Nonlinear interactions of inertia-gravity modes and planetary waves in rotating fluid flows

T. W. N. Haine [1], P. D. Williams [2] and P. L. Read [3]

[1] *Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, USA (thomas.haine@jhu.edu)*
[2] *Centre for Global Atmospheric Modelling, Department of Meteorology, University of Reading, UK (p.d.williams@reading.ac.uk)*
[3] *Atmospheric, Oceanic and Planetary Physics, Clarendon Laboratory, Oxford University, UK (read@atm.ox.ac.uk)*

Inertia-gravity waves exist ubiquitously throughout the stratified parts of the atmosphere and ocean. They are generated by local velocity shears, interactions with topography, and as geostrophic (or spontaneous) adjustment radiation. Relatively little is known about the details of their interaction with the large-scale flow, however. This talk reports on a joint model/laboratory study of a flow in which inertia-gravity waves are generated as spontaneous adjustment radiation by an evolving large scale mode.

The impact on the large-scale dynamics is generally small. In certain circumstances, however, the fast waves can exert a dominant influence. In a flow which is baroclinically-unstable to a range of zonal wavenumbers, and in which there is a close match between the growth rates of the multiple modes, the fast waves can strongly affect wavenumber selection. The fast waves also appear to force spontaneous wavenumber transitions in the large-scale flow, which do not occur in their absence. These phenomena can be viewed as a stochastic resonance effect. One important implication is that deterministic subgrid-scale parameterizations in general circulation models, such as gravity wave drag, cannot always capture the full nonlinear interaction.