SLOW ABYSSAL CLOCKWISE ROTATING EDDIES IN THE IONIAN SEA

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Abstract
The dynamical characteristics of the deep currents flowing over the KM4 site (36° 30'N; 15°50'E) measured, from July 2001 to March 2003, through two Aanderaa RCM 7-8 current meters set at 2700 m and 3050 m depth (230 m from the bottom) are here investigated. The presence of 8 large scale slow barotropic vortices, clockwise rotating, is discussed.
Keywords : Abyssal, Ionian Sea, Currents.

From the year 1999, within the NEMO project, a current meter chain has been deployed at the KM4 site (at 36°30'N; 15°50'E, Ionian sea, Central Mediterranean Sea, Fig 1) about 130 km south-east of Cape Passero, the meridional tip of the Island of Sicily. This site is on a rather flat plane 3280 m deep, at 50 km from the oriental Sicilian sharp shelf break. The velocity, temperature and density outputs from two Aanderaa RCM 7-8 current meters, set at 2700 m and 3050 m depth (the latter at $\sim$ 230 m from the sea-bottom) have been analysed. The characteristics of the KM4 site are: *i*) the mean measured salinities are consistent with those of the Aegean water; *ii*) the deep sea current is mainly "barotropic", with an average current of $\sim$ 1.89 cm/s towards north-north-west; *iii*) strong inertial and tidal signals are present; *iv*) the baroclinic signal is concentrated around the inertial range. Its energies are $\sim$ 5 % of those of the "barotropic" velocities; *v*) 9 mesoscale large signals, crossing the site during the measurements period, have been detected. Among them, one is a crossing front and 8 are large scale clockwise rotating vortices (Fig.2). Their crossing-time 10<*T*<30 days and their chord (diameter, if the center of the vortex crossed the current meter chain) 20<D<45 km can be estimated: the crossing times of maxima velocities of these vortices is $\approx T/2$. But other smaller signals appear as vortices sideways crossing the KM4 site.

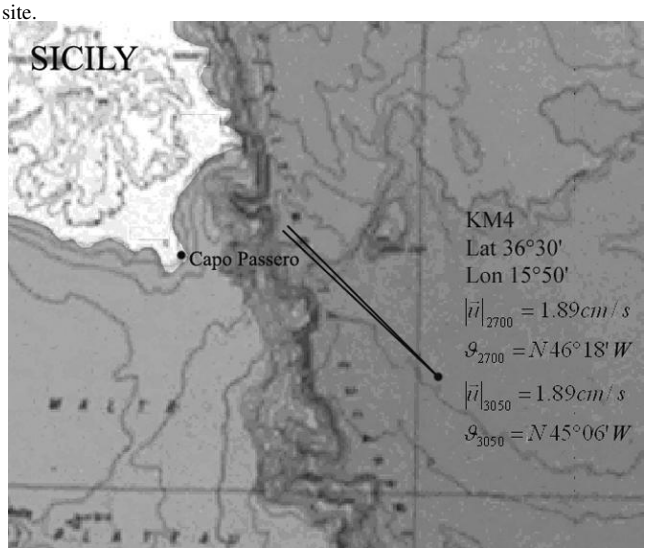

Fig. 1. Geographical position of the KM4 moorings and time-averaged vectors for both depths

From the termohaline characteristics of the water column we estimate the internal Rossby radius R $\sim$ 7 km, the Rossby number $\sim$ 3 x 10^{-2}, the Burger number $\sim$ 0.4-0.7, the Brünt-Vaisala frequency $\sim$ 3x10^{-3}s^{-1}, the Richardson number *Ri* $\sim$ 60. In synthesis the abyssal KM4 flow is geostrophic, there is no evidence of turbulence, and *L* is about 3/2 the Rossby radius of deformation. A spectral and a rotary analyses show three "barotropic" kinetic energy peaks at periods of $\approx$ 19.8 $\pm$ 2 days, 15.2 $\pm$ 1 days, and $\approx$ 29.5 $\pm$ 4 days. Over the entire spectral band, as that of the mesoscale vortices, the rotary coefficient is always large and <0, so the idea of persistent clockwise motion of these vortices is supported. The possible dynamic origin of the mesoscale vortices has been investigated, as due to: *a*) a local wind blowing over the site; *b*) a basin resonance with the wind, *c*) a 'cyclogenesis' process [1, 2] generated along the dense current down-flow, after the dense Aegean water crosses the Antikithira strait and enters in the Ionian Sea [3]. Against hypotheses *a*) and *b*) there are the lack of anticlockwise vortices and the positive rotary coefficient of the winds at the peaks frequency range. The last hypothesis c) appears to be the most reliable at the moment. At the light of these partial considerations, only further measurements can verify these hypotheses.

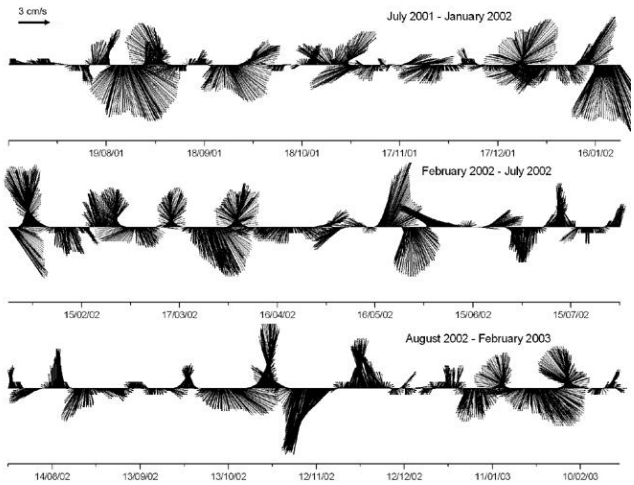

Fig. 2. Stick diagram of the "barotropic" low-pass filtered current in the half-month running average frame

References

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