## MMM SEMINAR

NCAR

## Large-Eddy Simulations and Damped-Oscillator Modeling of Unsteady Ekman Boundary Layers

## Elie Bou-Zeid

Department of Civil and Environmental Engineering Princeton University

The Ekman boundary layer is a central problem in geophysical fluid dynamics that emerges in atmospheric and oceanic boundary layers when pressure gradient forces, Coriolis forces, and molecular or turbulent friction forces interact in a flow. The equations describing the transient version of the problem, which occurs when these forces are not in equilibrium such as when the pressure gradients are changing in time, are solvable analytically only for a limited set of forcing variability modes, and the resulting solutions are not succinct nor easy to interpret. In this talk, we demonstrate that the problem can be formally reduced to a second-order ordinary differential equation that is very similar to the dynamical equation of a mass-spring-damper (damped oscillator) system. In parallel, we conduct large-eddy simulations (LES) of various unsteady cases that reveal the distinct responses of the ABL and their dependence on the ratio of the natural frequency of the ABL over the frequency of the forcing variability. The LES also serves to refine and validate the damped oscillator model. The combined analysis elucidates the physical origin of the inertia (mass), energy storage (spring), and energy dissipation (damper) attributes of the Ekman layer.

This seminar will be webcast live at: http://www.fin.ucar.edu/it/mms/fl-live.htm

Recorded seminar link can be viewed here: https://www.mmm.ucar.edu/events/seminars

Thursday, 20 November 2014, 3:30 PM Refreshments 3:15 PM NCAR-Foothills Laboratory 3450 Mitchell Lane Bldg 2 Main Auditorium, Room 1022

> MMM SEMINAR COORDINATORS Rich Rotunno, 303.497.8904, rotunno@ucar.edu Chris Snyder, 303.497.8966, chriss@ucar.edu http://www.mmm.ucar.edu/events/seminars