PLEASE POST

MMM SEMINAR *ASP*

The Evolution of Nonhydrostatic Meteorological Modeling: from Cloud to Global Scales

Joe Klemp

National Center for Atmospheric Research
Boulder, CO

Nonhydrostatic processes in the atmosphere are characterized by features in which the horizontal and vertical length scales are comparable. Because the fully compressible equations of motion admit acoustic modes as well as gravity-wave and rotational modes, much early modeling emphasis focused on developing efficient numerical techniques to accommodate these fast moving the sound waves, which are typically not of meteorological interest. Several approaches have evolved over the years to mitigate these acoustic constraints, employing either semi-implicit or split-explicit time integration techniques, filtered (anelastic) equation sets, or artificial compressibility approximations. Early 3-D nonhydrostatic modeling in the 1970's-80's focused heavily on idealized simulations of moist convective storms. Due to the significant limitations in computing power, strong emphasis was placed on developing upper and lateral boundary conditions for relatively small model domains that allow the outward propagation of gravity-wave energy with minimal reflection. By the 1990's, nonhydrostatic research models with full physics were being successfully employed to forecast the evolution of convection in real weather systems, and by the next decade the use of nonhydrostatic numerical weather prediction (NWP) models for operational regional/mesoscale forecasting became routine. With the continuing advances in computing power, it is now becoming feasible to consider running global atmospheric models at high resolutions O(km) that require the inclusion of nonhydrostatic processes. In designing the numerical techniques for global nonhydrostatic models, strong emphasis is placed on conservation properties and on scalability to large numbers of processors. After considering alternative approaches, we are developing a global nonhydrostatic Model for Prediction Across Scales (MPAS) using finite-volume numerics with C-grid staggering on a variable resolution unstructured Voronoi (nominally hexagonal) mesh for the horizontal discretization on the sphere. These numerics are intended to provide a unified modeling system that is well suited for future NWP, regional-climate, and climate applications.

Thursday, 20 February 2014, 3:30PM
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/sem/seminars.html