

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
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Comment on hess-2021-460

Anonymous Referee #2

Referee comment on "Soil moisture estimation in South Asia via assimilation of SMAP retrievals" by Jawairia A. Ahmad et al., Hydrol. Earth Syst. Sci. Discuss.,
<https://doi.org/10.5194/hess-2021-460-RC2>, 2021

Review of "SMAP retrieval assimilation improves soil moisture estimation across irrigated areas in South Asia" by Ahmad and co-authors submitted for publication in HESS.

The study presents a soil moisture assimilation framework applied across South Asia, using soil moisture from SMAP and the Noah-MP land surface model. Two setups were tested, using CDF matching correction and no correction to SMAP retrievals. A key finding is that the CDF matching of SMAP retrievals, a common approach when dealing with satellite soil moisture estimates, can remove some of the information related with irrigation. The manuscript is well presented and of general interest for several communities focusing on land surface, soil moisture, irrigation and data assimilation. Therefore, my recommendation is to accept the manuscript for publication after a few points, listed below, have been addressed by the authors.

Major point

The comparison with in situ soil moisture measurements is the only direct and independent evaluation. However, the stations are not located in the regions with higher irrigation-equipped areas. These are the regions with higher impact, and with some indirect evaluation via the signal on evapotranspiration. While the results are consistent, the main conclusions are not fully supported by independent evaluation. Therefore, I suggest that this limitation is highlighted in the conclusions and abstract. For example, Line 473: "and improved the spatiotemporal soil moisture patterns (Figs. 3 and 7) and associated evapotranspiration (Fig. 8), particularly over irrigated areas." Since there are no direct observations of evapotranspiration and Soil moisture over the irrigated areas, I would recommend to say that the results "suggest improvements".

Also on this point, the title can be a bit misleading since there is no clear evidence of improved soil moisture across irrigated areas, but we see the impact of the assimilation across irrigated areas. Therefore, I also suggest a change in the title to clearly reflect the manuscript content.

Minor details

line 185 " perturbations used by Kwon et al. (2019) (Table 2)" For completeness, I would recommend replicating Table 2 of Kwon 2019 (if there were no changes?) in the appendix for example.

Figure 3: Please define acronyms in figure captions. E.g. "TPO" in red symbols are the observations ? SMAP-CDF are the collocated SMAP observations after CDF matching ? Also in Figure 10, e.g. panel c) FS GPP == FluxSat GPP ?

Lines 336-354: It's not clear what's the motivation of Figure 6. To link some potential impact of the DA as a function of soil texture ? While it was clear in Figure 5 for the land cover, I would recommend removing Figure 6, and just mention in the text that no clear link was found between soil moisture in OL vs DA-NoCDF for different soil textures.

Line 47: please define PMW