JOINT
APPLIED MATHEMATICS COLLOQUIUM & PHYSICAL MATHEMATICS SEMINAR

"On the Spontaneous Generation of Inertia-Gravity Waves in Geophysical Flows"

Leslie M. Smith
(University of Wisconsin-Madison)

Abstract: The equations governing atmosphere-ocean flows are multi-scale in space and time, and thus mathematical and physical understanding has been based largely on reduced models valid for limiting parameter regimes. One of the simplest such reduced models is the celebrated quasi-geostrophic (QG) equation, valid as the buoyancy frequency and the frame rotation rate both become relatively large. However, the QG equations filter out all inertia-gravity waves, and thus cannot capture the spontaneous generation of waves nor other important effects such as cyclone/anticyclone asymmetry. Methods to include wave effects include slaving and WKB. Here we show how to derive a hierarchy of non-perturbative models intermediate between QG and the full governing equations, by successively adding back more and more classes of wave-vortical interactions. We use the model hierarchy to shed light on the spontaneous generation of inertia-gravity waves from balanced initial data, as well as on the formation and evolution of geophysical vortices.

For an initially balanced dipole, the spontaneous generation of inertia-gravity waves increases the speed of the dipole and causes a cyclonic drift in the trajectory of the dipole. For random initial data, we identify the class of wave-vortical interactions necessary for generation of vortices with appropriate size and orientation.

Monday April 29, 2013
4:30PM
Building 4, Room 145

Applied Math Colloquium: http://www-math.mit.edu/amc/spring13/
Mathematics Department: http://www-math.mit.edu

Massachusetts Institute of Technology
Department of Mathematics
Cambridge, MA 02139