Oceanic internal waves spectra:
Towards synthesis of observations, theory and DNS

Yuri V. Lvov, Kurt Polzin, Esteban Tabak, and Naoto Yokoyama

We present results of observations, theory and numerical simulations aimed at explaining the spectral energy density of internal waves in the deep ocean. Observations document substantial variability of spectral energy densities around the canonical Garrett–Munk spectrum both in terms of variability of spectral power law indices and deviations from power law behavior. We use our isopycnal Hamiltonian to derive a wave turbulence kinetic equation for describing the evolution of the internal wave energy spectrum. We show that the scale-invariant solutions to the kinetic equation leads to divergences for almost all spectral power-law exponents. These divergences come from resonant interactions with infra-red and/or ultra-violet wavenumbers with extreme scale-separations, and violate assumptions necessary to derive kinetic equation. We find one convergent steady state solution, and we also demonstrate that there are possible solutions for which infra-red and ultra-violet divergences are balanced. Our Direct Numerical Simulations are consistent with these findings. Finally, we elucidate on how a first principles theory for strongly interacting internal waves might be developed.