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Discussions

Interactive comment on "The impact of near-surface soil moisture assimilation at subseasonal, seasonal, and inter-annual time scales" *by* C. Draper and R. Reichle

Anonymous Referee #2

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Comments on "The impact of near-surface soil moisture assimilation at subseasonal, seasonal, and inter-annual time series" by Draper and Reichle.

The authors analyze biases between AMSR-E, Cathment model, and in-situ SMs at three different time scales – subseasonal (short), seasonal, and long term – and investigates the impacts of assimilating rescaled AMSR-E SM into the Catchment model. SM-DA showed consistent improvement of SM at all time scales at four ARS sites. It is also shown that rescaling for one-year model-observation can result in updated SM worse than open loop SM.

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Interactive Discussion
Discussion Paper

This paper deals with an important emerging question in land data assimilation (multi-scale biases between different 'measurements') and how SM-DA affects individual time components when SM is scaled at a lumped time scale. The manuscript is well written and tables/figures concisely summarize results. I recommend that this manuscript should be accepted for publication after addressing comments listed below.

1. In the Introduction, the authors mention a possibility of model-observation biases varying at different time scales citing Su and Ryu (2015). It naturally leads to an expectation that the authors rescale sub-seasonal $\sim$ long-term time components separately, but AMSR-E SM is rescaled for the lumped time scale in both control and treatment cases. It needs to be clarified in Introduction that the main focus this work is analyzing the effects of SM-DA with a lumped rescaling on updated SM at multiple time scales. It would also be good to add discussions about rescaling individual time components separately.

2. It is written in Section 2.2 that a CDF-matching is used to rescale the observations, but it was later in the Result, Section 3.4, that I found that actually a linear model using mean and variance was used. The authors need to move this specific description to the Methods section because the use of mean-variance-based linear rescaling can influence the rescaling results discussed in the earlier sections.

3. The basis for using linear rescaling in place of CDF-matching is that variance distribution across time scales did not vary after CDF-matching. This argument should be strengthened with more specific supports. For example, CDF-matching can be a more robust choice for non-stationary time series or when model and observation pdfs feature very different symmetry.

4. Was the mean perturbed ensemble (open loop) compared with the unperturbed single run? Please make sure the perturbation of soil moisture was done without unfairly penalizing the perturbed background predictions.

5. In Figure 6c, changes between M and Ac in SM_seas looks unrealistically substan-

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tial. With given AMSR-E SM pattern at LR shown in Figure 2, neither rescaling nor Kalman update would likely to make that large difference. Please double check the data to ensure the correctness.

More specific comments

- Page 7977, “due to very low observation counts over the study period at the other sites”: Please provide more information about the data scarcity in these sites (e.g., % of period the root-zone SM is available).

- Page 7984, “AMSR-E could be expected a priori to have a larger fraction of . . . in the remotely selected observations.”: This a priori expectation (relatively large SMshort Var over SMseas Var) contradicts somehow "exaggerated seasonal cycle" of AMSR-E at Little Washita and Little River. Need discussion on this contradiction.

- Page 7988, line 1: “forecast” → “predicted”

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 7971, 2015.