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INTERNAL TIDE SCATTERING AT MIDOCEAN TOPOGRAPHY

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By
Thomas Michael Shaun Johnston

Dissertation Committee:

Mark A. Merrifield, Chairperson
Eric Firing
Douglas S. Luther
Bo Qiu
Gary M. Barnes

ABSTRACT

The scattering of mode-one M_2 internal tides from 1) idealized Gaussian topography and 2) the Line Islands Ridge is examined with a primitive equation numerical model. Internal tide scattering at topography leads to a loss of energy to mixing and to a redistribution of energy flux in space, frequency, and mode number.

Scattering from idealized ridges focuses wave energy directly downstream, while scattering from seamounts produces azimuthal energy dispersion. Scattering to higher modes occurs in the lee of near- and supercritical seamounts and ridges. The Mellor-Yamada level-2.5 submodel parameterizes turbulent mixing. For the near- and supercritical ridges with realistic stratification, elevated mixing is found over the leading edge of the topography and along a tidal beam up to the first surface bounce. A transition from a beam structure near the topography to a low-mode structure further away occurs due to an increased contribution from the mode-one internal tide as it refracts around the topography and not due to turbulent dissipation.

At the Line Islands Ridge, runs with baroclinic and barotropic forcing are performed to distinguish scattered from locally-generated internal tides. Spatial and modal distributions of energy density and flux show internal tide scattering dominates at Hutchinson Seamount, while higher modes are generated locally at Sculpin Ridge. Hutchinson Seamount's slopes are steeper over a greater continuous area than Sculpin Ridge, which make Hutchinson Seamount a strong scatterer. Overall 37% of the incident mode-one energy flux is lost due to scattering into modes 2-5 (19%), dissipation by the model's turbulence parameterization (15%), and nonlinear transfer to the M_4 internal tide (3%). Two TOPEX groundtracks pass through the model domain roughly normal to the ridge topography and confirm the general features of the modal and spatial distribution found in the model.