# Internal gravity waves as mediator of mixing and drag in the ocean circulation

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## *Abstract*

Internal gravity waves play a major role in the energetics of oceanic circulation. Powered by energy supply from mainly tides and wind they interact with the mean circulation and eddy field, ultimately transferring energy to small-scale turbulence by wave breaking, thus mediating the energy cascade from large-scale to small-scale motions and the feed-back via density mixing. Global climate models usually resolve at most a small part of the full spectrum of gravity waves so that mixing induced by waves and wave-mean-flow interaction need special parameterizations. An energetically consistent model of the mixing and wave drag requires a closed model of the wave energetics, including generation, wave-mean-flow interaction, nonlinear transfer within the wave field and dissipation. The IDEMIX (Internal wave Dissipation, Energetics and Mixing) framework meets these requirements by heavy truncation of the radiation balance equation: the energetics is formulated for the evolution of the wave field in phase space and reduced to a small number of compartments by integrals over respective parts of the spectral wavenumber space. The model is working in physical space - the global ocean - with wave propagation by spectrally averaged group velocities. The IDEMIX concept yields an energetically consistent and practical framework to describe wave effects and has been shown to be successful for ocean applications: it predicts plausible magnitudes and three-dimensional structures of internal wave energy, dissipation rates and diapycnal diffusivities in rough agreement to observational estimates. We briefly review the most important sources, sinks and interaction processes in which the gravity wave field in ocean is involved, placing emphasis on parameterizations suitable for implementation into a spectrally oriented radiative transfer approach. Wave breaking processes, critical layer effects and wave refraction in a sheared mean flow are specifically addressed in this discussion. The construction of IDEMIX models is illustrated.