Abstract View

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Scattering of Inertial Waves by Rough Bathymetry

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ABSTRACT

Interactions between near-inertial waves and rough bathymetry are studied theoretically and numerically. Rough bathymetric features cause scattering, even when their length scales are much smaller than the wavelengths of the incident waves. The scattering efficiency depends on the relative slopes of the incident wave propagation and bottom features. Scattered wavelength are comparable to wavelengths of the bathymetry. In a steady-state situation over an isolated bump, most of the kinetic energy is associated with upward propagating waves, in agreement with observations. A spectral model shows that first-mode incident waves with wavelengths >150 km, and second-mode waves with wavelengths >50 km are completely scattered into smaller wavelengths, primarily into wavelengths smaller than the bathymetry spectrum roll-off, 40 km. This model is applied to a spectrum of incident internal waves. The principal interactions involve the scattering of low-frequency, low-wavenumber incident waves into higher wavenumbers. Because of its higher wavenumbers, the scattered wave field has elevated shear levels and a Richardson number that is reduced by a factor of about 3.6 with respect to the incident wave field. A time-dependent numerical model simulates the evolution of wind-induced waves over rough bathymetry. All of the first vertical mode, containing about 35% of the initial energy, is scattered into higher modes after 40 inertial periods.