

A coupled generation-propagation model for internal tides, with an application to Gibraltar

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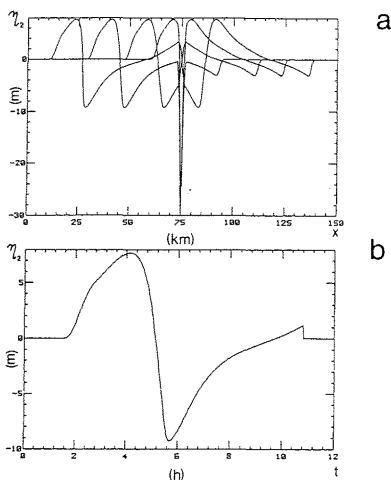
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The internal tides, i.e. those long internal waves generated by the interaction of a tidal current with variations in bottom topography, have been recognized in many oceanic sites, near the shelf edges and particularly in straits, where tidal currents are very strong and shallow sills are present. The propagation of such internal tides out of the straits where they are generated gives rise to dispersive internal waves and to strong one-sign current pulses accompanied by solitary isopycnal displacements. An example of this is given by the internal tides generated in the strait of Gibraltar, whose eastward propagation out of the strait leads to the solitary internal patterns observed in the Alboran sea (KINDER, 1984), that were recently described through a two dimensional, nonlinear dispersive model (PIERINI, 1989).

In this propagation model the internal tide in the strait of Gibraltar was prescribed as a function of time on the basis of the knowledge of field data. A more general theoretical approach should imply the determination of the internal tide by means of a generation model, whose input is given by the mean flows and tidal currents. This problem was faced by the authors, and a one-dimensional nonlinear hydrostatic two-layer model with topography was thus developed (LONGO, MANZO and PIERINI, 1990a-b) and applied to the region of interest.

In Fig. (a) an example of internal semi-diurnal tide at times $t=3, 6, 9, 12$ hours is shown for a maximum tidal current $U=0.4$ m/s in the absence of mean flows and for geometrical and hydrographic values representative of the strait of Gibraltar at the Camarinal sill (centered at $x=75$ km). During the first half tidal cycle an internal disturbance develops near the sill. When the tide slackens and then reverses the perturbation thus generated travels away from the underwater barrier giving rise to an internal tidal cycle. The domain of integration is much longer (150 km) than the real strait, but this is required to avoid the interaction of the waves with the ends of the domain. On the other hand, a time series taken near the obstacle (within the strait) does represent the correct response. Fig. (b) shows such a time series at 10 km from the center of the sill

The signal in the example of Fig. (b) is suitable as an input for the 2D propagation model by PIERINI (1989). Therefore this is an example of how a wave generation model can be used in conjunction with a wave propagation model. The oceanographic information needed to feed this coupled model now reduces to the knowledge of the mean and tidal flows in the strait.



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