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Mitigation of biases in SMOS Level 2 soil moisture retrieval algorithm

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The Soil Moisture and Ocean Salinity (SMOS) mission of the European Space Agency (ESA) relies on the L-band Microwave Emission of the Biosphere (L-MEB) radiative transfer models to retrieve soil moisture (SM). These models require, as input, parameters which characterize the target like soil water content and temperature. The Soil Water Volume at Level 1 (SWVL1) from the European Centre for Medium-Range Weather Forecast (ECMWF) is used in the SMOS Level 2 SM algorithms as both an initial guess for SM in the iterative retrieval process and to compute fixed contributions from the so called "default" fractions. In case of mixed fractions of nominal (low vegetation land) and forest, retrieval is performed over one fraction while the contribution of the other is assumed to be fixed and known based on ECMWF data. Studies have shown that ECMWF SWVL1 is biased when compared to SMOS SM and represents values at a deeper layer of soil ($\sim$7 cm) than that represented by SMOS ($\sim$ 2 to 5 cm). This study uses a well know bias reduction technique based on matching of the Cumulative Distribution Functions (CDF) of the two distributions to help reduce the biases. Early results using a linear matching method provide very encouraging results.
A complication with respect to performing CDF matching is that SMOS SM values are not available where they are needed, i.e. over the default fractions. In order to remedy this, we treat mixed fractions as homogeneous targets to retrieve SM over the whole target. The obtained values are then used to derive the CDF matching coefficients. A set of CDF coefficients derived using average and standard deviation of soil moisture values for 2014 has been used in reprocessing SMOS data for 2014 and 2015, as well as over selected sites (with in-situ data) over a longer period. The 2014 was selected due to its lower Radio Frequency Interference (RFI) contamination in comparison with other years.
The application of CDF coefficients has lead to a wetter SM for many pixels (both in 2014 and 2015), where pixels are close to forested areas. It has also led to improvements in the frequency of successful retrievals for these pixels. These results are in agreement with our current state of knowledge that SMOS is dryer than expected near forests, and hence are encouraging and in support of future incorporation of CDF matching in the operational processor. We also discuss the performances of the CDF matched SM values in comparison with the operational ones over a number of sites where in-situ data is available, like Soil Climate Analysis Network (SCAN) in North America.