

## ***Interactive comment on “Assimilation of space-based passive microwave soil moisture retrievals and the correction for a dynamic open water fraction” by B. T. Gouweleeuw et al.***

**Anonymous Referee #1**

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### **Overview**

The study investigates the influence of the temporal changes in the extent of small water bodies on the soil moisture retrieval from the Advanced Microwave Scanning Radiometer-E (AMSR-E) for three areas in Oklahoma, US. Results seem to demonstrate that the bias in the retrieved soil moisture data against soil moisture observations can be attributed to the presence of relatively small areas (<5%) of open water in the sensor footprint.

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### **General Comments**

The paper is fairly well written, well structured and clear; the language is fluent and precise. The topic of the paper is of great interest for the HESS reader as the effect of small water bodies on soil moisture retrievals from remote sensing has to be clearly assessed whether this information has to be used for hydrological or meteorological applications through, for instance, a data assimilation scheme. Despite the paper merits, I found some issues to be solved before its publication mainly related to the interpretation of the results.

In the paper, three different areas in Oklahoma are investigated for which in situ observations, modelled data and AMSR-E soil moisture retrievals are available. For the Eastern area, the Open Water Fraction (OWF), as obtained by *Jones et al. (2009)*, shows a marked seasonal change (see Figure 5) that could be the responsible for the observed overestimation of the LPRM soil moisture retrievals (see Figure 3). However, for the South-Central area, the LPRM soil moisture product still overestimates the ground observed and the modelled data even though the OWF remains quite constant all over the year. This was explained by the authors as due to the different spatial resolutions involved (see lines 10-11 pag. 1022). Notwithstanding I could agree with this explanations, I have several doubts on the reliability of the overall methodology and, hence, on the derived conclusions.

In fact, when different soil moisture data sets are compared, as in the present study, particular attention should be paid to the intra- e inter-annual range of the different soil moisture products. This range is usually mainly related to the soil properties used for the definition of the soil moisture product itself and, specifically, to the minimum and maximum soil moisture values (sometimes referred as residual and at saturation soil moisture values). The overestimation of the LPRM soil moisture retrievals could be simply related to a different specification of these minimum and maximum soil moisture values and not to the temporal dynamic of small water fraction. Looking at Figure 3 (middle and right panels) it seems that the LPRM soil moisture overestimates the

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other products throughout the whole year (also evident in Figure 7) and not only when the presence of the OWF is higher. On the other hand, the soil moisture product named AMSR-E UoM tends to underestimate all the other products and, hence, also this product seems to be not appropriate (the correction is too strong). Moreover, the AMSR-E LPRM overestimation and the AMSR-E UoM underestimation can be also found in the Western area (left panel of Figure 5) for which the OWF shows no temporal dynamics and very low values; this is not expected. I would like that these aspects will be better addressed in the paper. For instance, I suggest rescaling all the soil moisture products to a common range and, then, to assess if the overestimation of the AMSR-E LPRM product occurs exactly during the periods for which higher OWF-values are observed (conform to theory).

I found the title of the paper not appropriate. In fact, reading it I was very interested because the assimilation of satellite soil moisture product represents my main field of interest. However, it is clear that this is not a data assimilation study, the title should be changed; e.g. "Effect of dynamic open water fraction on space-based passive microwave soil moisture retrievals".

### Minor Comments

I believe that several points should be better clarified.

1. If the selected 0.25° grid cell contains more than 1 station, the observations are simply averaged (line 1 pag 1017)). If the soil moisture range of the stations is very different, this procedure can provide not reliable results. Please check.
2. Three sets of forcing data are used as input for the two Land Surface Models (line 27-28 pag. 1017). Please specify why are they used? To reduce uncertainties of input data? Which are the differences between the different runs? Are they relevant? Please specify better these issues.

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3. The more detailed analysis is carried out only for the year 2003 but in situ, modelled and satellite soil moisture data are surely available for a much longer period (Figure 7). Why is only 1 year used? I believe that the analysis for a longer period would be more robust (see also above comments).
4. The soil moisture product named AMSR-E UoM is only briefly described (lines 25-26 pag. 1020). As the paper by *Jones et al. (2009)* is a conference proceeding I suggest giving more details on the algorithm used for the derivation of this product.
5. According to the Vegetation Optical Depth (VOD) and the Land Surface Temperature (LST) time series, higher errors/biases in the summer period should be observed. This is exactly the opposite of what it is observed. Please add more explanations for this behaviour.

On these bases, in my opinion, I find that the paper may become worthy of publication on HESS after a major revision.

### Specific Comments/ Technical Corrections (P: page, L: line or lines)

P1014, L24: See also *Brocca et al. (2012)* for a recent study on the assimilation of satellite-derived surface soil moisture data into rainfall-runoff modelling.

P1014, L26: "independent" from what? Please specify.

P1016, L7-9: This sentence is a bit out of context. Please relate it better with the next paragraph.

P1016, L20-23: This sentence is not clear and should be revised. What does "(wooded) grassland and cropland (East) mean? Wooded, grassland or cropland (or all of them)?

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P1017, L15-16: Please add the website where the information on the LSMs can be obtained and downloaded.

P1021, L5, 11: Please be consistent in the use of the acronyms. CLM or CLM2?

P1021, L8: The layer depth in the Noah model is quite high if compared with in situ and, mainly, satellite data. Probably, if the analysis is carried out for a longer period only the CLM2 model could be applied.

Tables 1-2: Please specify the unit of measure of the RMSE. Moreover, I suggest also considering the correlation coefficient as further metric used to evaluate the agreement between the different products.

Figures 1-2: This 2 figures can be easily merged.

Figures 2: Please specify in the caption the meaning of the grids and the dots.

Figures 3, 5-7: All these figures are hard to read.

#### **Additional Reference**

Brocca, L., Moramarco, T., Melone, F., Wagner, W., Hasenauer, S., Hahn, S. (2012). Assimilation of surface and root-zone ASCAT soil moisture products into rainfall-runoff modelling. *IEEE Transactions on Geoscience and Remote Sensing*, in press, doi:10.1109/TGRS.2011.2177468.

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