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Error attribution and validation of SMOS high-level salinity products with Argo data

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In the context of the E-AIMS project (7FP Project No. 284391), the role and suggested improvements of the Argo array in the validation of SMOS sea surface salinity (SSS) have been investigated. Here, a summary of the main results is shown and discussed.

The Argo array continues to be the sole component of the ocean observing system to provide routine observations of temperature and salinity profiles at global scale with a time sampling period of about ten days. The observations provided by an Argo profiler are publicly available a few days from being taken (Real Time Mode) after application of automatic quality control filters. Scientific quality data (Delayed Mode) is generated after a human supervised quality control.

In this study, the highest quality, delayed mode, near-the-surface data are being used to validate the SSS Level 3 and Level 4 products generated by the SMOS Barcelona Expert Centre (http://cp34-bec.cmima.csic.es). The products being validated here are the weighted binned average (L3), an Optimal Interpolation (OI), and a data fused product exploiting the spatial variability of OSTIA SST. An Argo profile is considered if its quality flags of position and time are equal to one (good), two (probably good), five (value changes) or eight (value interpolated). However, temperature, salinity and pressure data are used only if their quality flags are equal to one (good). The uppermost (but deeper than 0.5 m) salinity measurement is taken as an approximation of the in-situ SSS, but only if the salinity profile allows a robust interpolation of the salinity at 7.5 m (this additional requirement is introduced to ensure that the salinity profile is properly sampled near the surface). At the moment of performing this study, the main drawbacks have been the lag in the Delayed Mode processing, and the lack of salinity observations in the first five meters below the ocean surface. While 5500 profiles in Delayed Mode were available for January 2011, about 1000 were available for December 2013. Valid observations in the top five meters have been 2600 and 235, respectively.

Comparison between Argo data and SMOS illustrates some of the systematic deficiencies of the salinity retrieval approach. Among them, land-sea contamination and model deficiencies at low and high temperatures. Moreover, Argo data may illustrate some deficiencies one of the auxiliary fields, namely the Sea Surface Temperature, used in the retrieval approach. When the Argo and SMOS match-up pairs data are properly filtered, the mean and standard deviation of the differences in the latitudinal band of 60S-60N are (L3/OI/L4): -0.00/-0.01/-0.06 and 0.49/0.29/0.28. When match-up pairs are limited to the 30S-30N band the mean and standard deviation are -0.02/-0.03/-0.12 and 0.37/0.23/0.23. While these figures have been found to be robust when Argo observations are taken deeper than five meters, their differ when Argo data is restricted to the first four meters of the ocean. However, more upper-surface measurements are required to elucidate the robustness of these changes.