Abstract View

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Direct Simulation of Internal Wave Energy Transfer

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ABSTRACT

A three-dimensional nonhydrostatic numerical model is used to calculate nonlinear energy transfers within decaying Garrett–Munk internal wavefields. Inviscid wave interactions are calculated over horizontal scales from about 1 to 80 km and for vertical mode numbers less than about 40 in an exponentially stratified model ocean 2000 m deep. The rate of energy transfer from these scales to smaller, numerically damped scales is used to make predictions of the dissipation rate ε in the open ocean midlatitude thermocline. In agreement with the theoretical analyses based on resonant interaction and eikonal theories, the simulation results predict $\varepsilon \propto \bar{E}^2 N^2$, where $\bar{E}$ and N are the internal wave energy density and the ambient buoyancy frequency respectively. The magnitudes of the simulated dissipation rates are shown to be in good agreement with the dissipation measurements taken from six diverse sites in the midlatitude thermocline. The results suggest that the rates of dissipation and mixing in the ocean thermocline are controlled by the nonlinear dynamics of the large-scale energy-containing internal waves.

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