Numerical simulations of internal wave dynamics in the vicinity of Izu-Oshima Island, off Sagami Bay, Japan

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Physical processes off the southern part of Japan mainland are strongly influenced by both tides and Kuroshio (eastern boundary current). The tidal forcing generates internal tides, which results in nonlinear internal bores accompanied by strong flows and turbulent mixing. Currents and eddies induced by Kuroshio generate strong mass transports and turbulent mixing when they cross shallow ridges, such as Izu-Ogasawara Ridge. In this study, we focus on internal wave dynamics around Izu-Oshima Island located on Izu-Ogasawara Ridge, off Sagami Bay, Japan. Regional Ocean Modeling System (ROMS) was employed to simulate physical processes in the study area. By using a one-way offline nesting approach, the horizontal grid spacing was down to 300 m around the study area. Two model case were run to investigate internal wave dynamics: (1) numerical run with the tidal forcing, and (2) numerical run without tidal forcing. Numerical results from the case with the tidal forcing showed strong internal tidal bores generated around the Island, which results in strong currents near the coast. The volume-integrated kinetic energy was 2 times higher in shallow area (depth<250 m) for the case with tides than that of the case without tides. The strength of internal waves (internal wave energy flux) was an order of 10 times higher for the case with tidal forcing than that of the case without tides. In addition, the tidal forcing reduced the surface temperature over the shallow ridge because of strong vertical mixing induced by tidal flows and internal tides. This study indicates that tides and internal tides dominates in the flow filed and significantly contribute to oceanic physical processes in the vicinity of Izu-Oshima Island.

Keywords: internal waves, tide, numerical simulations, Kuroshio

