need to be conducted. There are two groups of remotely sensed soil moisture (or brightness temperature) assimilation studies, one for soil moisture estimation typically through land surface models, and the other for runoff and streamflow prediction normally through catchment hydrologic models. The current

introduction mixed these two together, with a lack of detailed review on remote sensing constrained land surface modelling. The contribution of this study should be better articulated based on the review of the current progress on this topic. The authors discussed extensively on bias issue in the Introduction and Results sections, which I agree is an important issue; however, I did not see what is new in this study in addressing this issue. The CDF matching is a traditional approach with the advantage of removing relative bias. However, the problem is that it does not estimate and disaggregate the relative bias into model one and observational one. I did not see how this study addressed this issue. The design of the different DA experiments were not well justified. Technically, there is no problem to update all soil moisture layers through cross covariance, which should maximize the benefit of assimilating remotely sensed surface soil moisture by addressing the gross error accumulated in the deep soil moisture. So what was the point of just update the first 9 cm? It may be argued that updating only surface soil moisture could test the ability of the CLM to update the deep soil moisture by the model dynamics itself; however, I do not think a Kalman filter is the best choice to answer this question. The error in deep soil moisture is an accumulation of the error from the surface soil moisture and a smoother to assimilate the RS data to update both current and past surface soil moisture will have a better capacity on testing the capability of the model to update deep soil moisture through model dynamics. Besides, more in-depth analysis and discussions need to be added. For instance, what is the implication of the results from this study on the issues such bias? Whether the results is reasonable (and being improved after data assimilation) for the whole Australia? Also, I would suggest the authors to be careful in using the words "assimilate" and "update". It should be very clear through the paper that RS surface soil moisture was "assimilated" while different layers in the model were "updated". P2L31: Based on the review above, I cannot get to the conclusion that TB assimilation is under researched compared with soil moisture retrieval assimilation. P7L10-15: Why 32 ensembles? Why no spatial correlation was considered while most of the errors are known to be spatially correlated? How these error parameters are estimated/determined? 50% of rainfall is a lot,

I reckon. P10L1-5: A bit of details on the soil moisture measurements quality control.

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