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Inertia-Gravity Waves Emitted from Balanced Flow: Observations, Properties, and Consequences

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This paper describes laboratory observations of inertia-gravity waves emitted from balanced fluid flow. In a rotating two-layer annulus experiment, the wavelength of the inertia-gravity waves is very close to the deformation radius. Their amplitude varies linearly with Rossby number in the range 0.05–0.14, at constant Burger number (or rotational Froude number). This linear scaling challenges the notion, suggested by several dynamical theories, that inertia-gravity waves generated by balanced motion will be exponentially small. It is estimated that the balanced flow leaks roughly 1% of its energy each rotation period into the inertia-gravity waves at the peak of their generation.

The findings of this study imply an inevitable emission of inertia-gravity waves at Rossby numbers similar to those of the large-scale atmospheric and oceanic flow. Extrapolation of the results suggests that inertia-gravity waves might make a significant contribution to the energy budgets of the atmosphere and ocean. In particular, emission of inertia-gravity waves from mesoscale eddies may be an important source of energy for deep interior mixing in the ocean.