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Enhanced SMOS Sea Surface Salinity in the Western Mediterranean Sea: accuracy and mesoscale structures description

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The Mediterranean Sea is a hot spot for climate change. The water balance in the basin is characterized by an excess of evaporation over precipitation and river runoff, which is compensated by the entrance of fresher water from the Atlantic. This Atlantic water, AW, which spreads through the Mediterranean Sea, determines the surface circulation.

In the Algerian Basin, AW forms an unstable current that generates fresh-core coastal eddies that propagate downstream, eventually offshore. The eddy activity in the region enhances the mixing of the recently entered AW with the saltier resident water, strongly affecting the spatial distribution of salinity and, therefore, playing a major role in the surface circulation of the Mediterranean Sea. Besides, during winter, in the North Western Mediterranean, deep water convection occurs under the influence of dry and cold northerly winds.

In such a context, data from Soil Moisture and Ocean Salinity (SMOS) European Space Agency (ESA)'s mission spanning more than 8 years can help to gain a better understanding of the Sea Surface Salinity (SSS) dynamics in the Mediterranean Sea. Unfortunately, this critical area is strongly affected by Radio Frequency Interference and systematic biases due to the coast contamination (also called Land-Sea contamination). Both effects impair SMOS SSS retrieval in these areas.

A new methodology using a combination of debiased non-Bayesian retrieval, DINEOF (Data Interpolating Empirical Orthogonal Functions) and multifractal fusion has been used to improve to improve SMOS SSS fields over the North Atlantic Ocean and the Mediterranean Sea. The debiased non-Bayesian retrieval mitigates the systematic errors produced by the Land-Sea contamination. Besides, this retrieval improves the coverage by means of multiyear statistical filtering criteria. This methodology allows obtaining SMOS SSS fields in the Mediterranean Sea. However, the resulting SSS suffers from a seasonal (and other time-dependent) bias. This time-dependent bias has been characterized by means of specific Empirical Orthogonal Functions (EOFs). Finally, high resolution remotely-sensed Sea Surface Temperature (SST) maps have been used for improving the spatial and temporal resolution of the SMOS SSS maps.

The presented methodology practically reduces the error of the previous SMOS SSS in the Mediterranean Sea by half. As a result, the SSS dynamics described by the new SMOS maps in the Algerian Basin and the Balearic Front agree with the one described by the TRANSMED in situ SSS time series, and the mesoscale structures described by SMOS in the Alboran Sea and in the Gulf of Lion coincide with the ones described by the high resolution SST satellite images.