IMPACT OF AN ATYPICAL WINTER OVER THE CATALAN CONTINENTAL SHELF

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Abstract

During the 1998-99 winter, the hydrodynamics of the Catalan continental shelf and slope was significatively altered. Pascual et al. (2002) have reported the presence of a very energetic eddy (diameter >100 km) located in the northern part of the Balearic sea from september 1998 to March 1999. This structure altered the normal dynamics in the downstream region (the Catalan shelf-slope). In this paper, we show the consequences of this atypical behaviour, in particular the effects of the eddy dissipation when a great amount of Winter Intermediate Water accumulated over the northern shelf was released.

Keywords : Circulation, Coastal Waters, Time Series, Western Mediterranean.

The dynamics of the Catalan shelf-slope region (NW-Mediterranean) is very influenced by the upstream processes [1]. The slope current, which is part of the so-called Northern Current [2], advects dynamical structures (i.e. eddies, filaments) and water masses downstream. This mechanism allows the presence in the southern Catalan shelf-slope of eddies and water masses generated in the Gulf of Lions.

In September 1998 a very intense and large (100 km) anticyclonic eddy was generated in the northern part of the Balearic basin [3] (figure 1). This structure remained almost in the same place until March 1999, when it dissapeared. The authors proposed a combination of effects such as the Mistral wind induced curl and the weakening of the Northern current to be at the origin of the eddy formation. Such a strong and large structure had, probably, an important impact over the circulation in the Balearic basin. Nevertheless, until now, no evidence of that impact has been reported.

On the other hand, in the frame of the YOYO project (1998-1999), several moorings were placed in the shelf-slope region near the Ebre delta, downstream the large eddy position (figure 1). Those moorings were instrumented with current meters and thermometers at different depths as well as with a thermistors chain between 100-200 depth.

When looking at the current and temperature data the main conclusion is that the slope current was not altered by the presence of the eddy. The differences found during the 1998-99 winter were similar to those found in other years., showing the typical seasonal variability.

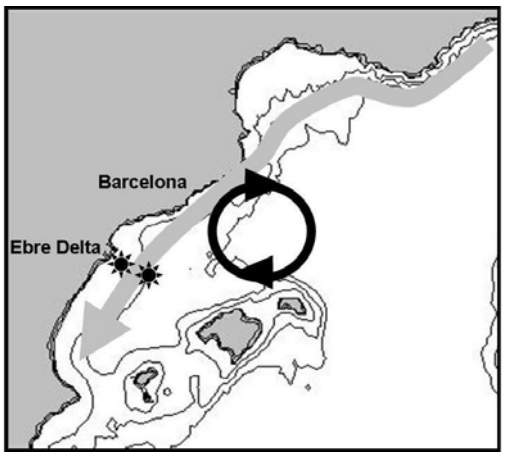

Fig. 1. Study region. The large eddy reported in [3] is represented as well as the typical path of the Northern current (grey arrow). The stars show the location of the mesurement points.

However, the temperature presented a striking feature. Between the 26 March and 6 April (days 1180-1190 in figure 2), the temperatures suddenly decreased by 0.6°C simultaneously between 100 and 500 m. This is a variation much more important than all other variations observed during the YOYO period and corresponds to the arrival of WIW (Western Intermediate Water) advected from the North. What is very unusual is the amount of such WIW filling the whole water column. In fact, this extraordinary release of rich waters probably favoured the increase of seabirds observed in 1999 (Daniel Oro, pers.comm.).

Our explanation to that phenomena is the following. The Catalan continental shelf in the north of Barcelona is a favourable place to generate WIW due to the cooling and convection of dense waters. Usually, the waters generated by that process over the shelf are advected downstream by the slope current, as it is done with the waters generated in the Gulf of Lions. However the eddy blocking prevented them to leave the generation place. The winter 1999 was especially strong and an important quantity of intermediate waters was generated in the Gulf of Lions [4], so it is expected that the same thing happened in the Catalan shelf. On the other hand, due to the eddy blocking, this water mass didn't displace and was accumulated during the winter months over the shelf. When the eddy dissipated in March, the current circuit was restablished and the cold and rich waters accumulated began to be advected southwards filling the whole water column and reaching the southern part of the Catalan shelf-slope in several days.

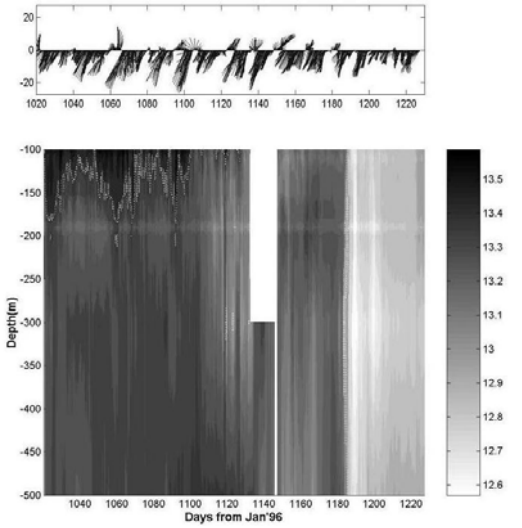

Fig. 2. Comparison of 100 m velocities (top) and temperature distribution between 100 and 500 m (bottom) measured over the slope.

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