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How oceanic Rossby waves break: Preliminary results from the Mid-Ocean Dynamics Experiment

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How do Rossby waves break in the ocean? In the atmosphere one has weather in the troposphere, and the stratosphere is sufficiently near radiative equilibrium that one might invoke radiative damping as an important diabatic process. Neither of these processes is relevant to the ocean. In the ocean, the standard concept is to consider the stratified interior as an ideal fluid and place all dissipative processes in either the bottom boundary layer or associate them with eddy/mixed layer interactions. This conceptual framework is typically abetted by a lack of sufficient observations to construct energy, momentum and vorticity budgets that might point to "missing forces".

Conducted during March-July of 1973, the Mid-Ocean Dynamics Experiment (MODE) was one of the first concentrated studies of mesoscale ocean variability. The experiment featured arrays of moored current meters, neutrally buoyant floats, standard hydrographic station techniques and the use of novel vertically profiling instrumentation.

Vertical profiles of horizontal velocity obtained with a free-falling instrument using a electric field sensing technique [Sanford, 1975: Observations of the vertical structure of internal waves. *J. Geophys. Res.*, **80**, 3861–3871] provided, for the first time, direct estimates of the high vertical wavenumber structure of the ocean internal wavefield. The data were assumed to be representative of the background internal wavefield and thus, despite some evidence of excess downward energy propagation [Leaman and Sanford, 1975. Vertical energy propagation of inertial waves: a vector spectral analysis of velocity profiles. *J. Geophys. Res.*, **80**, 1975–1978] that was interpreted in terms of atmospheric generation [Leaman, 1976. Observations on the vertical polarization and energy flux of near-inertial waves. *J. Phys. Oceonogr.*, **6**, 894-908.], provided the basis for a revision to the isotropic Garrett and Munk spectral model [Garrett and Munk,

1975. Space-timescales of internal waves. A progress report. *J. Geophys. Res.*, **80**, 291–297].

Rather than representing the background wavefield, those data appear to represent a stunning example of internal wave capture [Bühler and McIntyre, accepted, Wave capture and wave-vortex duality. *J. Fluid Mech.*] in a mesoscale strain field. Implications for mesoscale ocean dynamics and the “missing forces” problem will be addressed.