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Hydrology and Earth System Sciences
Discussions

Interactive comment on "An improved perspective in the representation of soil moisture: potential added value of SMOS disaggregated 1 km resolution product" *by* Samiro Khodayar et al.

Anonymous Referee #1

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Review of "An improved perspective in the representation of soil moisture : potential and added value of SMOS disaggregated 1 km resolution product" by Khodayar et al.

This study attempts to assess the potential of a new SMOS surface soil moisture (SSM) product to initialize ISBA land surface model, previously implemented at fine scale over the VAS (Valencia Anchor Station) area. It notably represents the first application of the newly released SMOS level 4 "all weather" disaggregated 1 km soil moisture, based on the ERA-Interim Land surface temperature (LST).

Although the study is interesting, the manuscript is a little bit confusing, and the structure should be better organized. Moreover, it is unclear why the authors chose to

aggregate the 1 km resolution product if the final objective is to improve the spatial representation of soil moisture. An in-depth analysis of the SMOS level 4 data and its added value compared to Level 2 or Level 3 data is required since no reference is given elsewhere.

Please find below a list of major comments, followed by specific points.

Major comments:

1) Few information about the SMOS L4 version 3.0 (section 2.2) are given and the reference Piles et al. 2015 (Quality report) could not be found in the reference list. When looking at SMOS L4 data maps (Figures 2 and 4), one question arises strikingly: what is the actual spatial resolution of the downscaled SSM? The spatial resolution of SMOS L4 seems to be much larger than that of L2 and L3. Has the meteorological forcing used to derive ERA-Interim LST anything to do with the apparent resolution of L4 product? What is the spatial resolution of ERA-Interim LST?

2) Another concern with the use of ERA-Interim LST data for downscaling SMOS data. As the LST is derived numerically from the ERA-Interim soil moisture data via the energy budget model of TESSEL, would it be equivalent to use the ERA-Interim soil moisture data directly?

3) Evaluation of the SSM product: Line 366: "the higher resolution SMOS L4 showing lower standard deviation". Line 415: "The CVs of the spatially averaged SMOS L4 is lower than those of SMOS L3 and L2 and in situ observations indicating that this data are less scattered." In my opinion, a lower variability for the downscaled SSM product is unexpected. It should be the opposite: higher variability for the downscaled SSM. Line 393: "L4 product shows SSM mean and variability in the same range of the SMOS L2 and L3 products, but with a finer-improved resolution representation of the spatial distribution". L398: "the potential added value of the 1 km product is manifest". The SMOS L4 has a spatial variability much lower than that of both L2 and L3 products. How to demonstrate that the slight 1 km variability is real information

and not an artifact (oversampling)? Line 633: “consistent with the finer resolution of this product which better captures local information on the 1 km x 1 km pixel, whereas coarser products smooth out this vital information”. To me, there is no information in this paper supporting the hypothesis that the downscaled product improves the spatial representation of SMOS L2 and L3 products. To really evaluate the SMOS L4 product, one should compare (in Table 3 for instance) the SMOS L4 versus in situ and SMOS L2 (or L3) versus in situ for each station separately, that is at a scale finer than the L2/L3 spatial resolution. Are statistics better for L4 than for L2 or L3? Bottom subtable of Table 3 is unclear. In addition errors are identified in the right column (OBS), which does not always correspond to the mean for all stations (?).

4) In the present form, the paper is a bit lengthy. The description of approaches is sometimes repetitive. The structure of the manuscript could be improved. For instance: lines 334-335 (and lines 507 to 512) three to four initialization experiments are presented, but the initialization using SMOS data is not mentioned, although claimed as the main objective of the paper. Conclusions are confusing as well. The authors should better highlight their findings by selecting few key results.

5) As the study focuses on SMOS derived SSM at high spatial temporal resolution including all weather conditions, I suggest two recent references to complement the state-of-the-art presented in the introduction: Malbéteau, Y., Merlin, O., Balsamo, G., Er-Raki, S., Khabba, S., Walker, J. P., Jarlan, L. (2018). Toward a Surface Soil Moisture Product at High Spatiotemporal Resolution: Temporally Interpolated, Spatially Disaggregated SMOS Data. Journal of Hydrometeorology, 19(1), 183-200. Djamai, N., Magagi, R., Goïta, K., Merlin, O., Kerr, Y., Roy, A. (2016). A combination of DISPATCH downscaling algorithm with CLASS land surface scheme for soil moisture estimation at fine scale during cloudy days. Remote Sensing of Environment, 184, 1-14.

6) Line 529: “soil moisture initialization in spatialized SURFEX simulations requires a single representative value for the whole simulation area. In this case, we use as input the SMOS L4 1 km disaggregated soil moisture mean over the whole simulation

area for the initialization day”. Why not initializing the model at 1 km resolution if 1 km resolution data are available? What is the point of disaggregating SMOS L2/L3 data then?

7) On the usefulness of surface soil moisture data to initialize ISBA. Line 229: “Particularly relevant for this study is the specific definition of the soil hydraulic parameters which they made for the VAS area, since most of the hydrological parameters are site dependent”. Does the approach require in situ measurements for the calibration? Since the objective is to initialize ISBA using SMOS L4 data, I am wondering whether the site specific calibration could be done using SMOS L4 data solely (without relying on in situ measurements for ISBA simulations). Line 488: “Initialization of land surface models is a crucial issue and its impact on the accuracy of model estimation is widely recognized to be significant”. What about the initialization of the root-zone soil moisture, which has supposedly more weight in the initialization than the SSM?

Specific points:

- It is unclear at which spatial resolution ISBA model is run over the VAS?

- Confusion is often made between observation and sampling grid resolution. Ex. Line 10: 25 km and 15 km are the resolutions of sampling grids, the actual spatial resolution for both products being about 40 km.

- Figure 2 (and Figure 4): Image at the middle is not correctly georeferenced compared to the left (top) and right (bottom) images.

- Units in m3/m3 are sometimes missing the text and the figures.

- Line 306: “SMOS L4 soil moisture grid cells are averaged over the 10x10 km2 area and compared to the mean from the soil moisture network stations to address the issue related to spatial averaging”. Please clarify the issue to be addressed?

- Notations: SURFEX-SAFRAN (SURFEX forced by SAFRAN), SURFEX-ECMWF (SURFEX forced by ERA-Interim) and SURFEX-ISBA are used. The terminology

SURFEX-ISBA is confusing as it corresponds to SURFEX (ISBA) forced by station-based meteorological measurements. For clarity, I suggest to replace SURFEX-ISBA by (for instance) SURFEX-VAS

- Some references are missing in the reference list: I have noted Louvet et al. 2015; Piles et al. 2015; and maybe others.

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