Weekly CEAFM Seminar: Fall 2014

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Date: **Friday, September 5, 2014**

Time: 11:00 AM

Location: Gilman Hall # 132

Speaker: **Prof. Elie Bou-Zeid** (Princeton University)

Title: ***"New insights into the dynamics of the stably-stratified Ekman boundary layer from direct and large-eddy simulations"***

Abstract

The activation of buoyant forces in wall-bounded flows, through wall heating or cooling; for example, results in significant modifications to the structure and dynamics of turbulence that further complicate an already-challenging problem. However, understanding and parameterizing turbulent fluxes in such flows remains critical for a wide range of geophysical, environmental, and engineering applications. Statically-stable flows, where buoyant forces damp turbulent kinetic energy (TKE), are particularly challenging due to the potential breakdown of Kolmogorov's theory and to the emergence of laminar regions, gravity waves, and other complicating flow patterns.

To develop a more fundamental understanding of how buoyancy influences turbulence in such statically stable flows, direct numerical simulations and large eddy simulations of turbulent boundary layers with rotation (Ekman boundary layers) are performed. Under the highest stabilities, global intermittency (the almost compete decay of turbulence and then its regeneration) is observed. The intermittent bursts are important to study under these conditions since they become the main agent of vertical transport in the SABL. Under more moderate stabilities, continuous turbulence is maintained, but it is significantly damped compared to neutral flows. This reduction of the TKE under stable conditions is very well known; however, in this presentation, we show that it is mainly triggered by reduced mechanical production associated with reduced transport of Reynolds stresses from aloft toward the surface, rather than by direct destruction of TKE by buoyancy. This raises questions about the suitability of some conventional stability parameters, such as the flux Richardson number, in describing the influence of buoyancy in such flows. Finally, variability of surface temperature is shown to result in unexpected flow patterns: TKE is potentially higher under the more stable patches due to advection, and the subsidence and lofting of air over the different patches can counteract the effect of spatial TKE variability on the vertical fluxes.