Boulder Fluid Dynamics Seminar Series

Tuesday, October 14, 2014
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado at Boulder

Numerical Simulation of Gravity Wave Breaking in the Middle Atmosphere

Thomas Lund, *Northwest Research Associates*

The earth's stably stratified atmosphere supports a broad spectrum of internal (gravity) waves that are effectively launched by sources involving vertical displacements, such as convective storms or winds blowing over mountainous terrain. Much like waves on the surface of the ocean, atmospheric internal waves can transport momentum and energy over distances measured in thousands of kilometers. Furthering the analogy with surface waves, atmospheric internal waves can break, thereby releasing their associated momentum and kinetic energy. An important distinction with surface waves is that internal waves are constrained to propagate at an angle inclined to the horizontal. The vertical component of propagation not only provides the mechanism for breaking, but it also dictates that the waves deposit their momentum and energy at altitudes well above the source regions. It is common for internal waves to break within the stratosphere, where they become an important source of turbulent mixing in this otherwise stable region. Under the correct conditions, internal waves can propagate much higher - into the mesosphere and even the lower thermosphere before breaking.

Direct numerical simulation is used as a tool to investigate the mechanisms responsible for internal wave breaking and to assess the resultant mixing and modifications to the mean winds. The results of these studies have lead to the construction of improved internal wave parameterizations needed by larger scale atmospheric models that cannot resolve the wave breaking process.

My Model Has Too Many Parameters! Active Subspaces for Dimension Reduction

Paul Constantine, *Colorado School of Mines*

CFD models often contain several imprecisely specified parameters that must be calibrated or inferred from measurements. Unfortunately, methods for such inference struggle when the number of parameters is large. The benefits of dimension reduction cannot be overstated. If one is able to approximate a model with hundreds of inputs by a comparable interface with a handful of derived inputs, then several otherwise intractable techniques (e.g., optimization, inverse calibration, response surface construction) become possible.

I will discuss our research efforts and progress on active subspaces for dimension reduction, including tests that discover if such dimension reduction is possible and strategies to exploit it when present.