Hydrol. Earth Syst. Sci. Discuss., 8, C5199–C5205, 2011
www.hydrol-earth-syst-sci-discuss.net/8/C5199/2011/


Hydrology and Earth System Sciences Discussions



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

**M. Parrens et al.**

jean-christophe.calvet@meteo.fr

Received and published: 10 December 2011

Reviewer #1

The authors thank the anonymous reviewer #1 for his/her review of the manuscript and for the fruitful comments.

1.1 [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.]

Response 1.1

Yes. Calvet and Noilhan (2000) and Pellarin et al. (2006) have discussed the impact of the sampling time on root-zone soil moisture retrievals. They showed that a sampling time of 3 d (or better) is needed. In Tables 2 and 3, the number of satellite data corresponds to the data that were actually used, after RFI filtering. Indeed, in some regions, many SMOS data are lacking due to RFI. On average for the whole of France, for the year 2010, 122 SMOS-L2 and 187 ASCAT morning SSM observations can be used. These numbers correspond to an average effective sampling time of 3 d for SMOS and 1.95 d for ASCAT. Note that for the 9 new stations of the SMOSMANIA network (Table 1), in the Mediterranean region, the average effective sampling time of SMOS-L2 is 5.9 d, only. For the 12 western stations of the network, the SMOS-L2 sampling time (3.4 d) is closer to the average value of 3 d.

1.2 [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.]

Response 1.2

Yes, the use of Eq. (2) requires several SMOS-L1 configurations and this tends to reduce the number of points used for testing the regression. For the 12 western stations and for the 9 new eastern stations, on average, 38 and 19 points are used, respectively (Table 3). The p-value columns of Table 3 permit the assessment of the relevance of the empirical regression Eq. 2. It must be noted that the SMOSMANIA network observations is a long-term monitoring effort and this will allow the consolidation of the results of this study using longer SMOS time series. As shown in this study over France, the application of Eq. (2) over large areas requires additional information provided by a land surface model. A priori, there is no obstacle to the extension of this technique at a global scale. The LAI can be either computed by a land surface model or derived from satellite observations.

1.3 [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.]

Response 1.3

The possible spatial correlations between the parameters of Eq. (2) were investigated. The highest spatial correlations were obtained between A and F ($r^2$=0.41), and between A and B ($r^2$=0.16). All the others squared correlation coefficients were lower than 0.09. Moreover, various configurations of Eq. (2) were tested, such as removing one, two, or three factors from the regression. The spatial distribution of the remaining coefficients were almost not affected. However, decreasing the number of terms of Eq. (2) tended to decrease the regression score and the percentage of grid cells obtaining a significant score. While Eq. (2) presents significant scores for 55% of the grid-cells, removing one, two, or three of the five factors reduced this fraction to 46%, 36%, 31%, on average, respectively.

1.4 [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.

Response 1.4

Yes, we agree that a sufficient number of triplets is needed. The results presented in Fig. 7 need to be consolidated using a longer time series.

1.5 [P8566, L26: See also Brocca et al. (2010) for an example showing the importance of assimilating satellitederived soil moisture observations for improving flood prediction and forecasting.]

Response 1.5

Yes. Brocca et al. (2010) showed the added value on the simulation of a number of flood events, of assimilating a soil wetness index derived from ASCAT in a rainfall-runoff model.

1.6 [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.]

Response 1.6

Yes. Brocca et al. (2011) analysed the performance of the ASCAT SSM over various European regions, including in southern France, using three SMOSMANIA stations (URG, PRG and LZC). For the latter, their results are consistent with the results presented in this study.

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

Response 1.7

Yes. The International Soil Moisture Network (Dorigo et al. (2011)) now gathers data from many stations around the globe, including those from the SMOSMANIA stations (www.ipf.tuwien.ac.at/insitu/).

1.6 [P8575, L20: The Teff symbol is not defined.]

Response 1.6

The Teff symbol corresponds to the effective soil temperature affecting the land surface emission at L-band. In this study, Teff is derived from the surface temperature computed by the ISBA-A-gs model.

1.7 [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)).]

Response 1.7

Yes. The “< >” symbols are lacking in Eq. (6).

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

Response 1.8

In terms of anomaly correlation with the ISBA-A-gs model, ASCAT performs better than SMOS-L2 for 99% of the grid cells. For few areas in the Champagne region (48.81N, 4.02E) and close to Narbonne (42.85N, 2.58E) SMOS-L2 performs better than ASCAT.

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

Response 1.9

Indeed, this sentence is a repetition and will be removed from the final version.

1.10 [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



HESSD

8, C5199–C5205, 2011

modelling (see e.g. Li et al. (2011)). Likely, this sentence could be rephrased]

Response 1.10

Li et al. (2011) have tested the assimilation of AMSR-E soil moisture retrievals, in units of m3m-3, without removing the systematic biases with the land surface model. In practise, this is a difficult exercise as the SSM climatology is model-dependent to a large extent, and the simulated root-zone soil moisture has to be consistent with the surface fluxes (e.g. evapotranspiration). Using a wrong SSM climatology tends to bias the assimilation and to force the analysed variable (e.g. the root-zone soil moisture) towards unrealistic estimates (e.g. of the soil water content available for plant transpiration). This bias problem was discussed by Calvet et Noilhan (2000) and by Reichle and Koster (2004).

1.11 [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-Ags modelled quantities. I would remove this sentence.]

Response 1.11

Yes, this statement should be qualified. More research is needed to analyse the soil sampling depth at L-band and C-band, using a multi-layer soil hydrology scheme .

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, 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., and Bittelli, M.: Soil moisture estimation through ASCAT and AMSR-E sensors: an intercomparison and validation study across Europe. Remote Sensing of Environment, in press,



HESSD

8, C5199–C5205, 2011

Interactive Comment

doi:10.1016/j.rse.2011.08.003, 2011.

Calvet, J.-C. and Noilhan, J.: From near-surface to root-zone soil moisture using year-round data, J. Hydrometeorol., 1(5), 393-411, 2000.

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.: 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, 2011.

Li, B., Toll, D., Zhan, X., and Cosgrove, B.: 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, 2011.

Pellarin, T., Calvet, J.-C., and Wagner W.: Evaluation of ERS scatterometer soil moisture products over a half-degree region in southwestern France, Geophys. Res. Lett., 33, L17401, doi:10.1029/2006GL027231, 2006.

Reichle, R.H. and Koster, R.D.: Bias reduction in short records of satellite soil moisture. J. Geophys. Res, 31, L19501, doi: 10.1029/2004GL020938, 2004.

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 8565, 2011.