Abstract View

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Scattering of Sound by Internal Wave Currents: The Relation to Vertical Momentum Flux

W. Munk and P. Worcester

Scripps Institution of Oceanography, La Jolla, CA 92093

F. Zachariasen

California Institute of Technology, Pasadena, CA 91109

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ABSTRACT

Internal waves scatter sound by two related perturbations: 1) those associated with vertical particle displacements $\zeta(x, y, z, t)$ in the presence of a vertical gradient of (potential) sound speed ($\delta c = \zeta_z c_p$); and 2) those associated with horizontal particle velocities $u(x, y, z, t)$. The combined fractional perturbation in propagation velocity is $\delta c/c + u/c$. The second term, generally neglected, introduces a nonreciprocity when source and receiver are interchanged. Nonreciprocity is expected to be relatively small except for transmission along a deep downward loop. The principal internal wave contribution to nonreciprocity is from inertial frequencies. The sum and difference of reciprocal travel times are a measure of ζ and u, respectively, along the ray path,, the quadrature spectrum of reciprocal travel times is related by an integral equation to the spectrum of the momentum flux $\langle \zeta u \rangle$. Precise measurements of nonreciprocity could provide an estimate of the vertical momentum flux in an internal wave field.