FOOTPRINTS OF MESOSCALE EDDY PASSAGES IN THE OTRANTO STRAIT (ADRIATIC SEA)

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Abstract

Mesoscale eddies play an important role in transferring particles, nutrients and other passive material vertically or horizontally. Their typical dimensions are of the order of several internal radii of deformation. In the Adriatic Sea the baroclinic radius of deformation is of the order of 5 km. Here, the footprints of mesoscale eddies propagating through the Strait of Otranto are shown, and their formation mechanism and area are hypothesized.

Keywords: Adriatic Sea, Mesoscale Phenomena, Currents

Introduction

On average, an inflow takes place along the eastern coast of the Strait of Otranto (70 km wide and about 800 m deep channel connecting the Adriatic and Ionian - Fig.1), while the outflowing current occupies its western portion. Besides, an outflow of the Adriatic Dense Water (AdDW) occurs as a density-driven current in the bottom layer pressed against the continental margin of the western coast [1]. Previous observational studies in the Strait of Otranto [2] presented evidences on the unstable flow in the shear zone between the northward and southward currents and explained them in terms of the near-inertial waves and counterclockwise mesoscale eddies, appearing as a 10-day variability in the current record.

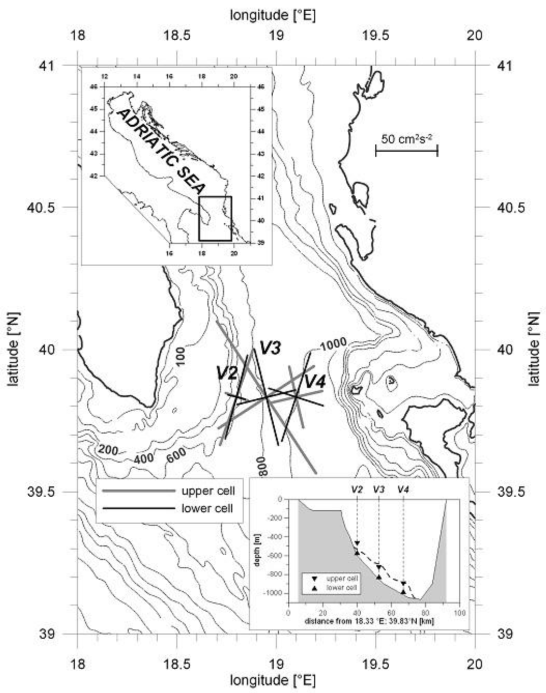

Fig. 1. Study area with the position of moorings and principal axes of sub-inertial current oscillations. Upper insert: Adriatic Sea with the study area denoted by the rectangle. Lower insert: the schematic of the vertical section with the three ADCP moorings positioned within the AdDW outflow (denoted by dashed line).

Data and Methods

Currentmeter data obtained from three moorings with bottom-mounted upward-looking Acoustic Doppler Current Profilers (ADCPs), that were maintained from September 1997 until June 1999 and from November 2006 until April 2007 at a transect in the core of the outflowing Adriatic Dense Water, are analyzed. Data were quality controlled and the missing data for periods less than 6 hours were linearly interpolated. Harmonic analysis was performed in order to de-tide the time series and, finally, a low-pass filter (33-hour cut-off period) was applied to remove inertial oscillations, thus obtaining sub-inertial non-tidal flow.

Results

The principal axis analysis of the sub-inertial flow shows that currents, especially those close to continental margins, are strongly polarized along isobaths (Fig.1). Low-pass records at all three moorings reveal energetic events of vertically uniform current vector rotation at about a weekly time-scale (Fig.2). Rotary spectra reveal their clockwise (counter-clockwise) sense of rotation at station V3 (V4), while wavelet analysis shows their timing. The two moorings close to the center of the strait show coherent current vector rotation suggesting a southwestward propagation of mesoscale eddies trapped by the bottom topography. Eddy dimensions are estimated to be between 20 and 30 km while the propagation speed is about 7 cm/sec. Eddy passage leaves a strong signal in the turbidity time-series as well, probably due to sediment resuspension by strong currents and their advection through a canyon. We hypothesize that the eddies' generation is based on the conservation of the potential vorticity for the water column passing over the sill about 100 km located upstream of the section, as suggested by [3] for the Denmark Strait. The stretching of the intermediate water layer induces cyclonic vorticity and the formation of eddies that propagate southwestward following isobaths.

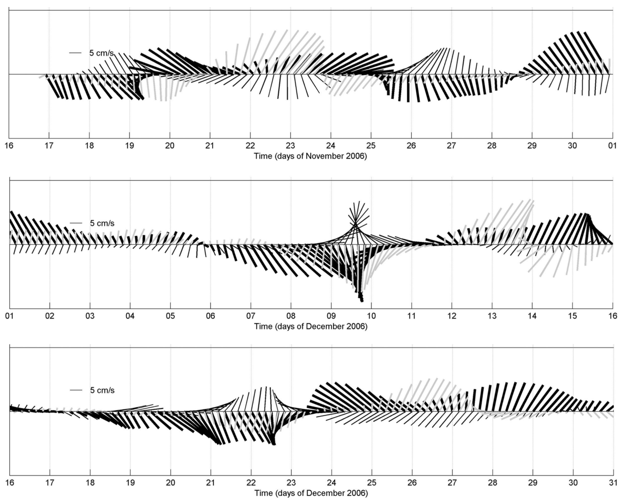

Fig. 2. Stick diagram of one cell per mooring for the period 16 November – 31 December 2006: V2 nominal cell depth 545 m (grey line), V3 nominal cell depth 720 m (black thick line) and V4 nominal cell depth 898 m (black thin line). The mean over the indicated period was removed from each time-series.

References

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