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Improved satellite sea surface salinity maps to further the understanding of the Southern Ocean dynamics

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The Southern Ocean (SO), directly connected to the global ocean through the Atlantic, the Indian and the Pacific basins, may be responsible for transporting vast amounts of salt, heat and nutrients across basins, which in turn might have a direct influence in the global climate. According to the Coupled Model Intercomparison Project Phase 5 (CMIP5) predictions, a freshening around the Antarctic coast which can change the ocean dynamics around the Antarctic Peninsula is possible. However these predictions are hampered by the limited number of in situ temperature and salinity observations. the development of reliable satellite observation systems for sea surface salinity (SSS) and sea surface temperature at high southern latitudes can therefore contribute to improve the CMIP5 inter-annual variability and trends, as well as the understanding of the dynamics associated with the SO seasonal and intra-seasonal variability.

The Barcelona Expert Centre (BEC) has generated an enhanced SO SSS dataset (2011-2018) from the Soil Moisture and Ocean Salinity (SMOS) mission. This SSS product uses an innovative SSS retrieval approach, known as debiased non-Bayesian scheme [1], which has proven to increase the satellite capabilities to observe SSS dynamics in the Arctic and sub-Arctic regions [2]. The new SMOS SSS product is validated in the SO region against both in situ and an ocean reanalysis (ARMOR), model (GLORYS), and climatology (WOA) data. The in situ database comprises a suite of Fiducial Reference Measurements (FRM) which include ARGO floats, marine mammals observant and ship based observations (e.g., CTD, TSG, etc.) which have been collected by different research vessels (e.g. the Astrolabe, Hesperides, Agulhas, Agulhas II, and Akademik Treshnikov) over their Southern Ocean crossings. We have assessed the SMOS salinity fields in three different bands: Subantarctic, Antarctic and Subpolar bands. ARMOR, GLORYS, WOA and SMOS are in good agreement in the Subantarctic and Antarctic bands (with SMOS discrepancies of +/-0.1 psu). In the Subpolar bands SMOS is in better agreement with GLORYS than with ARMOR and WOA. In this region both, GLORYS and SMOS show fresher salinity fields and larger salinity variations than WOA and ARMOR. Regarding comparison with TSG, SMOS is able to capture fresh and saline plumes in the Weddell Sea, which are not captured by any of the other analysed products (ARMOR, GLORYS and WOA).

References:

[1] Olmedo, E., Martinez, J., Turiel, A., Ballabrera-Poy, J., Portabella, M. "Debiased non-Bayesian retrieval: A novel approach to SMOS Sea Surface Salinity", 2017, Remote Sens. Environ.,193, 103-126.

[2] Olmedo, E., Gabarró, C., González-Gambau, V., Justino Martínez, J., Ballabrera-Poy, J., Turiel, A., Portabella, M., Fournier, S. and Tong Lee, T. "Seven Years of SMOS Sea Surface Salinity at High Latitudes: Variability in Arctic and Sub-Arctic Regions", 2018, Remote Sensing 10(11):1772 , DOI: 10.3390/rs10111772