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Anticyclonic eddy energy and pathways in the Algerian basin (1993-2007)

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The Algero-Provençal basin plays a key role in the circulation of the entire Mediterranean Sea. Consequently, in the past its hydrodynamics has been intensively studied with infrared and colour satellite imagery, moorings, surface drifters and altimetry observations. The basin is divided into two sub-basins by the North Balearic front, a thermal front characterized by a high seasonal variability: the Provençal sub-basin in the north and the Algerian sub-basin in the south.
The Algerian basin is dominated by mesoscale phenomena, especially anti-cyclonic eddies. The Algerian current becomes unstable and meanders; often giving rise to mesoscale eddies of both signs. The anti-cyclonic eddies (hereafter Algerian Eddies or AEs) can grow rapidly in horizontal and vertical extension. They can also detach from the Algerian slope and circulate for several months within the sub-basin, while the cyclonic ones quickly disappear. In spite of its limited dimensions, the Algerian sub-basin can contain as many as three long-life AEs, which can interact with each other and with sub-basin dynamics.
In spite of the current body of research, a study on the tracking, energy and interaction of these long-life eddies in time and space is still lacking.
In order to fill this gap, we applied the automated eddy detection and tracking method created by Penven (2005), which reveals the complex movements and dynamics of eddies in the Algerian sub-basin. The Penven algorithm combines the detection of the largest closed contours in SSH (Sea Surface Height) with a positive value of the relevant Okubo-Weiss parameter. The latter has already been successfully used in the Algerian Basin by Isern-Fontanet et al. (2003). The eddy-tracking algorithm is based on the minimization of a general distance that takes into account the difference in coordinates, radius, vorticity, mean height and amplitude between eddies of consecutive temporal steps. The code was modified and adapted in order to optimize its use in the study area.
This automated method allowed the investigation of mesoscale eddy variability using several years (1993-2007) of satellite altimetry observations. To verify the reliability of the technique, we compared the eddy pathways derived from the application of the modified Penven method with independent observations.
Preliminary results suggest that AEs, moving anticlockwise within the sub-basin, complete as many as two or three laps, depending on their lifetime, following the Algerian Gyre path. We suppose that AEs acquire kinetic energy from the Algerian current, occasionally in sufficient magnitude to cause their detachment. This phenomenon mainly takes place near the Sardinian Channel. Eddies formed on the thermal front, called Frontal Anticyclonic Eddies (FAEs), remain localized in the northern part of the sub-basin and have lower energy and shorter life than AEs. They usually don't interact with AEs.
Basic statistics on eddy trajectories and energy characteristics allow the evaluation of these mesoscale structures' relevance of on (sub-) basin circulation.