THE NORTHERN CURRENT DYNAMICS IN THE WESTERN MEDITERRANEAN SEA

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In the western Mediterranean Sea, the Northern Current is a major component of the circulation, formed by the junction, in the Ligurian Sea, of the currents flowing northward along each side of Corsica. It flows all year long as an entity along the continental slope as far as the Catalan Sea, surrounding the central zone where convective phenomena occur in winter. The seasonal and mesoscale variabilities of the Northern Current have been analysed from a fortnightly hydrological survey carried out off Nice as far as ~55 km, from October 1990 to July 1991, and from ~30 current time series collected as deep as 2000 m, on 4 moorings set perpendicularly to the coast within a ~30 km coastal band, from December 1990 to May 1991, in the framework of the PRIMO-0 experiment (ALBEROLA, 1994; ALBEROLA *et al.*, 1994).

The hydrological characteristics of the different water masses have mainly evidenced some seasonal variations, concerning mainly the seaward spreading of LIW from the beginning of the formation of WMDW, the transformation of MAW into WIW in the deep winter, as well as the advection of less modified MAW. From a dynamic point of view, the seasonal variability is mainly depicted as a well-defined episode of narrowing, deepening and shoreward shift, from late January to mid-March, of a generally wide and shallow Northern Current. Currents have clearly appeared to be similar and highly correlated in an upper layer, the thickness of which is at least a hundred metres (between ~60 and 150 m), whatever the location of the points and the season are.

The flux of the Northern Current has ranged within 1-1.6 Sv, in agreement with the published values (e.g., BETHOUX *et al.*, 1982), and its temporal evolution has emphasized somewhat a rather long winter season (December-March) when relatively high values (>1.2 Sv) are maintained; the flux is maximum in December and slowly decreases till July at least. The maximum probably corresponds to the one reported by BETHOUX *et al.* (1982) and might be due to the maximum of the Eastern Corsican Current as hypothesized by ASTRALDI and GASPARINI (1992). The still-large values observed in winter might be due to the maximum of the Western Corsican Current expected to occur later on (ASTRALDI and GASPARINI, 1992), while the decrease from spring is coherent with the expected forcing phenomena and with the characteristics described by SAMMARI *et al.* (1994) who account for no marked variations from spring to early autumn.

A description of a complete annual cycle has been possible by using other observations (TAUPIER-LETAGE and MILLOT, 1986; SAMMARI *et al.*, 1994) with which ours are clearly coherent. Thus, the mesoscale activity increases from autumn to the deep winter and then displays a continuous decrease till summer at least; it has been clearly observed to propagate to the open sea in the deep winter. Mesoscale events have appeared to have a vertical extent of some few hundred metres, displaying quasi no rotation of the fluctuations with depth. So, such events should have a relatively simple vertical structure, corresponding mainly to the first baroclinic mode with its zero-crossing at 400-500 m. Currents are relatively well represented by the barotropic and first baroclinic modes, the baroclinic one being predominant and more energetic, especially in winter. However, consequently to the variations of the vein in width and depth, our most seaward mooring (~30 km) is either out or more or less in it; the dynamic regime is thus generally more complex there, except in the deep winter when the observed mesoscale events become the barotropic ones of the central zone governed by vigorous convection.

The fluctuations have generally time scales shorter in winter than in spring. Due to dramatic wintery transformations, the Northern Current is mainly altered by instability processes, leading to features looking like meanders. Indeed, it is very spectacular to note that its major fluctuations are quasi transverse within its core itself and that the anticlockwise energy increases while the clockwise energy vanishes when progressing seaward accross it. These meanders, steep and large, occur at 10-20 days and involve much more energy in winter than in spring when they have slightly shorter periods (~10 days). As previously observed (SAMMARI *et al.*, 1994), shorter fluctuations at 3-6 days are also associated with a meandering current and are expected to be intensified from spring-summer to the deep winter. The amplitudes of these meanders might be smaller than those of meanders at 10-20 days. In spring, while the flow is more stable, the predominant fluctuations look like pulses expected to have an horizontal extent of a few tens of kilometres. A fundamental observation for coastal oceanographic problems is that the circulation is actually unforeseeable in a very coastal zone (of ~10 km), dominated by turbulences. The main mesoscale phenomena, in this zone, have periods slightly shorter than well within the current.

The major seasonal and mesoscale features of the Northern Current (high flux values maintained during a relatively long winter season, narrowness and shoreward shift of the current leading the central zone to extend to the most seaward mooring) lead us to consider that the winter dense water formation should be one of the major forcings of the circulation in the northern part of the western Mediterranean Sea.

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