Impact for the validation of satellite observations: Sea Surface Salinity

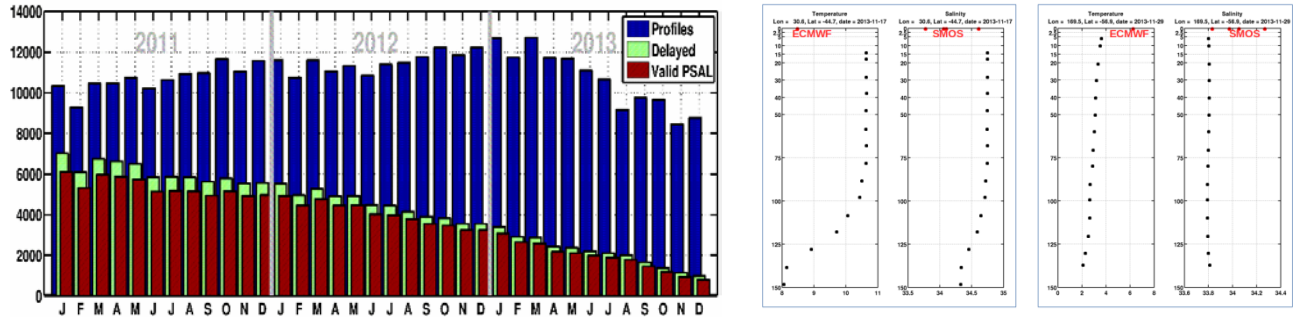
Authors: Joaquim Ballabrera (CSIC)

Description of impact study carried out (overview, objectives, role of Argo): The overall objectives of this task have been: 1) review the state of the art of SSS validation; 2) study how changes in the sampling properties of Argo would have in the validation of SSS; and 3) provide a set of recommendations for the evolution of Argo. The Argo array continues to be the sole component of the Global Ocean Observing System able to routinel and monitor in-situ global salinity variability. The observations acquired by an Argo profiler are available few days later (Real Time Mode) after an automatic Quality Control (QC) process. Scientific quality data (Delayed Mode) are generated after a human-supervised QC. Three remote sensing SSS products have been validated here. They are nine-day averages (every three days) defined on a 0.25 degree grid. The three products are: i) Binned product (called L3) constructed from the weighted average of all the Level 2 SSS retrievals produced by ESA; ii) Optimal Interpolation product (called OI); and iii) Data-fusion product (called L4) merging L3 SSS with the OSTIA sea surface temperature. The period is the reprocessed period: 2011-2013. These products are generated and distributed by SMOS-BEC (http://cp34-bec.cmima.csic.es/). The results have been provided as final deliverable of this task (D4.443).

Results: The validation of the SMOS SSS products has relied on the match-up pairs of gridded SMOS SSS maps and the in-situ SSS derived from Argo salinity profiles. The uppermost valid salinity observation has been used as an estimate of the in-situ SSS if three different interpolation schemes give the same value at 7.5 m depth. Only scientific quality (Delayed Mode) data is used to validate SMOS. Pressure, temperature and salinity Argo measurements have been if their QC flag is equal to '*good*'. Around 5500 Delayed Mode profiles were available on January 2011, but less than 1000 were available on December 2013 (Figure below, left). Salinity observations in the top five meters have been 2600 and 235, respectively. The validation activities have illustrated some of the systematic deficiencies of the current remote sensing salinity retrieval: land-sea contamination and model deficiencies at low and high temperatures. Moreover, Argo data have revealed some deficiencies in the Sea Surface Temperature used in the retrieval approach (Figure below, right). 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, mean and standard deviation are -0.02/-0.03/-0.12 and 0.37/0.23/0.23. The negative bias means SMOS fresher than Argo. These values are consistent when Argo observations are taken deeper than five meters. However, bias changes sign when Argo data are restricted to the first four meters of the ocean. More upper-surface measurements are required to elucidate the robustness of these changes.

Conclusion: Robust estimates of the difference between SMOS and Delayed Argo have been found. The standard deviation of the differences is below 0.3. At the moment of this study, the main drawbacks have been the lag in the Delayed Mode processing, and lack of salinity observations in the top four meters of the ocean.

Figures:



Left: Number of Argo profiles by month during 2011-2013. Right: Examples of SST values used to infer SMOS SSS and the corresponding SMOS retrieval and in-situ salinities. Errors in auxiliary fields may lead to erroneous SSS estimates.