EXTREME CONDITIONS IN THE STRAIT OF ISTANBUL (BOSPHORUS)

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Abstract

The extreme conditions in the Strait of Istanbul are investigated based on observation of the chemical and bacteriological parameters together with hydrographic and current measurements. The upper and lower layer blockages occurred in 2003 at the strait which has a maximal exchange flow system. The distributions of the fecal coliform, nutrients, total suspended solids and dissolved oxygen along the strait during the blocking events indicate the behavior of the materials and its transportation in the strait.

Keywords: Bosphorus, Nutrients, Bacteria, Hydrography

The Strait of Istanbul (Bosphorus) is a narrow, long and shallow channel which connects the Marmara Sea and the Black Sea. It has a two-layer exchange flow system. The upper layer with ~18 psu flows from the Black Sea and the lower layer with ~38 psu flows from the Sea of Marmara [1, 2]. The average volume fluxes of the layers (600 $km^3 year^{-1}$ in the upper layer, 300 $km^3/year^{-1}$ in the lower layer) were calculated in terms of the salt and water budget of the Turkish Sea Straits [1, 3]. However, instant measurements of the volume fluxes change in a wide range since atmospheric conditions determine the flow exchange [4]. Blocking of the upper or lower layer are the extreme conditions in the strait. In this study both types of extreme conditions in the strait are presented. The two layer exchange flow in the Strait of Istanbul plays an important role on the environmental problem in the region. The discharge of waste water from the city of Istanbul has been eliminated by taking advantage of the strait flow structure. The volume fluxes and transport of materials between the Black Sea and the Sea of Marmara and renewal time of water and material in these seas mainly depend on exchange characteristics in the strait. Reliable estimates of these exchanges can be made only from data collected systematically and in a long term period including extreme conditions in the region.

The CTD (conductivity temperature depth) and ADCP (acoustic doppler current profiler) data were collected in the Strait of Istanbul in February and October 2003 by R/V ARAR of the Istanbul University, Institute of Marine Science and Management (IMSM-IU) The seawater samples were pretreated with persulphate digestion and analyzed by autoanalyser for total nitrogen (TN) and total phosphorus (TP) [5]. Among the bacteriological indicators of pollution, fecal coliform (FC) was studied by membrane filtration technique [6].

The lower layer blockage occurred in February 2003 when the strong northerly winds blew during several days (Figure 1). In the northern exit of the strait temperature and salinity were almost constant in the water column and its current directed to the south. The dissolved oxygen (DO) and total suspended solid (TSS) values were also homogenous throughout the surface to the bottom. Although the total nitrogen, total phosphorus and FC generally increased with depth till bottom due to the continuous deep discharge flow at the Strait of Istanbul [7], the vertical profile of the nutrients and FC were homogenous through the water column and bottom values were close to surface values during the lower current blockage. In the southern exit of the strait, the lower layer detected several meters in the bottom. Therefore, the deep discharge was blocked at the southern exit of the strait and could not reach to the northern exit during the lower layer blockage.

The upper layer blockage occurred in October 2003 when the strong southerly winds were dominant (Figure 1). Although salinity profiles at both exit of the strait indicated two-layer structure the current directions of the water column were the same in these two layers. Moreover the interface between the two layers was very thick and it was located upper depth along the strait. The bottom values of DO, TSS, TN, TP and fecal coliform were higher than the normal conditions and the beginning of the increase was above the halocline, primarily controlled by the velocity of the current flow during the upper layer blockage.

The blocking of the current flow is an extreme condition for the strait hydrography. The lower layer blockage is critical since the deep discharges given to the lower layer current flow are also blocked and the discharge diffuses to a larger zone in the water column, which might also affect the surface water quality. However, these extreme conditions instantly develop during strong meteorological events such as persistent northern winds encompassing rather small period of the whole year.

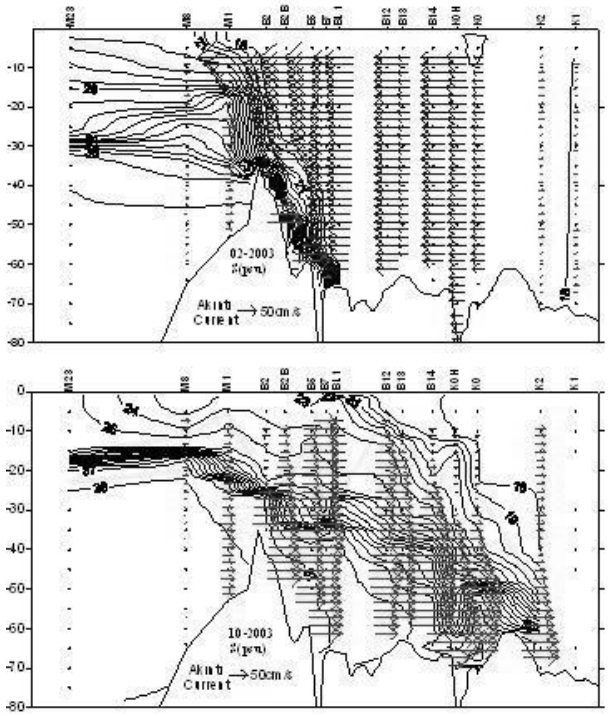

Fig. 1. Lower and upper layers blockage

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