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Hydrology and Earth System Sciences Discussions

Interactive comment on "Joint assimilation of soil moisture retrieved from multiple passive microwave frequencies increases robustness and quality of soil moisture state estimation" *by* A. I. Gevaert et al.

A. I. Gevaert et al.

a.i.gevaert@vu.nl

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Comment #1

Two precipitation products are considered to assess the influence of their quality on soil moisture assimilation. It was recently done also in Massari et al. (2018, doi: 10.3390/rs10020292), and I believe it is a very interesting approach. However, a gauge-corrected product (research version of TRMM) and a gauge-based product are considered. I would suggest to consider also the real-time version of TRMM, better of

TMPA, that is only satellite-based and would provide information of the impact of soil moisture assimilation in areas of the world in which raingauge are not present. I believe that it would not be too much work to be done, and the corresponding results would be of strong interest (at least for me).

Response #1

The results presented in our study are in fact based on the real-time version of TRMM, though we now see that the text wrongly refers to the research version. As you explain, by using the real-time version we can assess what the benefits of (joint) assimilation of the soil moisture products would be where good-quality precipitation data is not available.

We have also assessed how model quality differs when using the research or real-time version of TRMM (Fig. 1). When using the real-time version, the agreement between top layer soil moisture and observational data is a bit lower than when the research version is used (by 0.04 on average), as expected. The quality of root-zone soil moisture is similar for both models. However, even for the top layer the difference in the quality of the TRMM precipitation products is relatively small when model results using AWAP gauge-based precipitation are used as a reference. As a result, the impact of soil moisture assimilation based on Δr is very similar for both TRMM precipitation products. On average, Δr is 0.01 to 0.03 larger when the real-time version of TRMM is used than when the research version is used, depending on the soil moisture product assimilated.

In the revised version of the manuscript, we will make the choice for real-time TRMM clearer.

Comment #2

The analysis has split the assimilation in wet and dry periods, as in wet conditions AWRA-L model is not performing well. However, in many previous studies it was obtained that the higher impact of soil moisture assimilation is obtained in the transition periods between dry and wet conditions (and viceversa between wet and dry conditions). I would suggest including these periods in the analysis (again, it should be easy to be added).

Response #2

Thank you for your suggestion. We have analyzed the impact of assimilation for transitional conditions. However, we have found that assimilation is not necessarily more informative in these months than in the (shortened) wet and dry periods (Fig. 2 below). In the top layer, the impact of assimilation in the transitional period compared to the wet and dry seasons depends on the retrieval. For L-band, the impact of assimilation is highest in the transitional period (on average). For C-band, however, it is lowest, and for X-band the impact is higher than the dry season, but lower than the wet season. For root-zone soil moisture, the impact of assimilation in the transition and wet seasons is similar (except for C band) and higher than in the dry season. Based on anomaly time series, assimilation is only informative in the top layer during transitional periods, and not for the root zone.

In the revised version, we will evaluate the impact of soil moisture assimilation for the transitional periods between the wet and dry seasons as well. Therefore, Fig. 4 will be replaced by Figure R2. The text referring to the seasonality of the impact of assimilation will be updated to reflect the new results.

SPECIFIC COMMENTS

R3) Page 10, figure 3: The performance of the Open Loop simulation for root-zone soil moisture simulation should be added

A3) Agreed, we will add the performance of the open loop for the root zone to Figure 3.

R4) Page 11, line 9: “no difference”. I suggest changing with “a small difference” or equivalent, as some differences are present also for root-zone soil moisture.

A4) Agreed, this will be changed in the revised manuscript.

R5) Page 16, Discussion section: I suggest adding a paragraph of comparison with studies that have considered the joint assimilation of active and passive soil moisture products, to highlight the similarities and the differences.

A5) In the introduction of our study we reference two studies that jointly assimilated an active (both ASCAT) and a passive (both AMSR-E) soil moisture retrieval into land surface models, Draper et al. (2012) and Renzullo et al. (2014). Both of those studies are also (partly) based on Australian sites, resulting in some overlap with our study sites.

