Date: February 28

Time: 11:00 AM

Location: Ames 234

Speaker: Dr. Samar Khatiwala
Lamont Doherty Earth Observatory, Columbia University

Title: "Generation of internal tides in a fluid of finite depth: Analytical and numerical calculations"

Abstract

Mixing in the abyssal ocean is known to play an important role in controlling the large scale ocean circulation. In the search for sources of mechanical energy for mixing, internal tides generated by the interaction of the barotropic tide with bottom topography (``mode conversion") have been implicated. However, estimates of the rate at which barotropic tidal energy is converted into the internal wave field are quite uncertain. Here, I present analytical and numerical calculations of internal tide generation in a fluid layer of finite depth to better understand the energetics of the wave generation process. Previous theoretical models of wave generation have assumed an upper radiation boundary condition appropriate for an ocean of infinite depth. But recent observations of internal tides at significant distances from their generation region indicate that this boundary condition is not always valid, and that reflection from the upper surface is important. I show that the presence of an upper free-surface reduces the rate at which energy is fed into the internal wave field (the power) and thus the energy available for mixing. This reduction increases with the horizontal extent of the topography (relative to the wavelength of a mode-1 internal wave. Fully non-hydrostatic, nonlinear numerical calculations are used to both test the theory and to explore more realistic parameters for which linear theories are formally invalid. As bottom topography becomes steeper, linear theory underestimates mode conversion by an increasing amount, although even at critical slope the difference is quite small (O (20%)). An important finding of this study is that for certain topographic shapes the power input into the wave field can saturate as the topography becomes supercritical. A comparison of model results with a recent finite amplitude theory suggests that even though finite become important when the topography is of finite amplitude. The results of process studies such as this should lead to improved estimates of mode conversion in the ocean.