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SMOS SSS uncertainties associated with errors on auxiliary parameters

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The European Soil Moisture and Ocean Salinity (SMOS) mission, aimed at observing sea surface salinity (SSS) from space, has been launched in November 2009. The L–band frequency (1413 MHz) has been chosen as a tradeoff between a sufficient sensitivity of radiometric measurements to changes in salinity, a high sensitivity to soil moisture and spatial resolution constraints. It is also a band protected against human-made emissions.

But, even at this frequency, the sensitivity of brightness temperature (TB) to SSS remains low requiring accurate correction for other sources of error. Two significant sources of error for retrieved SSS are the uncertainties on the correction for surface roughness and sea surface temperature (SST).
One main geophysical source of error in the retrieval of SSS from L-band TB comes from the need for correcting the effect of the surface roughness and foam. In the SMOS processing, the wind speed (WS) provided by the European Centre for Medium-Range Weather Forecasts (ECMWF) is used to initialize the retrieval process of WS and Sea Surface Salinity (SSS). This process compensates for the lack of onboard instrument providing a measure of ocean surface WS independent of the L-band radiometer measurements. Using multi-angular polarimetric SMOS TBs, it is possible to adjust the WS from the initial value in the center of the swath (within $\pm$300km) by taking advantage of the different sensitivities of L-band H-pol and V-pol TBs to WS and SSS at various incidence angles. As a consequence, the inconsistencies between the MIRAS sensed roughness and the roughness simulated with the ECMWF WS are reduced by the retrieval scheme but they still lead to residual biases in the SMOS SSS. We have developed an alternative two-step method for retrieving WS from SMOS TB, with larger error on prior ECMWF wind speed in a first step. We show that although it improves SSS in some areas characterized by large currents, it is more sensitive to SMOS TB errors in the vicinity of coasts.

The SST used in the SMOS SSS retrievals is from ECMWF Meteorological Archival and Retrieval System (MARS) archive which uses Operational Sea Surface Temperature and Sea Ice Analysis (OSTIA) SST. There are noticeable differences between the OSTIA SST and Reynolds SST product derived from satellite and in situ SST. We estimate the SMOS SSS uncertainties due to uncertainties in SST and WS, especially in the tropical Pacific Ocean where there are significant and sometimes coupled variations of SST and WS due to strong seasonal upwelling, zonal surface currents and the development of tropical instability waves.