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Detection and tracking of mesoscale eddies in the Algerian Basin from altimetric data and in-situ measurements

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The circulation of the Western Mediterranean Sea (WMED) is dominated by highly variable and inhomogeneous mesoscale circulation. It is affected by the formation of eddies (AEs), mainly in the Algerian Basin. These strong and large propagating structures can be both cyclonic and anticyclonic. Due to the short persistence of cyclonic eddies, only anticyclonic ones are considered in this work.
In order to investigate the spatial and temporal distribution of eddy generation and their respective paths in the WMED, we use an automated detection and tracking method applied to 22 years of altimetric (SLA, Sea Level Anomalies) daily data (AVISO merged, delayed-time, SLA data).
The tracking algorithm provides information about the lifetime of each detected eddy, and permits the evaluation of their mean properties, such as radius, kinetic energy and translational velocity.
We treat separately the eddies with lifetime respectively under and over 100 days. We find that short-life eddies mostly occur in the northern part of the domain, above 39 N, along the North Balearic Front and we refer to them as Frontal Anticyclonic Eddies (FAEs). Most are formed in fall and winter. By contrast, longer-life eddies tend to arise in the southern part of the basin, along the Algerian Current, mainly in spring and summer. A clear spatial and seasonal complementarity is evident between the two kinds of structures.
We observe two preferred areas of formation along the Algerian slope, at 5 E and at 7 E. The southern long-life AEs are more energetic and move eastward along the coast to the Sardinia Channel. We estimate that high salinity on the surface layer hinders the transit of the eddies through the channel, forcing them to deviate northward with the cyclonic circulation.
From the perspective of eddy kinetic energy (EKE), we find that the punctual EKE in the south is higher than in the north of the domain, and presents an annual periodicity, due to the seasonality of heat fluxes, and a periodicity of 4.4 years. The latter should be more comprehensively examined with a larger data set.
In order to investigate the vertical extension of the features and the water masses involved, we use CTD data sampled in the course of three oceanographic cruises in the WMED. We superimpose the CTD transepts on the SLA maps in each eddy location. Two transepts intersect southern AEs and a third intersects a FAE. In all cases we measure a minimum level of salinity in the sub-surface layer (50-70 m depth) co-located with the eddy core. It is Atlantic Water trapped by the structure. The CTD data also provide the physical characteristics (potential temperature, salinity and potential density anomaly) of the water masses involved in the AEs. We found that southern AEs reach $1200 - 1500$ m depth and the FAEs $600 - 700$ m depth.
The detection and tracking method is a powerful instrument to study the eddies and their variability, and the combination with in-situ data allows a more complete characterization of these structures.