ADVECTION OF ANTICYCLONIC EDDIES ACROSS THE BLANES CANYON, NW MEDITERRANEAN

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Abstract

Time series observations of temperature were carried out at several mooring locations in the Blanes canyon area during summer 1993. The temperature records reveal the southward advection of mesoscale anticyclonic eddies at a mean speed of 5-10 cm/s. These eddies are also evidenced by collateral AVHRR imagery and trajectories of Lagrangian drifters. Research is in progress to understand the genesis of these mesoscale features, which have very important effects on the shelf circulation. It is suggested that both the alongslope advection of light water from the gulf of Lions and the morphology of the Creus-Palamós-Blanes canyon system may play a crucial role in eddy generation.

Key-words : Circulation, mesoscale phenomena, remote sensing, time series, Western Mediterranean

Introduction

In the framework of a study of the mean circulation in the northern Catalan shelf, R/V *Hespérides* performed a high-resolution oceanographic survey of the Blanes canyon area in June 1993 (see figure 1). The cruise included the acquisition of CTD and ADCP data and the release (and further Argos-tracking) of Lagrangian LCD drifters upstream of the Blanes canyon. Rojas *et al.* [1] reported the mesoscale circulation patterns observed during the cruise, and Olivar *et al.* [2] and Granata *et al.* [3] discussed the influence of the mean flow on the distribution of larval fish species and on the fluxes of particulate matter. In the upper layer, a mesoscale anticyclonic vortex was observed in association to a low salinity core advected by the Liguro-Provençal-Catalan or Northern Current into the Blanes canyon. The surface circulation pattern was interpreted by Rojas *et al.* [1] as the result of geostrophic adjustment.

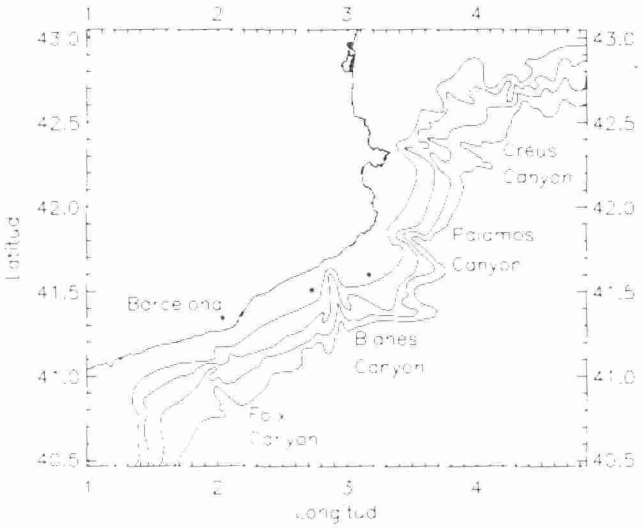

Figure 1 : Location of the Blanes canyon off the Catalan coast and location of the "upstream" and the "downstream" moorings described in the text.

3-month series of current and temperature data were recorded by means of several moorings deployed at the end of the hydrographic survey. In particular, two moorings containing one single RCM-7 current meter at 70 m depth were deployed respectively upstream and downstream of the canyon on bottom depths of 140 m. The current meters happened to remain just below the pycnocline and recorded very low flow velocities (the current data time series are not shown here), but their temperature records exhibited very interesting features.

Results and discussion

Figure 2 displays the time series of temperature measured at 70 m on the upstream and the downstream moorings. A number of strong temperature signals can be easily traced in both records, in particular several transient temperature increases by 0.5°C to 1.0°C. The duration of each of these warm events is of the order of 10 days, and the interval between two consecutive events in a record is about 20 days. The coherence between the two temperature records is high, and the phase lag between both time series is around 9 days. On the basis of the post-cruise trajectories of our Lagrangian LCD drifters and of collateral AVHRR imagery covering the time series observation period, we conclude that those temperature signals were caused by mesoscale anticyclonic eddies advected southwestwards across the Blanes canyon producing transient depression of the isotherms. According to our interpretation of the temperature records, the eddies were advected by the Northern Current at a mean speed of 5-10 cm/s.

