SUBTIDAL WATER FLOW ACROSS THE STRAIT OF OTRANTO DURING WINTER, SUMMER AND AUTUMN PERIODS

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Abstract

The subtidal flow across the Strait of Otranto during the three periods (winter, summer, and autumn) is investigated on the basis of direct current measurements. It is shown that in winter and autumn the greatest portion of the flow variance is associated with the intense fluctuations of the outflow along the western shelf and of the inflow in the upper layers along the eastern flank of the strait. These fluctuations are mostly driven by the local north-south winds. The flow fluctuations in the remaining zones are of much lesser importance. In summer when the wind forcing is less enhanced, the barotropic flow fluctuations, intensified in the bottom layers, and confined to the western slope and central regions, are evidenced. They are connected with the outflowing Adriatic Deep Water over the Otranto Sill. The forcing for these fluctuations has not yet been identified.

Key-words: currents, time series, wind, Adriatic Sea

Introduction

The Strait of Otranto is about 80 km wide passage, with a maximum sill depth of about 800 m, through which the Adriatic Sea communicates with the adjacent Ionian Sea. The water masses of different origin take part in the circulation across the strait: relatively warm and saline Ionian Surface and Levantine Intermediate Waters (ISW and LIW, respectively) inflow into the Adriatic along the eastern portion of the strait; the Adriatic delivers its fresh surface waters along the western shore, while the dense Adriatic Deep Water (ADW) contributes to the bottom waters of the Eastern Mediterranean (see [1] for the review). A subtidal flow in this paper is discussed on the basis of a recently conducted direct current measurement experiment.

Experiment design

During 1994 and 1995 six currentmeter moorings were deployed along the southernmost transversal section in the Strait of Otranto (Fig. 1), in the framework of the MAST-Otranto Project and Otranto Gap Experiment. Current flow was monitored by autonomous classical currentmeters and by the Acoustic Doppler Current Profiler. Raw data sampled at 10 and 20 minutes time step were transformed into mean hourly current speed and direction time series at each location in the three layers. Nominal depths are 50 and 300 m below the sea surface for the surface and intermediate layers, respectively, and a few tens of metres above the sea floor for the bottom layer.

Results and discussion

The mean circulation confirms general cyclonic shear of the flow across the strait. Due to the strait morphology the flow is polarized in the north-south direction, especially along both eastern and western boundaries, and in the deepest zones of the strait. Over the shallow western continental shelf the mean flow is southward (mean speed is about 17 and 6 cm/s in the surface and bottom layers, respectively), and is associated with the coastal, density driven outflow from Adriatic [2]. Along the eastern side, the surface and intermediate flows are northward, with mean speed of about 18 cm/s and 4 cm/s, respectively, and are associated with the inflow from the Ionian Sea. In the surface and mid-depths in the central region of the strait the mean flow is less polarized and less intense than along the boundaries. There it is influenced by the frequent passages of the mesoscale eddies in the shear zone between the prevalent outflow to the west and inflow to the east [3]. In the central bottom layer the mean flow is southward and more intense (4-5 cm/s) than above, and is associated with the ADW outflow into the Ionian.

At almost all measurement sites a substantial variability occurs, both in the tidal and subtidal frequency range. In order to study the subtidal flow fluctuations across the strait, mean hourly north current components, perpendicular to the mouth of the strait, were filtered using a digital symmetric filter [4]. The subtidal flow was examined in the three time intervals during which a relatively good spatial coverage with current data permitted a determination of the flow structure across the strait. These periods are identified roughly as winter (December 1994 - January 1995), summer (May - August 1995), and autumn (September - November 1995) seasons.

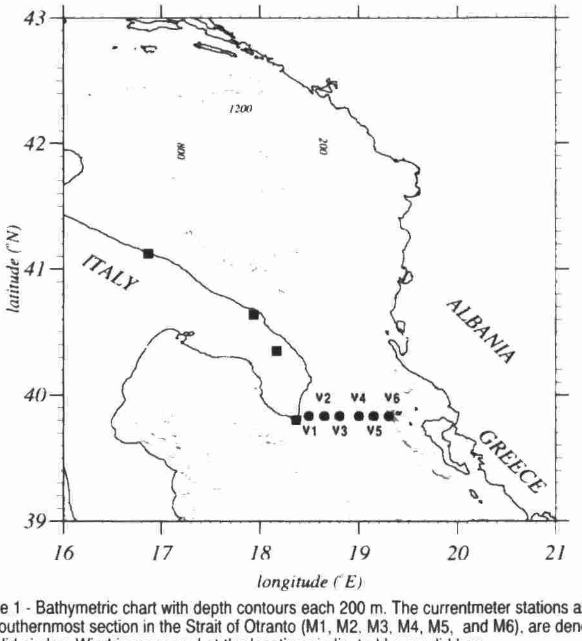

Figure 1 - Bathymetric chart with depth contours each 200 m. The currentmeter stations along the southernmost section in the Strait of Otranto (M1, M2, M3, M4, M5, and M6), are denoted by solid circles. Wind is measured at the locations indicated by a solid box.

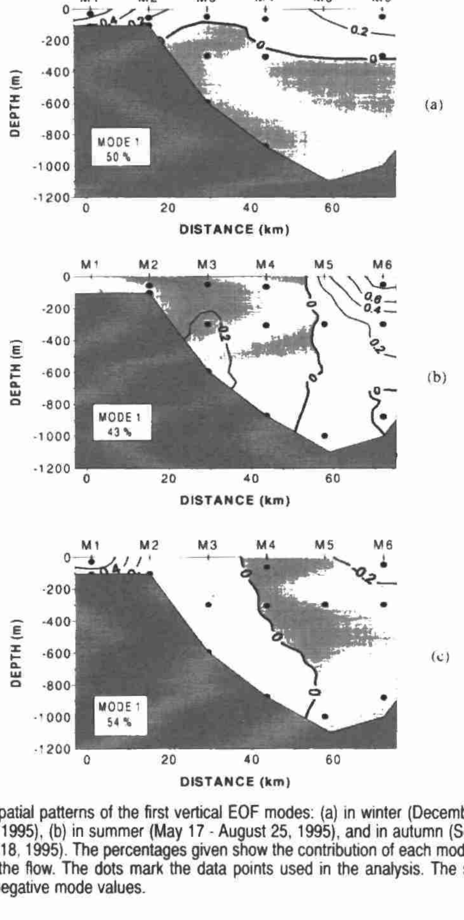

Figure 2 - Spatial patterns of the first vertical EOF modes: (a) in winter (December 3, 1994 - January 29, 1995), (b) in summer (May 17 - August 25, 1995), and in autumn (September 10 - November 18, 1995). The percentages given show the contribution of each mode to the total variance of the flow. The dots mark the data points used in the analysis. The shaded area represents negative mode values.