Climate Science: Roger Pielke Sr.

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A Global/Mesoscale Modeling Breakthrough

A new GRL paper on applying fine scale spatial resolution in a global model has appeared. This is a major engineering breakthrough and provides a means to avoid some of the pitfalls of dynamic downscaling of a gobal model using a different mesoscale/regional model (see).

The article (subscription required) is by

Shen, B.-W.; Atlas, R.; Chern, J.-D.; Reale, O.; Lin, S.-J.; Lee, T.; Chang, J. is entitled "The 0.125 degree finite-volume general circulation model on the NASA Columbia supercomputer: Preliminary simulations of mesoscale vortices" Geophys. Res. Lett., Vol. 33, No. 5, L05801

The abstract reads,

" The NASA Columbia supercomputer was ranked second on the TOP500 List in November, 2004. Such a quantum jump in computing power provides unprecedented opportunities to conduct ultra-high resolution simulations with the finite-volume General Circulation Model (fvGCM). During 2004, the model was run in realtime experimentally at 0.25 degree resolution producing remarkable hurricane forecasts (Atlas et al., 2005). In 2005, the horizontal resolution was further doubled, which makes the fvGCM comparable to the first mesoscale resolving General Circulation Model at the Earth Simulator Center (Ohfuchi et al., 2004). Nine 5-day 0.125 degree simulations of three hurricanes in 2004 are presented first for model validation. Then it is shown how the model can simulate the formation of the Catalina eddies and Hawaiian lee vortices, which are generated by the interaction of the synoptic-scale flow with surface forcing, and have never been reproduced in a GCM before."

An extract from the conclusion states ("GCMS' refer to Global Circulation Models and "MMs" refer to Mesoscale Models),

"Traditionally, GCMs and MMs have been developed by different research groups with different goals. Because of a breakthrough in computing power provided by the Columbia supercomputer, the 0.125° fvGCM becomes one of a few mesoscale resolving GCMs, and has a resolution comparable to the first mesoscale GCM at the Earth Simulator Center, and to the finest resolution of the NASA QuikSCAT 12.5 km seawinds data. Numerical simulations of mesoscale vortices, which include three major hurricanes, the Catalina Eddy and Hawaiian vortices in 2004, have been discussed to demonstrate the model's capability of simulating scale interactions between convection and large-scale flow, between coastal surface forcing and synoptic-scale flow, and between high mountains and nonlinear flow. To our knowledge, the fvGCM is the first to simulate the formation of these mesoscale vortices in a global environment"

The model has already demonstrated important potential predictive skill with hurricane track (see Shen et al., 2005: Hurricane forecasts with a global mesoscale resolving model on the NASA Columbia Supercomputer preliminary simulations of Hurricane Katrina (2005)).

This new pioneering model will permit improved understanding of climate processes. It also is a challenge to other global/regional/mesoscale modeling groups.