ON THE MIXING CHARACTERISTICS OF THE TURKISH STRAITS

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Abstract

The physical oceanography of the Turkish Straits is considered in conjuction with mixing of the transiting waters of the Black and the Mediterranean Seas. The regions where intense vertical entrainment of the Mediterranean waters into the surface layer takes place are identified.

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The Mediterranean and the Black Seas exchange their waters through the Turkish Straits System (TSS), composed of the Dardanelles, the Sea of Marmara and the Bosphorus. Physiographically, the Dardanelles and the Bosphorus are both shallow and narrow straits. The Dardanelles is 62 km in length with an average width of 4 km and depth of 55 m. The Bosphorus is shorter in length (31 km), narrower and shallower, having an average width of 1.6 km and depth of 36 m. The two straits are by no means straight passageways. Dardanelles, especially have (in the middle of the strait) an elbow section that is called NARA, where the waterway makes nearly a 90^{o} turn. Between the two straits, the inter-continental Marmara basin with a surface area of 11500 km^2 is situated. The Sea of Marmara is relatively deep, having a maximum depth of 1335 m.

The heavier and highly saline waters of the Mediterranean flows north through the TSS to attain its own level. The highter and less saline waters of the Black Sea flows as a southward bound surface flow.

Between the northern entrance of the Bosphorus and the Aegean exit of the Dardanelles, the salinity of the traversing Black Sea Waters increases from nearly 17.5 ppt to 27 ppt. An increase of 1.5 ppt occurs within the Bosphorus and of 4 ppt within the Dardanelles. The remaining 4 ppt change takes place within the Sea of Marmara. While this the case with the Black Sea Waters, the Mediterranean water entering from the Dardanelles mixes very little until it reaches the northern upper most reaches of the Bosphorus, keeping its salinity of 38.5 ppt nearly a constant in the TSS proper.

The most striking aspect of the steady state average salt-water budgets of the TSS system is that before reaching the Bosphorus nearly sixty percent of the under flow entering from the Aegean Sea is mixed accross the helocline into the surface layer and subsequently returns back to the Aegean. Nearly 40 percent of this upward mixing evidently occurs within the Marmara basin.

Eventhough the budgetary considerations indicate significant upward mixing within the Dardanelles and the Sea of Marmara, the physical origins of the enterainment in these components of the TSS as well as the regions of their predominance can not be inferred. The previously obtained data supplemented by detailed information collected in recent cruises reveals two specific regions where considerable vertical entrainment occur.

The meso-scale surface jets emanating from the Bosphorus into the Sea of Marmara is found to lead, through vertical mixing, the most rapid increase in the surface salinity within 30 km. Very little changes in salinity occurs in the remaining Sea of Marmara. Within the Dardanelles, the elbow shaped NARA causes significant upward mixing of the Mediterranean waters to take place.