THE SURFACE CIRCULATION IN THE EASTERN BASIN OF THE MEDITERRANEAN SEA

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Abstract

The Atlantic Water (AW) circulation schemata widely referred to nowadays (1, 2, 3) represent a cross-basin meandering jet, thus disagreeing with a pioneering work (4) and a former analysis of IR images (5, 6). A roughly similar controversy was elucidated in the western basin where this imagery was proven reliable. This has motivated the visual analysis of daily/weekly (~1000, 1996-2000) and monthly (since 1985) composites. In our schema, the mean flow is anticlockwise along the upper part of the continental slope and it generates mesoscale eddies that tend to follow the deeper isobaths. Other eddies are induced by the Etesians every year. All eddies can have several-year lifetimes, propagate and merge.

Key-words: Mediterranean Sea, eastern basin, IR imagery, surface circulation, mesoscale eddies

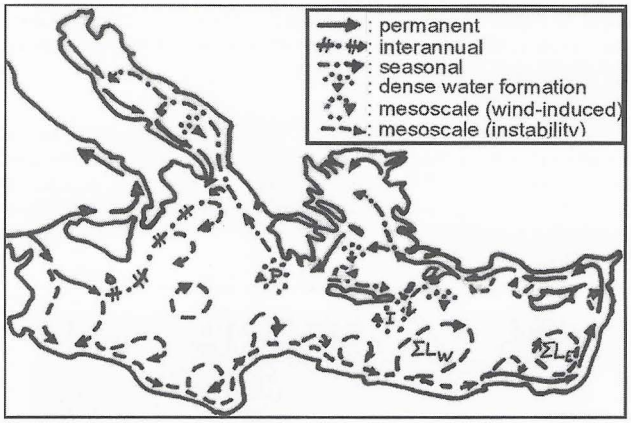
Overall, the AW circulation (100-200 m thick) is alongslope and anticlockwise. It is permanent from Tunisia to Turkey and seasonally variable in the Aegean, the Ionian around Greece and the Adriatic. A branch, having spread for years (up to early 1998) from the Sicily channel towards the northern Ionian before vanishing, represents interannual (not seasonal) variability. Mesoscale eddies, generated by the instability of the AW flow or by orographic effects on the Etesians, were not correctly described before. Although they have characteristics almost specific to each subbasin and/or to their generation mechanism, the largest are anticyclonic, reach diameters of a few 100s km and can be tracked for months/years propagating at up to a few km/d . They represent a relatively large amount of AW and play a fundamental role in spreading it seaward.

In the southern Ionian, large eddies generated by the AW flow as soon as the depth exceeds a few 100s m seemingly drift along intermediate to deeper isobaths, probably depending on their vertical extent. An eddy, initially found east of Sicily, drifted southwards as far as Libya where it disturbed the AW alongslope flow more than two years later. All eddies originated either in the north (including Pelops) or in the south can drift in the central Ionian and create there a complex eddy-field that, being only partially investigated, was incorrectly associated with the alleged "Atlantic Ionian Stream" and "Mid-Ionian Jet". On average, AW does not cross the Ionian in its central and/or northern parts but ultimately concentrates in the south as an alongslope anticlockwise flow that is unstable and generates anticyclonic (Libyan) eddies.

These eddies then propagate downstream along the eastern Libyan slope and eventually interact with Ierapetra, thus increasing the interannual variability of the latter. In addition, Ierapetra can remain stationary more than one year and thus be intensified the year after, it can drift over 100s km, merge with a former Ierapetra and / or reach the Libyan and Egyptian slopes; hence, successive Ierapetra's can be found simultaneously. At the entrance of the Levantine, the largest Libyan eddies tend to follow the deeper isobaths and thus detach from their parent current. Then, together with Ierapetra, they generally remain trapped by the Herodotus trough before finally decaying. Contrary to what has been believed hitherto, the "Mersa-Matruh" area (named ΣL_W) is occupied not by a recurrent / permanent feature but by slowly propagating and merging anticyclonic eddies originated elsewhere. The northwestern edges of such mesoscale eddies must have been confused with a northeastward "Mid-Mediterranean-Jet". The specificity of that area is thus due to processes never foreseen before.

The Shikmona area (named ΣL_E) is occupied by an offshore anticyclonic structure fed by various kinds of small-scale eddies originated alongslope. Both the "Cilician Current" and the "Asia Minor Current" are the continuity of the overall alongslope flow that meanders and generates medium-size eddies. The flow continues either into the Aegean, especially in winter, or southwestwards, up to feeding Ierapetra. North of Crete, most eddies propagate eastwards. In the northern Ionian, the flow towards the Adriatic displays a marked seasonal variability, intensifying in winter. In the Adriatic, it clearly surrounds the dense water formation zone in winter.

The monthly-composite analysis confirms that an alongslope and anticlockwise schema also applies to the late eighties - early nineties at least. In addition, all features evidenced with all available *in situ* data sets (in particular the POEM ones) can be seen with the IR imagery. It is thus concluded that i) all available data sets are reliable and ii) the POEM schemata (1, 2, 3) result from a misinterpretation of the observed features. Although mainly descriptive, our visual analysis of IR images allows proposing an alternative realistic schema of the AW circulation. The mean flow is anticlockwise alongslope and unstable. Mesoscale (100-200 km) anticyclonic eddies, propagate for months/years at up to a few km/d and tend to follow the deeper isobaths. An extended version of this paper is presently submitted to Progress in Oceanography.



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