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Internal Gravity Waves at Abrupt Topography
ARI: Flow over Abrupt Topography

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Research goals: Identification and modeling of the dynamical processes that determine the oceanic internal gravity wave spectrum, its evolution, and its variability. Understanding the role that internal waves play in the redistribution and mixing of momentum, potential vorticity, heat, and salt.

Objectives: Identification and modeling of the effects that irregular bottom topography exerts on internal gravity waves. Determining the significance of these effects by comparison with other known processes. Testing the idea that reflection and scattering of internal gravity waves at bottom topography and the subsequent (nonlinear) adjustment enhance wave breaking and mixing near topography.

Approach: Application of statistical scattering and wave–wave interaction theory. Evaluation of the scattering integral for typical internal wave and bottom spectra. Evaluation of the nonlinear adjustment of the scattered internal wave field from resonant wave–wave interaction.

Tasks completed: Derivation of the scattering integral in the limit that (i) the height of the topography is smaller than the internal wave vertical wavelength and (ii) the slope of the topography is smaller than the slope of the internal wave characteristic. Evaluation of the scattering integral for Garrett and Munk's 76 (Cairns and Williams, 1976) internal wave spectral model and Bell's (1975) bottom topography spectral model. Comparison with the redistribution of internal wave energy by reflection at a straight slope (Eriksen, 1985).

Scientific results: Both scattering at bottom topography and reflection at a straight slope redistribute part of the incident energy flux from low to high wavenumbers. The total redistributed flux is about 1 milliwatt per square meter (6% of the incident flux) for scattering and about 3 milliwatts per square meter for reflection. Scattering redistributes the flux to higher wavenumbers. The flux redistributed to horizontal wavenumbers larger than 0.1 cycles per kilometer is comparable for both processes, about 1 milliwatt per square meter.

Accomplishments: Derivation of the scattering integral describing the interaction of random internal waves with random topography. Evaluation of the scattering integral for typical internal wave and bottom spectra. Results show that scattering might be as efficient as reflection in causing high shears and boundary mixing.

References

Bell, T. H., 1975: Statistical features of sea–floor topography. Deep Sea Res., 22, 883–892.

Cairns, J. L. and G. O. Williams, 1976: Internal wave observations from a midwater float, Part II. J. Geophys. Res., 81, 1943–1950.

Eriksen, C. C., 1985: Implications of ocean bottom reflection for internal wave spectra and mixing. J. Phys. Oceanogr. 15, 1145–1156.

ONR–Sponsored Publications

PI Müller, P. and N. Xu: Scattering of internal gravity waves at random bottom topography.

R Holloway, G. and P. Müller, 1990: Topographic stress in the oceans. Trans. Amer. Geophys. Union, 70 (12), 343–344.

Statement "A" per telecon Dr. Alan Brandt. ONR/code 1122SS.

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PI Summary Data - for ONR programs
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PI Peter Muller

Statistics

	FY-90
Number of papers published in refereed journals	0
Number of papers submitted or in press, refereed journals	0
Number of books or chapters published, refereed non-serial publications	0
Number of books or chapters submitted or in press, refereed non-serial	0
Number of invited presentations at scientific conferences	0
Number of contributed presentations at scientific conferences	0
Number of technical reports and papers in non-refereed journals	1
Number of undergraduate students supported (at least part time)*	0
Number of graduate students supported (at least part time)*	1
Number of post-docs supported (at least part time)*	0
Number of other professional personnel supported (at least part time)*	1

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EEO and Minority Support Documentation

	FY-90
Number of female grad students	0
Number of minority grad students	0
Number of Asian grad students	1
Number of female post-docs	0
Number of minority post-docs	0
Number of Asian post-docs	0

FY 89 Patents and Awards

Please list Patents filed or granted and Awards, Honors and Prizes.