Response to comments “A plateau scale soil moisture and soil temperature observatory for quantifying uncertainties in coarse resolution satellite products” by Z. Su, J. Wen, L. Dente, R. van der Velde, L. Wang, Y. Ma, K. Yang, and Z. Hu”, Hydrol. Earth Syst. Sci. Discuss., 8, 243–276, 2011
www.hydrol-earth-syst-sci-discuss.net/8/243/2011/doi:10.5194/hessd-8-243-2011

hessd-8-C164-2011, Comments by W. Wagner
(Received and published: 25 February 2011**)**

In the recent years several global remotely sensed soil moisture data sets derived from active and passive microwave instruments have become available. It is extremely important that independent validation studies are performed over different climatic regions and environmental conditions to characterize the spatiotemporal error of these satellite data. So far, most validation studies have been conducted in temperate climate zones. Therefore this study, which uses in-situ measurements collected over three sites of the Tibetan Plateau, is a very welcome addition to the growing body of literature on this topic. However, there are some methodological problems related to the use of the satellite data that I would like to report. I only refer here to the ASCAT surface soil moisture product which has been developed by the Vienna University of Technology (TU Wien) in cooperation with EUMETSAT.

Response: We wish to thank Dr. Wagner for commenting on our manuscript. We have evaluated all the technical comments below and provide our responses on a point by point basis.

1. The authors use the ASCAT Level 2 surface soil moisture product disseminated by EUMETSAT in near-real-time (130 min after sensing). Because of operational constraints, updating of this product is not straight forward. Therefore, in terms of product accuracy, it lacks behind the off-line soil moisture products produced by TU Wien in the framework of the H-SAF (Satellite Application Facility in Support to Operational Hydrology) and related research projects. For this particular validation study, which is carried out over quite difficult terrain, I would like to recommend using the most recent data version as e.g. used by Brocca et al. (2010).

Response: Thank you very much for this suggestion. We plan indeed to evaluate the TU Wien off-line products once these are made available to us. For the sake of this manuscript, the ASCAT Level 2 data are evaluated because these data are currently used in the operational forecasts by the European Centre for Medium-range Weather Forecasts (ECMWF) and quantification of the uncertainty of these products on the Tibetan plateau are therefore urgently needed for better understanding the source of uncertainties in some model outputs (e.g. profile soil moisture).

2. The ASCAT surface soil moisture data are provided in degree of saturation (0-1). Multiplying the degree of saturation by the porosity (if expressed in m3m-3) gives a direct estimate of the volumetric soil moisture content. Global maps of soil hydrologic properties are unfortunately often not very accurate, which is our main reason for distributing the ASCAT soil moisture data in degree of saturation instead of volumetric soil moisture (which is the quantity usually preferred by the other satellite teams). The disadvantage of this approach is that the users of the data are responsible for correctly converting the ASCAT degree of saturation into volumetric soil moisture data. In the case of the Naqu test site, the ASCAT data converted by the authors using a soil database of FAO (2003) take on values between 0.5 and 0.8 m3m-3 which is physically not possible. So please note that this not an error of the ASCAT data but must be due to some error in the FAO database or in the conversion. Overall, I would recommend that the authors employ conversion methods as e.g. used by Pellarin et al. (2006) or Brocca et al. (2010).

Response: We thank Dr. Wagner for pointing out this important issue. Indeed several conversion methods could be used including the Cumulative Distribution Function matching method (e.g. Reichle and Koster, 2004). We have reevaluated the results and have studied in details the soil texture information used to convert ASCAT relative to volumetric soil moisture and have changed to use the porosity information from the Reynolds data for consistency because several retrievals and models (e.g. GLDAS, and AMSR-E data as evaluated here) also use it.

http://www.ngdc.noaa.gov/ecosys/cdroms/reynolds/reynolds/reynolds.htm#porosity

The results show much better agreements in Naqu site as shown below (Fig. R1). For the Maqu site, the soil texture information was consistent (Fig. R2). We agree that a site specific conversion would result in better agreement between ASCAT and in-situ observations when local soil information is used, however it is not straight forward to apply this method to regional/global scale where such detailed information is not available. We therefore prefer to use the porosity information. Other method could be a CDF matching (e.g. Reichle and Koster, 2004) but needs also local or approximate observations.

