A new parameterization of turbulent mixing caused by tidal flow over abyssal rough bathymetry

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It is believed that tidal interaction with abyssal rough bathymetry can create mixing hotspots extending upward from the ocean bottom. Although there exist parameterizations of bottom-enhanced tidal mixing, they do not take into account that the internal waves generated by tide-topography interactions transform from *internal tidal waves* to *quasi-steady internal lee waves* as $k_H U_0 / \omega$ increases and exceeds unity (k_H is the horizontal wavenumber of the bottom topography; U_0 is the amplitude of the tidal flow; ω is the tidal frequency) (Mohri et al., 2010).

In this study, we formulate a new parameterization of tidal mixing over abyssal rough bathymetry in which the vertical decay scale of the energy dissipation rate (ε) is estimated by multiplying the theoretically obtained vertical group velocity of the *internal tidal wave* or the *quasi-steady internal lee wave* by the time scale of its nonlinear interaction (induced diffusion) with the background Garrett-Munk (GM) internal wave field (McComas and Müller, 1981). The resulting parameterization explicitly shows that the vertical decay scale of ε becomes independent of U_0 but inversely proportional to k_H squared when $k_H U_0 / \omega < 1$ and independent of k_H but proportional to U_0 squared when $k_H U_0 / \omega > 1$.

It is confirmed that the formulated parameterization predicts the vertical distribution of ε in agreement with that obtained from the eikonal calculation for the *internal tidal wave* or the *quasi-steady internal lee wave* propagating from the ocean bottom up into the background GM internal wave field (Iwamae et al., 2009; Hibiya et al., 2017).

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