Draper et al. (2012) assimilated an active and a passive soil moisture retrieval into a land surface model and evaluated model performance over a number of sites in the US and the Murrumbidgee catchment in Australia. Their conclusion was similar to our own, namely that joint assimilation led to similar or better model performance than assimilating either product individually. In contrast, Renzullo et al., (2014) stated that joint assimilation resulted in a compromise between the two retrievals at a number of study sites spread around Australia. However, where reported, the correlations of the joint assimilation experiments were at most 0.02 lower than when assimilating the more informative soil moisture product individually (Renzullo et al., 2014), suggesting that the performance is largely similar. In the revised manuscript we will add a comparison of the results of the joint assimilation experiments to those of Draper et al. (2012) and Renzullo et al. (2014).

RECCOMMENDATION

R) On this basis, I found the topic of the paper relevant and interesting. Therefore, I suggest a minor revision before the publication in Hydrology and Earth System Sciences.

A) Thank you.

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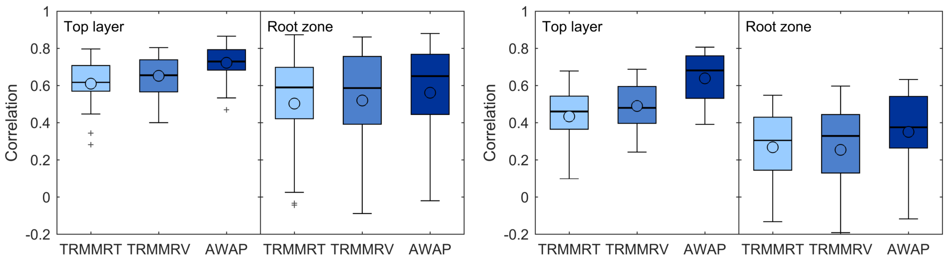

Fig. 1. Correlations between model and field-measured soil moisture for the top layer and root zone when using different precipitation products based on actual (left) and anomaly (right) time series.

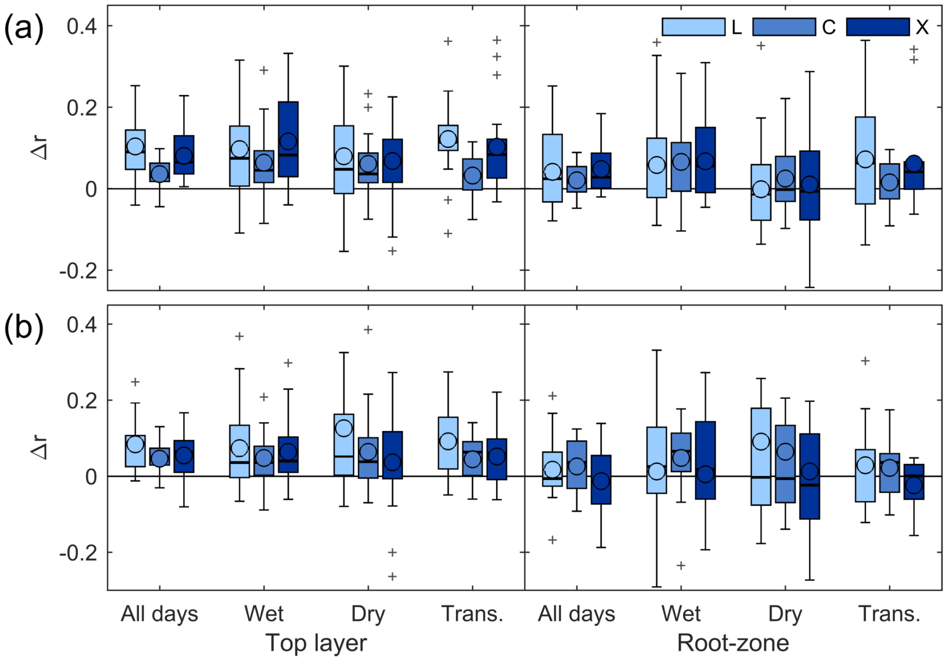

Fig. 2. The change in correlation (Δr) between modelled and field-measured top-layer and root-zone soil moisture after soil moisture assimilation based on actual (a) and anomaly (b) time series.