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Improving SMOS retrieved salinity: characterization of systematic errors in reconstructed and modelled brightness temperature images

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The Microwave Imaging Radiometer using Aperture Synthesis (MIRAS) instrument onboard the Soil Moisture and Ocean Salinity (SMOS) mission was launched on November 2nd, 2009 with the aim of providing, over the oceans, synoptic sea surface salinity (SSS) measurements with spatial and temporal coverage adequate for large-scale oceanographic studies.
For each single satellite overpass, SSS is retrieved after collecting, at fixed ground locations, a series of brightness temperature from successive scenes corresponding to various geometrical and polarization conditions. SSS is inversed through minimization of the difference between reconstructed and modeled brightness temperatures. To meet the challenging mission requirements, retrieved SSS needs to accomplish an accuracy of 0.1 psu after averaging in a 10- or 30-day period and 2ºx2º or 1ºx1º spatial boxes, respectively.
It is expected that, at such scales, the high radiometric noise can be reduced to a level such that remaining errors and inconsistencies in the retrieved salinity fields can essentially be related to (1) systematic brightness temperature errors in the antenna reference frame, (2) systematic errors in the Geophysical Model Function – GMF, used to model the observations and retrieve salinity – for specific environmental conditions and/or particular auxiliary parameter values and (3) errors in the auxiliary datasets used as input to the GMF. The present communication primarily aims at adressing above point 1 and possibly point 2 for the whole polarimetric information i.e. issued from both co-polar and cross-polar measurements.
Several factors may potentially produce systematic errors in the antenna reference frame: the unavoidable fact that all antenna are not perfectly identical, the imperfect characterization of the instrument response e.g. antenna patterns, account for receiver temperatures in the reconstruction, calibration using flat sky scenes, implementation of ripple reduction algorithms at sharp boundaries such as the Sky-Earth boundary.
Data acquired over the Ocean rather than over Land are prefered to characterize such errors because the variability of the emissivity sensed over the oceanic domain is an order of magnitude smaller than over land. Nevertheless, characterizing such errors over the Ocean is not a trivial task. Even if the natural variability is small, it is larger than the errors to be characterized and the characterization strategy must account for it otherwise the estimated patterns will unfortunately vary significantly with the selected dataset.
The communication will present results on a systematic error characterization methodology allowing stable error pattern estimates. Particular focus will be given to the critical data selection strategy and the analysis of the X- and Y-pol patterns obtained over a wide range of SMOS subdatasets. Impact of some image reconstruction options will be evaluated. It will be shown how the methodology is also an interesting tool to diagnose specific error sources. Criticality of accurate description of Faraday rotation effects will be evidenced and latest results about the possibility to infer such information from full Stokes vector will be presented.