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Hydrology and Earth System Sciences Discussions

Interactive comment on "Comparing soil moisture retrievals from SMOS and ASCAT over France" *by* M. Parrens et al.

Anonymous Referee #1

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Overview

The study compares the performance of the SMOS and ASCAT surface soil moisture products over France in 2010. Specifically, in situ soil moisture observations from the SMOSMANIA network (21 stations) and modelled surface soil moisture values simulated by the ISBA-A-gs model are used as benchmark. The performance is computed in terms of absolute values and anomalies and also by using the Triple Collocation Method (TCM) approach. Moreover, simple empirical logarithmic regression relationships are developed to obtain surface soil moisture estimates by the brightness temperature values measured by SMOS and additional information about vegetation (Leaf Area Index) and surface temperature. The results of all the comparison are reported in

the paper.

General Comments

The paper is well written and structured and the topic is very relevant. In fact, it represents the first study analyzing the reprocessed SMOS surface soil moisture product that has been recently made available for 2010. The comparison with the ASCAT surface soil moisture product by using both in situ observations and modelled data for the whole France allows a robust and comprehensive evaluation. However, several aspects could be improved before the publication.

An important difference between SMOS and ASCAT is the number of satellite observations that are available for the two sensors. From Table 2, on average, it is equal to 87 and 141 for SMOS and ASCAT, respectively. Missing SMOS data due to the RFI problem can be also higher than 60%. This is a significant aspect that was not clearly underlined in the paper. In fact, if satellite soil moisture observations have to be employed for applications requiring a dense temporal resolution (e.g. hydrological modelling), this could be an important limitation.

The results of the application of the empirical regression equations (Eq. 2) are very interesting because the performance in terms of surface soil moisture retrieval are very good and much improved if compared with the results of the SMOS-L2 product. However, the number of parameters to be estimated is high (6) and also additional information about Leaf Area Index and surface temperature are required. On the other hand, the number of observations used for testing is very low (from Table 3, on average equal to 31). This should be clearly stated because its application over large areas could be difficult and also its relevance can be limited.

Moreover, due to the high number of parameters, the analysis of the regression coefficients reported in Figure 9 can be affected by the mutual correlation among the coefficients. Consequently, the estimation of the spatial pattern of one parameter can be also very different if they are calibrated with a different approach. In my opinion, the possible correlations between parameters have to be carefully investigated.

For the application of the TCM approach, a minimum number of triplets equal to 40 is selected. However, *Dorigo et al. (2011)* suggested that at least 100 triplets have to be used to obtain an unbiased estimated of the variance of residual errors. I am aware that this is depending on the fairly limited time period used in this study (1 year). However, the uncertainty related to these estimates should be quantified to have a better understanding of the results.

In the specific comments, I report a number of further changes and clarifications that should be required.

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

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

P8566, L26: See also *Brocca et al. (2010)* for an example showing the importance of assimilating satellite-derived soil moisture observations for improving flood prediction and forecasting.

P8568, L14: See also *Brocca et al. (2011)* for a recent study analyzing the ASCAT surface soil moisture product performance over different countries in Europe.

P8568, L17: Actually, nowadays the number of in situ soil moisture network is highly increased (see e.g. *Dorigo et al. (2011)*).

P8575, L20: The T_{eff} symbol is not defined.

P8578, L2: The computation of the variance of the residual errors requires the averaging of the residual errors (see e.g. *Dorigo et al. (2010)*).

P8580, L25: Please quantify the number of grid cells for which ASCAT performs better than SMOS (90% ?).

P8582, L11: Change "Mars" with "March". However, this sentence is a repetition and might be removed.

P8586, L6-9: Even though I basically agree with this sentence, i.e., on the need to rescale satellite observations to fit modelled quantities, the SMOS soil moisture product was aimed to obtain an absolute estimate of the volumetric soil moisture that could represent an additional benefit for its data assimilation in meteorological and hydrological modelling (see e.g. *Li et al. (2011)*). Likely, this sentence could be rephrased.

P8587, L1-4: I do not think that the different layer depth investigated by SMOS have a strong influence on the correlation between SMOS soil moisture products and ISBA-A-gs modelled quantities. I would remove this sentence.

Additional References

Brocca, L., Melone, F., Moramarco, T., Wagner, W., Naeimi, V., Bartalis, Z., and Hasenauer, S.: Improving runoff prediction through the assimilation of the ASCAT soil moisture product, *Hydrol. Earth Syst. Sci.*, 14, 1881-1893, doi:10.5194/hess-14-1881-2010.

Brocca, L., Hasenauer, S., Lacava, T., Melone, F., Moramarco, T., Wagner, W., Dorigo, W., Matgen, P., Martínez-Fernández, J., Llorens, P., Latron, J., Martin, C., Bittelli, M. (2011). Soil moisture estimation through ASCAT and AMSR-E sensors: an intercomparison and validation study across Europe. *Remote Sensing of Environment*, in press, doi:10.1016/j.rse.2011.08.003.

Dorigo, W. A., Scipal, K., Parinussa, R. M., Liu, Y. Y., Wagner, W., de Jeu, R. A. M., and Naeimi, V. (2010). Error characterisation of global active and passive microwave soil moisture datasets. *Hydrol. Earth Syst. Sci.*, 14, 2605-2616, doi:10.5194/hess-14-2605-2010.

Dorigo, W. A., Wagner, W., Hohensinn, R., Hahn, S., Paulik, C., Xaver, A., Gruber, A., Drusch, M., Mecklenburg, S., van Oevelen, P., Robock, A., and Jackson, T. (2011). The International Soil Moisture Network: a data hosting facility for global in situ soil moisture measurements. *Hydrol. Earth Syst. Sci.*, 15, 1675-1698, doi:10.5194/hess-15-1675-2011.

Li, B., Toll, D., Zhan, X., and Cosgrove, B. (2011). Improving simulated soil moisture fields through assimilation of AMSR-E soil moisture retrievals with an ensemble Kalman filter and a mass conservation constraint. *Hydrol. Earth Syst. Sci. Discuss.*, 8, 8131-8171, doi:10.5194/hessd-8-8131-2011.

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