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An assessment of SMOS version 6.20 products compared to ASCAT, ERA-Interim LAND and ISMN soil moisture data using the Quadruple Collocation (QC) technique

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A comparison study has been performed between two remotely sensed surface soil moisture datasets: one from the L-band Soil Moisture and Ocean Salinity (SMOS) radiometer (available through an ESA Category 1 project) and one from the C-band Advanced Scatterometer ASCAT onboard METOP (available through the EUMETSAT H-SAF project). The satellite retrievals have been compared to the modeled ERA-Interim Land soil moisture datasets and to the ground measurements of moisture gauges, belonging to the International Soil Moisture Network (ISMN). The data acquired during years from 2010 to 2012 have been considered. The SMOS-derived soil moisture content (SMC), produced by the processors (new version 6.20), will be used. As for ASCAT-derived SMC, since each data represents a soil moisture relative index between 0 and 100% (i.e., driest and wettest conditions), the ASCAT retrievals have been converted into volumetric soil moisture by specific strategies to obtain a reasonable comparison. The datasets have been collocated in time in order to minimize the temporal mismatch, while the nearest neighbor has been used for the space collocation; the in-situ probe has been up-scaled to the satellite resolution through averaging of the station measurements within the satellite field of view. Then, the retrievals have been compared using the Quadruple Collocation (QC) technique [1]. Such method is useful to evaluate unambiguous estimates of the error standard deviation of four systems in a same reference scale. As QC require a constant mean of the considered quantity (i.e., stationarity), the mean spatial pattern was estimated by averaging the SMC maps over time and removed. On the other side, two approaches was adopted for the seasonal variability of the soil moisture. The first one considers it as a temporal drift to be removed (i.e., looking just at the anomalies of soil moisture), while the second approach assumes the seasonal variability as part of the random variability which is retained in the data. The latter assumption can be done since the period of analysis covers almost three years of data.
Then, assuming uncorrelated noise with zero mean, the QC technique was implemented and the noise variances of the products will be estimated. In order to also point out the difference due to the processor version, the results will be also compared with those already obtained considering for the same analysis the SMOS data produced by the processor version 5.51 [1]. In this latter work, ERA-Interim Land showed the lower error standard deviation in the overall dynamic range or anomalies analysis, while the in-situ data, up-scaled at the satellite resolution, did not present a very good performances, which remained stable for both the cases. Such effect can be addressed to the fact that the we did not consider single soil moisture probes, but we evaluated the capability of a point wise measurement to reproduce the average soil moisture within an area equal to the field of view of the satellite sensors. Nevertheless, ground probes remain the only reliable source of point measurements. As for the satellite products, SMOS presented a better behavior when the whole variability of the soil moisture has been considered, but ASCAT performed better in looking the temporal anomalies.

[1] Pierdicca, N., Fascetti, F., Pulvirenti, L., Crapolicchio, R., Munoz-Sabater, J., Quadruple Collocation Analysis for Soil Moisture Product Assessment, 2015, IEEE Geoscience and Remote Sensing Letters, vol. 12, issue 8, pp.1595-1599, doi:10.1109/LGRS.2015.2414654.