Geophysical Research Abstracts, Vol. 8, 04344, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04344

Predicting hurricane landfall location and timing with the Ocean-Land-Atmosphere Model (OLAM)

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The Ocean-Land-Atmosphere Model (OLAM) has been developed to extend the capabilities of the Regional Atmospheric Modeling System (RAMS) to a global modeling framework. OLAM is a new model with regard to its dynamic core, grid configuration, memory structure, and numerical solution technique. It solves a finite-volume analog of the full compressible Navier-Stokes equations in conservation form, and exactly conserves mass, momentum, and internal energy. It uses an unstructured grid and pentahedral grid cells (with a triangular footprint), which easily conform to the sphere without a coordinate transformation. OLAM's grid configuration enables local mesh refinement to any degree without the need for special grid nesting algorithms; all communication between regions of different resolution is by conservative advective and diffusive transport. It represents topography using a form of the volume-fraction or shaved grid cell method in which model levels are strictly horizontal, rather than terrain-following, and therefore intersect topography. Grid cell face areas, which explicitly appear in the finite volume equations and are pre-computed and stored, are reduced in proportion to any blockage by topography, thereby correctly regulating intercell transport and preventing advective flux normal to the ground surface. Apart from its dynamic core and grid configuration, OLAM adopts many of the well established methods that were developed in RAMS and uses the same physical parameterizations for microphysics, land/vegetation water and energy balances, radiative transfer, and sub-grid cumulus convection. OLAM's capability and sensitivity to various parameters (including resolution and initialization) is demonstrated with the simulation of hurricanes that devastated the USA in 2004 and 2005.