GEOPHYSICAL RESEARCH LETTERS

Supporting Information for "Retrieval of eddy dynamics from SMOS Sea Surface Salinity measurements in the Algerian Basin (Mediterranean Sea)"

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Introduction

This auxiliary material provides additional examples of the comparison of SMOS Sea Surface Salinity (SSS) maps with Sea Surface Height (SSH). These examples are composed of an additional figure and a movie depicting the propagation of Algerian eddies as seen in SSS and SST

Text S1. Description of the temporal evolution of two Algerian eddies

The westernmost fresh-core anticyclonic eddy shown in Figure 2 of the Manuscript was tracked from January 3 to March 4 with SSS and SSH maps as shown in Movie M1. This eddy propagated downstream along the Algerian Coast. On 18 January 2013 a smaller eddy started to detach from the coastal eddy although this signature is only evident in the Okubo-Weiss parameter and cannot be clearly observed in SSS until 21 January 2013 and as close SSH contours until 24/25 January 2013. Since then the coastal eddy continued to propagate eastwards while the open sea eddy detached from it started to propagate westwards/southwestwards. The SSS signature of these Algerian eddies and its evolution was found to be in agreement with SSH maps. Nevertheless, some flaws could be observed: the time variability of SSS maps was sometimes too large and some potential artifacts may still be present, e.g. the coastal minimum of salinity located $\sim$ 2°E around 15 February 2013. Both vortex exhibited temporal variations of amplitude in SSS as it propagated. The vortex that split from the coastal eddy propagated westwards until it disappeared definitively, while it was still visible in SST and SSS. Notice, however, that the SSS signature of this westwards propagating eddy reduced and probably become close to the sensitivity limit of the present generation of SMOS products, which could explain the lack of continuity in its tracking. On the other side, the coastal eddy also disappeared on 19 February 2013 and 22-23 February 2013 although it reappeared.

Text S2. Description of the methodology used to build SMOS SSS maps

SMOS SSS maps have been constructed from L1 SMOS data downloaded from ESA. First, Brightness Temperatures (TB) have been geolocalized in a Lambert Azimutal grid at 25 km and have been downloaded from the antenna to the Bottom of Atmosphere (BOA) reference frame using the dielectric constant model proposed in Klein and Swift [1977]. Then, resulting data were corrected for the galactic [Tenerelli et al., 2008], Sun glint [Reul et al., 2007] and roughness [Guimbard et al., 2012]) contributions and SSS have been derived from every resulting TB. Only SSS values between 0 and 50 PSU have been retained. The resulting TB have been processed following the methodology explained in Olmedo et al. [Enhanced retrieval of the geophysical signature of SMOS SSS maps, submitted to Rem. Sens. Env.]. This method is as follows. The statistical distributions of SSS acquired under the same conditions (location, antenna coordinates, orbit direction) have been derived and their second, third and fourth moments have been used to asses their significance and to define filtering criteria. Once a salinity distribution has been considered as significative, its modal value has been taken as the representative value of the corresponding class. All the salinities belonging to a given class have been corrected accordingly with its representative value before being used to produce each SSS daily map. Only SSS of classes considered as significative have been used. This approach provides SSS anomalies which are free of biases, particularly, close to the coast. Absolute values are then retrieved adding the annual climatology from the World Ocean Atlas (WOA) [Zweng et al., 2013]. Daily L3 SSS maps at 0.25 × 0.25° resolution have been, then, generated by means of a classical scheme of objective analysis applied over time periods of 9-days using the same influence radii as those used in the WOA SSS climatology, i.e. (321 km, 267 km and 175 km). Finally, Reynolds SST at 0.25 × 0.25° spatial resolution and daily temporal scale [Reynolds et al., 2007] have been used to reduce the noise and increase the time resolution of the L3 SSS maps using the vectorial approach of the multifractal fusion method presented at [Olmedo et al., 2016] The method imposes that the SSS and SST gradients are related by means of a matrix which is a composition of a scaling factor and a rotation. Although the methodology has some limitations when it is applied in a global map (due to boundaries problems when integrating the reconstructed gradient of SSS), these limitations are mitigated here by applying the algorithm locally (to the Western Mediterranean only).

Movie S1.

Temporal evolution of SMOS SSS maps with the SSH contours over-plotted. Black dots connected by a thin black line indicates the central position of the two eddies mentioned in the text.

Data set S1.

Sea Surface Salinities generated from SMOS measurements and Reynolds SST data in NetCDF format.

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