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Towards an optimal fusion of SMOS and Aquarius SSS data

Sebastien Guimbard (1,2), Marta Umbert (1,2), Antonio Turiel (1,2), Marcos Portabella (1,2)

(1) Institut de Ciències del Mar (ICM - CSIC), Department of Physical and Technological Oceanography, Barcelona, Spain (sguimbard@icm.csic.es, +34932309555), (2) SMOS Barcelona Expert Centre, Barcelona, Spain

The European Space Agency (ESA) Soil Moisture and Ocean Salinity (SMOS) mission was launched in November 2009, carrying onboard the MIRAS instrument, a novel fully-polarimetric L-band radiometer which estimates the surface brightness temperature (TB) by means of two-dimensional aperture synthesis interferometry. In June 2011, the National Aeronautics and Space Administration (NASA) and Argentina's Space Agency (CONAE) launched the Aquarius/SAC-D mission carrying onboard an L-band real aperture radiometer together with an L-band scatterometer. These two missions provide global coverage of sea surface salinity (SSS) with different repetition rates, spatial resolutions and accuracies. While SMOS has a wider coverage and higher spatial resolution, Aquarius has higher radiometric accuracy. To achieve the challenging mission requirements at weekly (0.1 psu at 200 x 200 km resolution) and monthly (0.1 psu at 100 km x 100 km resolution) scales, fusion of SMOS and Aquarius SSS is required.

A prerequisite for a successful data fusion is to perform a comprehensive intercalibration of the different SSS data sources. The SMOS and Aquarius instrument concepts are very different and, as such, we expect different calibration strategies as well as different impact of external noise contaminations (e.g., Sun, land-sea contamination, radio frequency interference, etc.). These differences will of course produce differences in the SMOS and Aquarius SSS retrievals. Despite these differences, both instruments measure the brightness temperature of the ocean surface at the same frequency (1.41 GHz) and polarizations (except for the Stokes 4 parameter which is not measured by Aquarius). As such, the theoretical relation between the brightness temperature and the different sea surface geophysical parameters (including SSS) is the same for both missions. In consequence, one would expect that by doing proper calibration and external noise corrections/filtering, SMOS and Aquarius SSS could be straightforwardly merged. However, this is not true since SMOS and Aquarius SSS retrieval algorithms differ and such differences lead to non-negligible differences in the derived SSS maps. This can be shown by simply analyzing the differences between the different products (i.e., different SSS retrieval algorithms) available for each mission separately.

In this work, a thorough assessment of the impact of using different auxiliary data (e.g., sea surface winds: ECMWF, NCEP, Aquarius scatterometer; sea surface temperature: Reynolds, OSTIA), different forward models (galactic, dielectric constant, and roughness models), and different retrieval approaches (multiparametric Bayesian inversion, direct retrievals by forward propagation to TB corrections for TEC, galaxy, and roughness) on the final SSS maps is carried out. This analysis sets the grounds for an optimal fusion of SMOS and Aquarius SSS data.