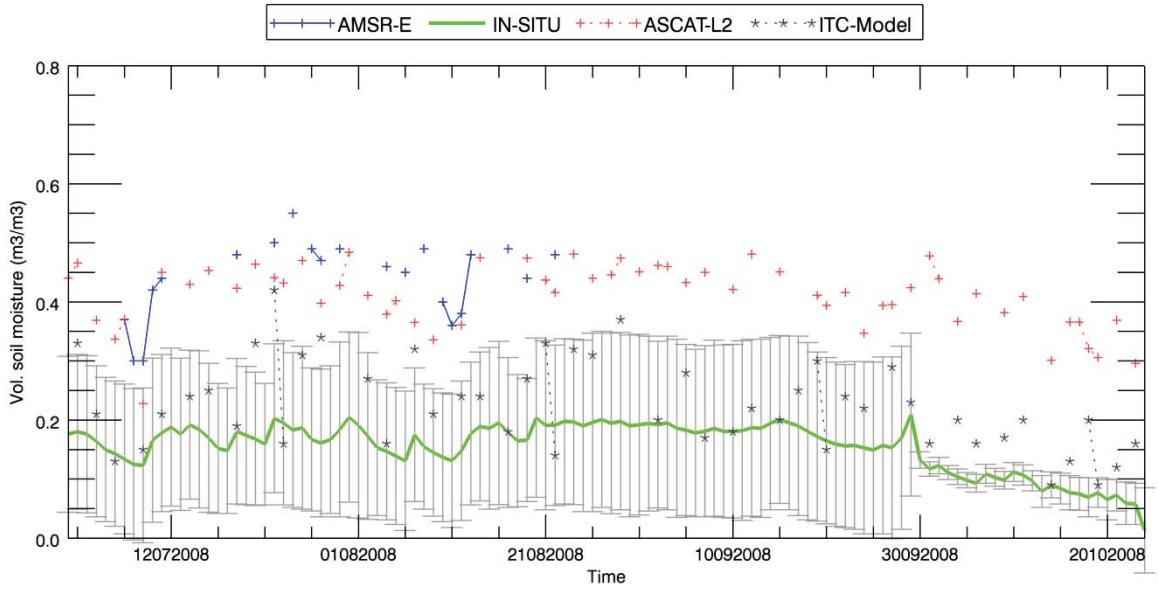

Figure R1. Comparison for Naqu site (all rescaled to volumetric soil moisture)

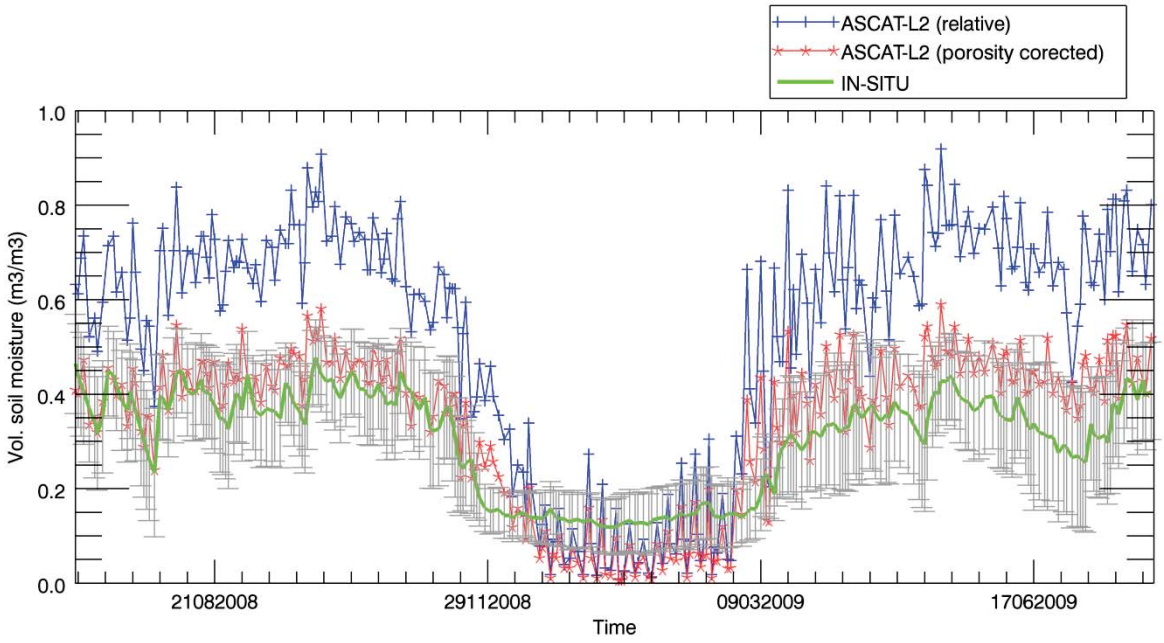

Figure R2. Comparison of ASCAT-L2 relative soil moisture (in terms of degree of saturation with respect to soil porosity) and volumetric soil moisture (rescaled with porosity) for Maqu site.

Ref: C.A. Reynolds, T. J. Jackson, and W.J. Rawls. 1999. Estimating Available Water Content by Linking the FAO Soil Map of the World with Global Soil Profile Databases and Pedo-transfer Functions. Proceedings of the AGU 1999 Spring Conference, Boston, MA. May 1-June 4, 1999.

3. Any soil moisture measurement technique that relies on the large dielectric contrast between a dry and wet soil cannot provide soil moisture estimates when the soil is frozen. So neither active or passive microwave measurements, nor the ECH20 probes used by the authors in their in-situ networks, can be used during the winter period. It is therefore physically wrong to conclude that ASCAT and AMSR-E under- or overestimate the measurements of the ECH20 probes in winter. As noted by the authors, there are frozen soil flags in the satellite data. In the case of ASCAT this is however only a probability flag which shall be replaced if more accurate information about the freeze/thaw status is available.

Response: We agree to a certain extent to this comment. It is true that neither active nor passive microwave sensors nor the ECH2O probes can be used to measure the total water content when the soil is frozen. Nevertheless, in a frozen soil, not all water molecules are necessarily frozen, therefore, these sensors should theoretically still be able to measure the liquid water content. Since both the in-situ and microwave sensors provide dielectric measures, they can be compared to each other. It should also be noted that in the Maqu site, measurements from 20 locations are used, which cannot be assumed to have the same freeze/thaw dynamics due to the differences in altitudes and soils. The discrepancy in Fig. 6 (e.g. in winter period from mid November to mid April) in our manuscript must be understood in the uncertainties of the used methods and assumptions in retrievals.

References

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