SOME ASPECTS OF BAROCLINIC WAVE MOTIONS IN THE IZMIR BAY AND THEIR CONNECTION WITH AEGEAN SEA DYNAMICS

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Abstract

Results of experimental investigations of baroclinic wave motions in the Izmir Bay is considered. It was found that low-frequency oscillations with periods 1-2 days are concentrated basically in the upper near-surface layer. They are connected with the dynamics of vortical formations constantly occurring in the Aegean Sea in the adjacent to the Izmir Bay areas. These eddies come into contact with the outer liquid boundary of the bay and initiate water exchange between the Izmir Bay and the Aegean Sea. Internal wave motions with periods from semidiurnal to inertial occur basically in the near-bottom layer of waveguide.

Key-words: Eastern Mediterranean, circulation, mesoscale phenomena, tides

Introduction

The ecosystem of the Izmir Bay is exposed to powerful antropogenic impact, which leads to its global changes [1,2]. At the same time, the processes responsible for the self-cleaning of the Izmir Bay waters have not been sufficiently studied. Active dynamical processes taking place in the Izmir Bay facilitate the reconstruction of the initial properties of marine environment. Barotropic and especially baroclinic oscillations contribute to the water mixing processes and ventilation of bottom water masses.

The bottom relief, occurrence of mean currents, tidal activity, seiches, upwelling motions - all these phenomena create conditions of the effective generation of both barotropic and baroclinic oscillations in the bay. Further progress in the understanding of the basic mechanisms responsible for generation and transformation of baroclinic oscillations, their influencing upon all dynamical processes taking place in the bay was achieved via conducting field experiments focusing on the study of a wide spectrum of variability of the hydrophysical fields using different methods.

Methods of investigation

Experimental investigations of the dynamics of background currents and their variability within the range of inertial gravity internal waves (hereafter IW) were conducted during the autumn of 1994 expedition of R/V *Piri Reis*. The main goal of these investigations was to carry out a study of the baroclinic oscillations occurring in the Izmir Bay, to determine their space-time characteristics, the mechanisms of generation of IW in various parts of the Izmir Bay. These investigations included the mapping of the areas exhibiting a large degree of intensification of short-period internal waves, the determination of their interaction with the bottom relief, and correlation with other hydrological processes taking place in the bay and adjacent areas of the Aegean Sea.

Six tested sites were chosen for conducting the investigations (Fig.1). The space temporal characteristics of vertical velocities and vertical deviations of thermocline caused by IW in test area 1, 2 and 5 were determined by means of the Gradient-Distributed Gauges of Temperature (hereafter GDGT) deploy from board of R/V *Piri Reis* (drifts D1, D2 and D3 in Fig.1). The GDGT covered the layer of thermocline, being intended for conducting long-term measurements of fluctuations of the integral temperature of a thermocline. For a range of short-period internal gravity waves, a special technique [3] permitted to define the orbital velocity's vertical component, using these data, and the vertical displacement of the fluid layer caused by IW. The space-time variability of the currents structure and IW vertical velocities in the areas 3, 4 and 6 was studied by means of moorings (M1, M2 and M3 in Fig.1). Current meters were deployed above and below thermocline. For determining the IW vertical velocity component and pycnocline's vertical wave oscillations due to IW, GDGT were set up at the moorings. The length of the current time series was equal to approximately two weeks.

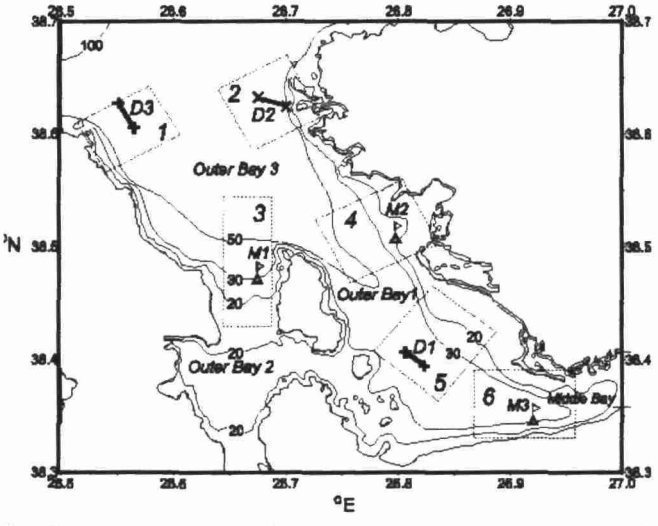

Fig.1. Bottom topography of the Izmir Bay and tested areas. (M 1-3 - moorings, D 1-3 - drift stations of R/V *Piri Reis*).

Analysis of *in situ* data

The analysis of *in situ* data have shown that the oscillations of the water masses with periods being in excess of 24 hours are concentrated basically in the upper near-surface layer (see spectra in Fig.2) and have the form of horizontal movements of fluid. The energy of such oscillations in the near-bottom layers is several times (and at the moorings 1,2 almost by an order) less than in the upper ones. The nature of these oscillations is, apparently, connected with the dynamics of vertical formations constantly occurring in the Aegean Sea within the triangle: Cape Kraburun - Lesbos island - Chandarly Bay (Fig.3). The periods of development and evolution of the eddies are equal to approximately 1-2 days. These eddies constantly come into contact with the outer liquid boundary of the bay and initiate water exchange between the Izmir Bay and the Aegean Sea in the upper layer of water. The assumption that the low-frequency fluctuations in the bay are produced externally is supported by the fact that as one moves away from the liquid boundary toward the Middle Bay (see Fig.1), the influence of these oscillations decreases (the difference in the levels of spectra of the near-bottom and near-surface layers diminishes, see Fig.2).

Horizontal mesoscale baroclinic motions with periods from semi-diurnal to inertial under the conditions of summertime stratification (the fluid is warmed and mixed up over the entire water column, and the pycnocline is located near the bottom), occur basically in the near-bottom layer of waveguide where the frequency of waves is lesser than the buoyancy frequency. The spectral level of horizontal oscillations in the frequency band from tidal to inertial at the nearbottom depth levels was several times larger than the counter part value in the near-surface one (Fig.2). The maximal vertical wave disturbances are concentrated slightly above the pycnocline in the intermediate layer. This probes how important it is to take into

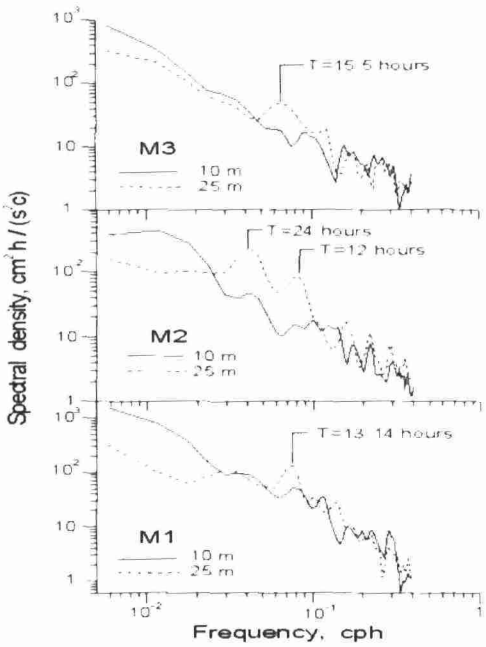

Fig.2. The energy spectra of current oscillations at the tepths of 10 and 25m at moorings M 1-3.