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Up to which extent can we characterize ocean eddies using present-day altimetric products?

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The most common methodology used to detect and characterize mesoscale eddies in the global ocean is to analyze altimetry based sea level gridded products with an automatic eddy detection and tracking algorithm. Although the different algorithms differ in the details of the methodology most of them rely on the identification of sea level anomalies as the signature of the eddies. However, a careful look at the altimetry track location shows that their separation is often larger than the Rossby radius of deformation. This implies that gridded products based on the information obtained along-track would potentially be unable to characterize the mesoscale variability and, in particular, the eddy field.

In this study, we analyze up to which extent sea level gridded products are able to characterize mesoscale eddies with a special focus on the North Atlantic and the Mediterranean Sea. In order to perform this task, our approach has been to generate synthetic sea level anomaly (SLA) maps using along-track data extracted from realistic high resolution ocean model simulations. Then we apply an eddy detection and tracking algorithm to the gridded synthetic product and to the original model fields and compare the characteristics of the eddy fields.

As a "ground truth" we use two high-resolution numerical simulations, one for the Mediterranean Sea (NEMOMED36 , 10 years with an horizontal resolution of 1/36 of a degree and 75 vertical levels) and another for the North Atlantic Ocean (NATL60, one year with an horizontal resolution of 1/60 of a degree and 300 vertical levels). The mapping algorithm we developed to interpolate along-track data is formally the same used by AVISO. A careful comparison between the results obtained applying the algorithm to real along track data and the AVISO maps shows very little differences giving confidence to the methodology.

Our results suggest that gridded products largely underestimate the density of eddies capturing only between 10- 25% of the total number of eddies. Also, the eddies obtained from the gridded products are 3-4 times bigger and with amplitudes 2-3 times larger. Moreover, the results show that it is not simply a matter of not capturing the smaller eddies but that the gridded product misinterprets the actual eddy field. We have estimated that in the Mediterranean Sea (North Atlantic Ocean) around 75% (90%) of eddies of eddies present in the real ocean fields are not detected in the reconstructed fields. From the eddies detected (25% (10%) of the total amount), around a 1.5% (1%) are false detections (these eddies are created by the optimal interpolation scheme), 9% (3%) correspond to one eddy in real fields and the remaining percentage has more than one real eddy inside (the interpolation scheme is merging several eddies into one). Moreover, in those cases where an eddy is identified in the altimetry as a single eddy from the model, their radius and amplitudes significantly differ from the real characteristics for eddies with a radius smaller than 60 km (100 km), that represent around 90% of them.