



COLLOQUIUM  
UNIVERSITY OF CENTRAL FLORIDA

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**Eleftherios Gkioulekas**

**University of Washington**

will speak on

**The Nastrom-Gage energy spectrum of the atmosphere, proposed theoretical explanations and the double cascade theory**

An analysis of wind and temperature measurements taken during the Global Atmospheric Sampling Program by Nastrom and Gage showed that there is a robust  $k^{-3}$  spectrum extending from approximately 3,000 km to 1,000 km in wavelength and a robust  $k^{-5/3}$  spectrum extending from 600 km down to a few kilometers. Attempts to explain these energy spectra in terms of the theory of two-dimensional turbulence has led to considerable confusion.

Tung and Orlando have demonstrated numerically that a two-layer model forced at large scales by baroclinic instability can reproduce the observed energy spectrum of the atmosphere. We will present recent theoretical results that explain why this model works. We have shown that for the case of finite Reynolds number, the enstrophy cascade of two-dimensional turbulence is accompanied with a hidden downscale energy cascade. Both cascades provide contributions to the energy spectrum that combine linearly, despite the nonlinearity of the governing Navier-Stokes equations. A mathematical constraint prevents the contribution of the downscale energy cascade from becoming dominant in the inertial range. However, in a two-layer model, this mathematical constraint is violated. The violation is caused by the baroclinicity induced by the presence of Ekman damping on the bottom layer but not the top layer.

**DATE:** Thursday, April 20, 2006  
**TIME:** 11:30 A.M. – 12:30 P.M.  
**PLACE:** Math and Physics Building, Room 233