Nonlinear internal waves excited by an interaction of tides and Kuroshio

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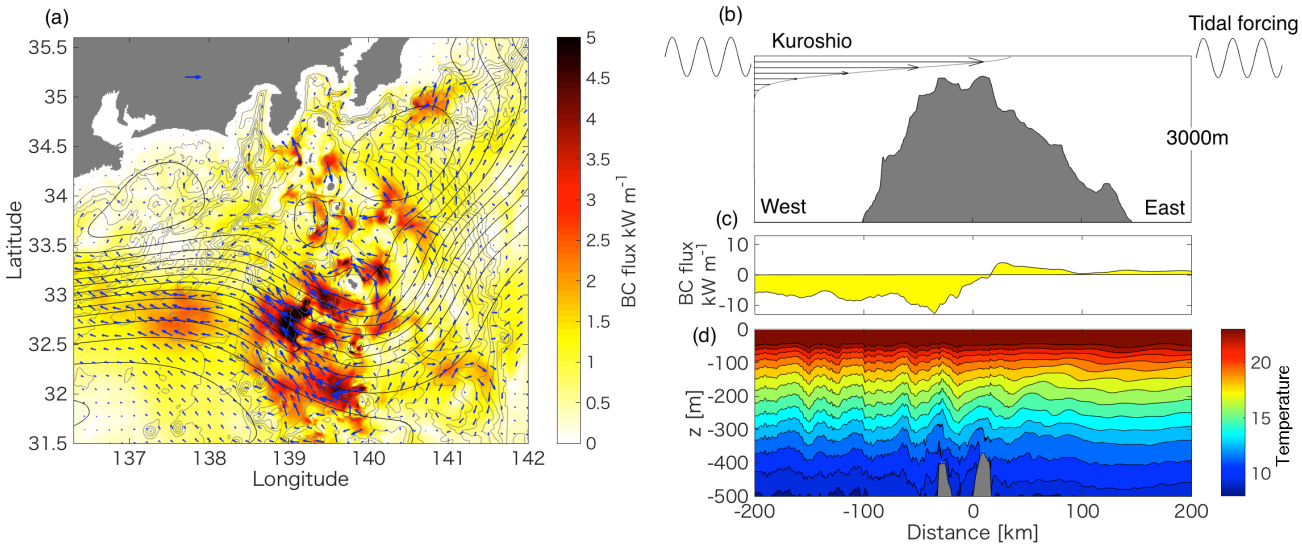
The Kuroshio and tides significantly influence oceanic environment off the Japan mainland. Tidally-induce highly nonlinear internal waves result in turbulent mixing and mass/heat transports. The Kuroshio generates strong eastward flows, the velocity reaching 2 m s^{-1}, which largely contributes to mass/heat transports in the northeast Pacific Ocean. Recent studies reported that barotrppic tides generate highly nonlinear internal waves over the Izu-Ogasawara Ridge. However, an interaction of the Kuroshio and tides/internal waves has not been reported in previous literatures. This study presents nonlinear internal waves excited by an interaction of tides and Kuroshio over the Izu-Ogasawara ridge. Numerical results from a 3D regional oceanic model (ROMS) showed strong internal wave flux form the ridge toward the upstream of the Kuroshio, the internal wave energy flux reaching 5 kW m^{-1}. To further investigate the interaction, a high-resolution nonhydrostatic oceanic model simulator, SUNTANS, was employed. Highly nonlinear internal waves propagate toward the west (upstream of the Kuroshio), and they were accompanied by solitary-like internal wave packets. The nonlinear internal waves were supposed to be generated by the westward internal wave flux against the eastward Kuroshio currents. The westward internal wave flux reached 12 kW m^{-1} under the condition of the Kuroshio velocity = 1 m s^{-1} and the semidiurnal tidal amplitude of 0.5 m. Such strong offshore ward internal waves may contribute to mixing and transport processes in deep ocean. Meanwhile, the eastward internal wave flux was weak, because the Kuroshio rapidly transport internal wave energy toward the offshore.

Keywords: Internal tides, Kuroshio, Nonlinear internal wawes



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