

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2020-611

Anonymous Referee #1

Referee comment on "Comprehensive evaluation of satellite-based and reanalysis soil moisture products using in situ observations over China" by Xiaolu Ling et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2020-611-RC1>, 2021

Soil moisture, as one of the essential climate variables, has attracted more and more attention from climate research. However, there is still a long way to go for the recently widely used soil moisture products, including reanalyses based on models and retrievals from remotely sensed data, to be comparable with observations. To further develop and properly use them, it is necessary to compare with in situ observations to reveal their uncertainties. In this manuscript, the five satellite-based and reanalysis soil moisture products were evaluated in China with in situ observations for top soil layer (0-10 cm). By now the manuscript still needs to further discuss the uncertainties of in situ observations of soil moisture data, the influence of sparse data samples, and thus the unfair to compare grid products using point-scale measurements. In particular, the author pointed out that the bias term controlled the deviations of soil moisture products from the observed values. This partly stems from the spatial mismatches in the comparisons of the soil moisture measured at a point with model grid means. So, it requires more discussion about its implications. In addition, the method part needs to provide more details, for example, how the monthly means were estimated using 3-sample observations per month.

Specific comments and suggestions:

- "mainland China" is NOT a right term, you can use: the Chinese Mainland, Mainland of China or China's Mainland.
- 2.1.1 ESA CCI SM, how the various retrievals of the passive and active sensors combined should be detailed a bit more, for example, using land surface model products?

- 2.1.5 ERA5 SM, the improvements of land processes in ERA5 against ERAI are helpful to understanding of the results with respect to in situ soil moisture in these two reanalyses.
- 2.2 In Situ SM and Preprocessing of Datasets, the in situ observations were taken from three datasets, so details about difference in the operation of measurements and the means of quality control for the datasets are necessary to assess the credibility of in situ data.
- The 'CN05.1' should be defined before its first citation.
- Line 155, 'different drought/well conditions', 'well' is a typing error?
- More detailed information on the decomposition of MSEs and the test methods is necessary for potential readers.
- Fig. 2, the spatial pattern for ERA-Interim looks pretty different from that for ERA5 and others, especially across the arid northwest and regions along the coasts. Please doublecheck it, otherwise, give an explanation.
- Line 195, the larger rRMSEs in the Yangtze-Huai basin may be associated with the irrigation influence on the in situ observations. However, it's hard to think of its direct links to monsoon precipitation.
- Fig. 4, the regionally averaged observations show higher soil moisture in NW than the other three regions. It is NOT consistent with the precipitation patterns in Fig. 1. The discrepancy should be discussed a little bit more.
- 3.2.2 Seasonality, since the previous results talk about the summer (JJA) soil moisture comparisons with observations, how the seasonal soil moisture were selected in this section should be clarified further. Further, the soil moisture discussed in the manuscript focused on the top soil layer (0-10 cm), so I guess its seasonality connected closely to precipitation annual cycle. However, in Fig. 6, it looks not so, please discuss it further.
- Line 230, 'snow or frozen soil during these periods.' The frozen seasons should be excluded in the comparisons, otherwise the model soil moisture is virtually a different variable from the observed.
- Line 286, 'The SC-PDSI is utilized (Wells et al., 2004).', for what is SC-PDSI used?