Tidal Turbulence and Eddy-Viscosity in Coastal Waters at NE-Brazil

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ABSTRACT

Vertical distribution of Turbulent Kinetic Energy (TKE) at coastal NE-Brazilian waters was evaluated using a combination of field data and numerical modelling. Microstructure temperature profiles obtained with a SCAMP probe were used to estimate the rate of TKE dissipation at coastal waters off Suape Harbour. SCAMP measurements and field cinematic information were then used as input data to a turbulence model and numerical results used to obtain simple eddy-viscosity formulations as a function of low-order parameters associated to measured characteristics of velocity profiles. Stronger TKE dissipation rates at Suape waters showed to be associated to surface and bottom boundary layers during spring tides, with values ranging between $5x10^{?7}\ m^2.s^{?3} ? ? ? 3x10^{?6}\ m^2.s^{?3}$. Less accentuated dissipation rates were found at the interior regions of the flow, with $5x10^{?8}\ m^2.s^{?3} ? ? ? 2x10^{?7}\ m^2.s^{?3}$. Numerical results indicated that energy balances immediately near boundaries are mainly driven by equilibrium between production and dissipation of TKE, reflecting classical log-layer behaviors near a wall. Diffusion of TKE acts as an important process for vertical energy distribution all over the interior flow depth at Suape area. Vertical distributions of TKE point out highest energy intensities at central part of the flows, which is reflected at the eddy viscosity profiles. Outside bottom and surface regions the turbulence production induced by velocity rotation is predominant. Model results and a performed scale analysis indicate the maximum eddy-viscosity for each situation is $?_t ? O(?? ?^{5/2})$, where ?? (rad) is the global current field rotation observed along water depth. This analysis is expanded to find a simple bilinear expression for eddy-viscosity along water depth.

ADDITIONAL INDEX WORDS: *Coastal waters, turbulence dissipation, (*k-?*) model, Suape Harbour.*