Eikonal Simulations for Energy Transfer in the Deep-Ocean Internal Wave Field near Mixing Hotspots

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In the proximity of mixing hotspots in the deep ocean, the observed internal wave spectra are usually distorted from the Garrett–Munk (GM) spectrum and are characterized by the high energy level E as well as the shear/strain ratio R_ω quite different from the corresponding value for the GM (R_ω = 3). On the basis of the eikonal theoretical model, Ijichi and Hibiya (IH) have recently proposed the finescale parameterization of turbulent dissipation rates in the deep ocean in terms of E and R_ω to reduce bias resulting from such spectral distortion. However, some simplifying assumptions are made in the theoretical model itself such as neglecting the vertical velocity associated with background internal waves and violating the WKB scale separation. To see the effect of such simplifying assumptions on the IH parameterization, this study carries out a series of eikonal simulations for energy transfer through various internal wave spectra distorted from the GM. Although the background vertical velocity as well as the strict WKB scale separation somewhat affects the calculated energy transfer rates, their parameter dependence is confirmed as expected from the IH parameterization; in other words, the calculated energy transfer rates εfollow the scaling $\varepsilon \sim E^2 N^2 f$ with N the local buoyancy frequency and f the local inertial frequency, and exhibit strong R_ω dependence quite similar to that predicted from the parameterization.

Keywords: Internal Wave Spectrum, Energy Transfer, Parameterization, Turbulence, Eikonal Simulation

