EVIDENCE THAT ALGERIAN EDDIES HAVE AN ANTICYCLONIC STRUCTURE THAT CAN EXTEND FOR MONTHS OVER THE WHOLE DEPTH (~2700 M)

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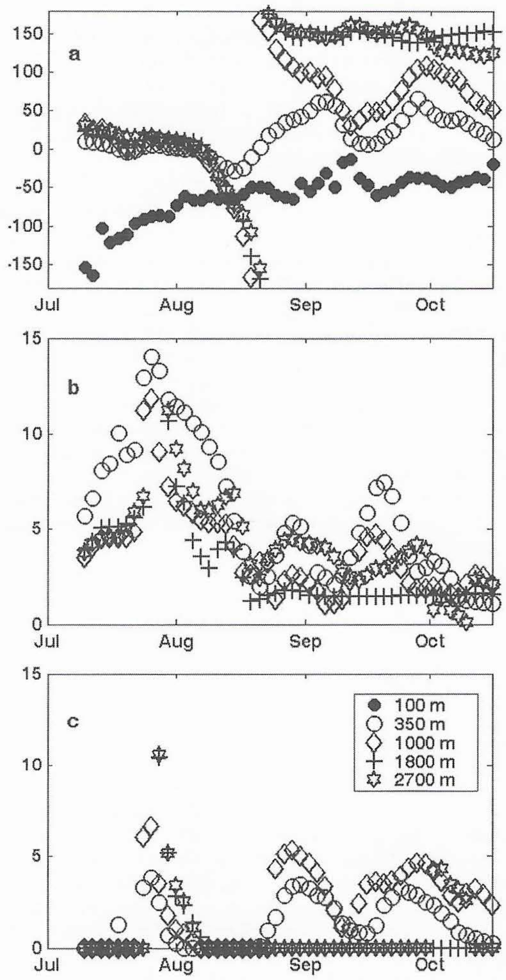
Abstract

The ~40 currentmeters deployed on 9 moorings for 1 year during the 1997-1998 ELISA experiment (www.com.univ-mrs.fr/ELISA/, 1) have shown that meso-scale Algerian Eddies (AEs) can extend over the whole depth. Simple realistic hypotheses about the linear combination of currents due to the AEs and to the large-scale circulation allow validating the hypothesis (2) that the AEs' structure can be anticyclonic for months over the whole depth with currents similar over the whole deeper layer (350 to 2700 m).

The Algerian Current (~50 km width, 100-200 m thickness, ~1 Sv transport) is markedly unstable (3). Infrared images (4) and current time series (5) have allowed specifying that two kinds of mesoscale features can be generated. One kind is considered as a series of paired cyclones and anticyclones (diameter up to 50-100 km) that propagate downstream at a few km/d and that do not have a large vertical extent (5). Simple analytical models (3), and sophisticated numerical computations as well (e.g. 6), suggest that these eddies result from a baroclinic instability process.

The other kind named event (5) is considered, in the surface layer, as a large meander (50-100 km amplitude) of the Algerian Current embedding an anticyclone and generating a short-lived (a few weeks) cyclone upstream from the meander's crest (2, 7, 8). Both in situ observations (5, 9) and laboratory experiments (7) support the hypothesis (2) that the circulation is anticyclonic in the whole deeper layer too. This is not consistent with a baroclinic instability process and might rather be created by a pressure gradient in the surface layer (i.e. a surface bump not compensated enough by the interface lowering; 7). Events are generated a few times a year only and can propagate downstream for months along the Algerian slope. They generally detach seawards at the entrance of the channel of Sardinia, and can then follow, during up to 3 years at least (10), an anticlockwise circuit in the eastern Algerian subbasin. Since the meander can then no longer be differentiated from the surface anticyclone, these eddies (diameters up to 200-250 km) are named Algerian Eddies (AEs).

The ELISA current time series have clearly demonstrated (11) that the mesoscale AEs sometimes extend down to the bottom (~2700 m) and are stronger than the large-scale circulation, thus reversing from eastwards to westwards the current measured at depth off Algeria. To better specify the deep structure of the AEs, we hypothesise that the meso- and large-scale currents combine linearly. We thus decompose, when possible, the currents measured at depth into a component oriented as the yearly mean current, expected to represent the large scale, and a component oriented as the current measured simultaneously at 100 m. The later being generally parallel to the surface isotherms, it mainly represents the mesoscale when within an AE. For instance, at point 3 in July-August (figure), currents measured at 350, 1000, 1800 and 2700 m are roughly oriented as the current at 100 m (**a**: direction at 100 m (0° for northwards and +90° for eastwards) and phases with respect to 100 m (positive when clockwise)). While the 100-m direction is changing due to the AE (96-1) propagation, the meso-scale components at depth remain in phase and have similar intensities (**b**, 5-15 cm/s) much larger than the large-scale ones (**c**, < 5cm/s). These features clearly account for the overall anticyclonic structure of 96-1 at that time (as supported by unpublished hydrological data). In September-October, while 96-1 was still over point 3, phases with respect to 100 m changed, but others (350/1000, 1800/2700) were rather constant, thus accounting for a coherent although more complex structure of 96-1 over the whole depth.



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