DYNAMICAL MODAL ANALYSIS FOR THE COASTAL SEAS AROUND TURKEY

H.I. SUR, T. OGUZ and U. UNLUATA

Institute of Marine Sciences, METU, P.O. Box: 28,
33731, Erdemli-Icel, TURKEY

The hydrographic data collected in six surveys of R/V Bilim in the Black Sea (BS), the Sea of Marmara (MS) and the Northern Levantine Sea (NLS) during 1988-1989 are used to perform the vertical modal analysis. Utilizing the Brunt-Vaisala frequency (N^2) and geopotential anomaly profiles obtained from averaged density field over the region, the relative contribution of the dynamical modes to the observed field of motion are determined by solving the vertical structure equation for each cruise.

The computed N^2 profiles show that the BS, MS and NLS are characterized by distinctly different stratification properties. In the BS, both the winter (April 1989) and summer (September 1988) N^2 profiles display presence of a two-layer stratification comprising the upper layer of 150m with substantial density variations and the layer beneath possessing almost no variations below 300m. The summer and winter N^2 profiles only differ within the uppermost 20-30m in response to seasonal thermohaline forcings. The stratification observed in MS for the winter (March 1989) and summer (September 1989) reveals even stronger two layer structure with a sharp pynocline at 25m separating two water masses. We note that the values of N^2 is one order of magnitude greater that those for the BS. In the NLS of the Mediterranean basin, the winter (March 1989) and summer (July 1988) N^2 profiles have substantial differences. The summer case reveals a surface layer of about 40m and subsequent transitional layer extending down to 80m with significant N^2 variations. The winter case, on the other hand, possesses no seasonal variations and is governed by relatively small density differences in the water column as implied by small values of N^2.

Modal analyses of the data show that the amplitudes of the first baroclinic mode in the Black Sea for both summer and winter seasons are confined to the surface layer and have zero crossings at 300m. The first baroclinic Rossby radius of deformation (R1) is found to be 19 km in each season. The first and third baroclinic modes respectively contain 80% ,10% of the total available potential energy (TAPE) in summer although the first mode contains 92% of the TAPE in winter In NLS, R1 is determined as 8 km and 11 km for the winter and summer cases, respectively. The first baroclinic mode has a zero crossing at 400m and the second at 50m and 900m for the summer case. The first mode contains 90% of the TAPE. The winter analysis, however, reveals substantially different modal structure. The zero crossing of the first mode occurs at 950m and the second at 320m and 1320m. The first mode contains only 82% of the TAPE. 14% of it is found in the second baroclinic mode. The MS exhibits completely different modal structure. R1 is determined as 15km and 20 km for the winter and summer cases, respectively. The TAPE is partitioned as 50% and 48% between the first and second baroclinic modes in the summer case. This partition occurs between the first three successive modes as 32%, 38% and 20% for the winter case.