

Comment on hess-2020-611

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Community 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-CC1>, 2021

This is an important study regarding the evaluation of long-term soil moisture products within mainland China. Several products, both reanalyzed and remotely sensed, were comprehensively evaluated in the spatial and temporal domain, and under hydrologically dry, normal and wet scenarios. The driving forces of soil moisture dynamics were examined with respect to precipitation, temperature and radiation (shortwave plus longwave). In my opinion, however, the major concern is spatial mismatch (both horizontal and vertical) between various products and in-situ measurements. In addition, most of current explanations and reasonings lack a solid physical background.

- The authors need to reappraise their motive of this study, because NOAA and NCEP soil moisture (SM) products (a spatial resolution of 2 degrees) are usually not qualified for hydro-meteorological studies (flood or drought as reviewed by Peng et al. 2020, in Remote Sensing of Environment) in mainland China. As pointed out by the other reviewer, such coarse spatial resolutions would cause errors of representativeness. Although spatial averaging to some extent can alleviate such an effect, I still think errors of representativeness (together with differences in effective soil depth) might contribute substantially to the bias values. That is probably the reason why CCI (a spatial resolution of 0.25 degrees) and ERA-5 (a spatial resolution of 31 kilometers) have a slightly better performance.
- The presentation of results should be improved. In numerous cases, the authors repeat the overestimation of modelling SM data and the underestimation of remotely sensed SM data.
- Some descriptions contradict each other throughout the manuscript. For example, in Lines 88-90, the authors first report the underestimation in northwest China and then report the opposite side.
- Line 79, the authors promise to discuss on sources of SM errors. However, most of the explanations are speculations and even key words. In Line 223 for example, why different land surface types and varying soil parameters cause differences between CCI and model outputs? In Line 227, how vegetation presence leads to a clear SM seasonal cycle? In Line 237, how precipitation and frozen soils increase autocorrelation? Then in the following sentence, what particular soil type and texture decreases autocorrelation?
- Section 3.2.2, how autocorrelation is related to the performance of soil moisture products.

- Lines 288-289, is this a manifestation of scaling effect? Spatial averaging (coarse resolution) masks out extremely low and high SM values.
- Line 45, "temporarily" should be "temporally".
- Line 65-66, this sentence makes no sense.
- Line 86, "plus" is incorrect here.
- Line 87, delete "underlying".
- The method section should provide more details, such as data interpolation in the vertical direction. The CCI has a penetration depth of < 2 cm, and the effective soil depth for model outputs is 0-10 cm, and the in-situ measurement depth is 10 cm. Such differences might also cause errors of representativeness.
- Line 166, "climate" should be "climatological".
- Line 178, "Discussions" should be "Discussion".
- Lines 184-185, this sentence has been already in the previous section, and it does not belong to Result section.
- Line 199, improper use of "According to".
- Line 214, what kind of mechanism?
- Line 217, what is "variability performance"?
- Lines 17-18, this sentence "demonstrating..." makes no sense.
- Line 232, the snow-covered and frozen grids were not removed in this study?
- Line 300, the explanations are unclear and confusing.
- Line 321, it is not quite right to say "CCI is not useful".
- Why not use GLDAS (the same grid resolution as CCI) or CLDAS (more spatial details) data as validation reference? Although with a shorter temporal coverage, other optimized SM data in mainland China can also serve as references. Using these data reduces errors of representativeness. Perhaps shorter time series also works assuming a temporally stable data quality of various SM products.