Seasonal Variability of the Inertial Signal in the Northern Adriatic

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Previous investigations of the inertia-period oscillations in the Northern Adriatic were mostly related to the individual summer events. They were based on measurements carried at various stations over short time intervals (30-60 days). The object of the present investigation was to document seasonal variability of the inertial signal and its decay time. The investigation was made possible by the year-long time series, recently collected in the Northern Adriatic.

We had at our disposal data taken by Aanderaa RCM-4 current meters at two stations in the Northern Adriatic in the period 1988-1990, as well as density measured traditionally at the same stations in the period 1966-1991. Station A was located about 15 NM west of Rovinj (bottom depth -37 m), Station B 15 NM west of Pula (43 m). Current meters were suspended from the subsurface moorings, at the 5, 20 and 30 m depth (station A), and the 5 and 37 m depth (station B). Density was measured at conventional depths.

To isolate the inertia contents of the current-vector time series, seven principal tidal components were synthesized and eliminated. Thereafter, the inertial signal was extracted, by applying a band-pass filter around the local inertial frequency (1/17 cph). The amplitudes thus obtained for different years were pooled in a single year, and were averaged over successive 15-day intervals. Finally, a polynomial was fitted to the data recorded at each particular station/depth.

The resulting curves for the three depths of Station A are shown in Fig. 1. A similar result was obtained for Station B. Maximum surface amplitude (about 10 cm/s) occurs in summer, minimum (< 2 cm/s) in winter. Ratio of amplitudes at the 20 and 5 m depth is minimal (about 0.15) at the beginning of March, and reaches maximum (over 1) in September. This property can be explained using a two-layer fluid model (CSANADY,1973; ORLIC, 1987). In the model the ratio of vertically averaged baroclinic velocities in the surface and bottom layer is equal to the bottom-to-surface ratio of thickness of the two layers. Density data show that stratification is negligible between November and the end of February. During March it begins to develop, with an average pycnocline depth of about 5 m. From March to October the pycnocline deepens to 20 m, which favours an intensification of bottom currents as related to the surface ones.

In order to determine the decay time of the inertia-period oscillations, exponential curves were fitted to the descending segments of the band-passed time series. Only episodes in which amplitudes exceeded 3 cm/s were considered. Decay times were averaged throughout the depth and over the successive 15-day intervals. Results were similar for the two stations: The greatest decay times were obtained for June and July.

The problem of damping of the inertia-period oscillations by bottom friction had been solved using the two-layer model (ORLIC, 1984). Here, the model was extended by introducing interface friction. It was found that the decay time depends on depths of the surface and bottom layers, on the proportionate density defect of the surface layer, as well as on the coefficients of interface (K) and bottom (k) friction. Empirical decay times and density data allowed the model to be inverted in order to determine the two coefficients. This exercise gave K=0.14-10-7 m/s and k=0.73-10-3 m/s. The contribution of interface friction to damping was found to be about 20 % in March and April. It decreases to about 10 % in June, due to stabilization of the water column. From July to October the contribution decreases further (to less then 5%) because the pycnocline then deepens and bottom friction gains in importance.

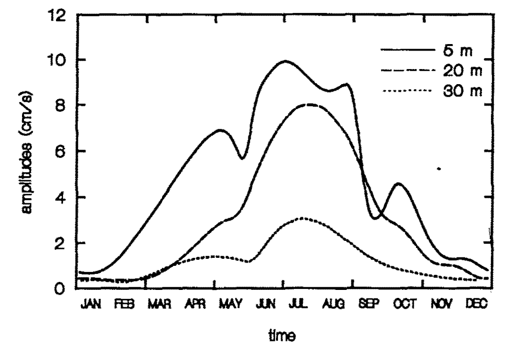

Figure 1. Annual cycle of amplitude of the inertia-period oscillations registered at Station A.

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