Figure 3 shows the SST field derived from an AVHRR image of the study area acquired on 24th June, 1993 -*i.e.* during the first temperature "jump" recorded on the upstream mooring-. The geometry of the cool water tongue advected alongslope from the gulf of Lions reveals an anticyclonic circulation pattern on the shelf northeast of the Blanes canyon. Furthermore, the trajectory of drifter

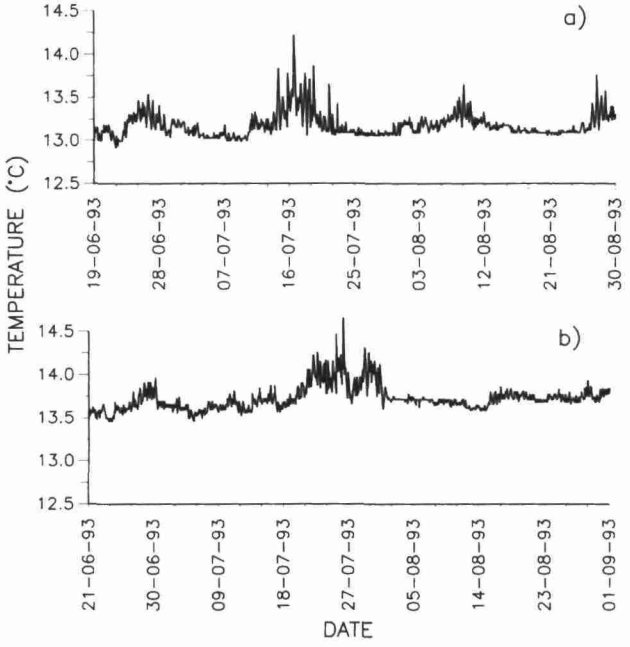

Figure 2 : Time series of temperature measured upstream (a) and downstream (b) of the Blanes canyon at 70 m in summer 1993.

#5 (it is one of the five drifters launched during the *Hespérides* cruise) between 22nd and 28th June suggests that the shelf stretch extending between the Blanes and the Palamós canyons was occupied by an anticyclonic eddy at the time when the first positive temperature anomaly was observed on the upstream mooring. The diameter of this eddy could be about 30 nautical miles according to the trajectory of the drifter. Figure 4 displays the distribution of SST on 28th June, *i.e.* when the first positive temperature anomaly was observed at the downstream mooring, and the quasi-contemporary trajectory of drifter #2. Both figures evidence that the shelf circulation was anticyclonic southwest of the Blanes canyon, which again supports our interpretation of the warm events in the temperature records as the signature of anticyclonic eddies. In fact, the trajectory of drifter #2 suggests that there were possibly two different length scales of anticyclonic motion downstream of the Blanes canyon, one of about 12 nautical miles related to a cool (and fresh) core "detached" from the leading edge of the tongue of gulf of Lions water southwest of the downstream mooring site, and another larger one of about 30 nautical miles.

The previous observations sustain our ideas about the fact that the warm events in the temperature records were related to anticyclonic eddies causing depression of the isotherms. However, the thesis that these eddies are advected across the Blanes canyon deserves further explanation. A closer inspection of figure 4 reveals that the anticyclonic circulation pattern southwest of the Blanes canyon coincided in time with the presence of an anticyclonic eddy on the shelf stretch extending between the Blanes and the Palamós canyons (which is possibly the same structure observed in the 24th June image), but we have no evidence to affirm that the first anomaly of the downstream temperature record was caused by the advection of a previous anticyclonic eddy across the Blanes canyon. Despite this, we do have other indications that such advection occurs. Figure 5 shows the SST field of 8th July and the trajectory of drifter #1 from 28th June to 14th July. The SST image shows the cool tongue of gulf of Lions water invading the shelf stretch between the Blanes and the Palamós canyons in relationship to southward flow on the shelf, which suggest that the anticyclonic eddy observed in both the 24th and 28th June images was not there on 8th July. On the other hand, if the drifter tracks shown in figures 3 and 5 are compared, it is noticed that the northeastern limb of the anticyclonic eddy migrated more