

The NRL Nested-Grid Limited-Area Numerical Weather Prediction Model

Simon Wei-Jen Chang

U. S. Naval Research Laboratory, Washington, D. C. 20375

Abstract

The limited-area numerical weather prediction system at the U. S. Naval Research Laboratory (NRL) has recently been improved to include a one-way interacting, movable, multiple nested grid system.

The new limited-area forecast system at NRL contains four major components: the analysis, the initialization, the dynamic model, and the output package. The Barnes successive correction scheme is used in the regional and mesoscale analyses. A quality control procedure has been added to eliminate spurious data, and a sectionalized method is utilized to save time and to limit error propagation. A vertical mode initialization for the nested grid are standard, but model predictions can start from the uninitialized fields, the nondivergent wind fields, or the nondivergent static balanced fields. The governing equations and the model physics are the same as the uniform grid NRL model. That is, the equations of the model are in surface-pressure-weighted flux primitive form for curvilinear horizontal and vertical coordinates. The model physics include simple radiation, dry convective adjustment, latent heat release in nonconvective clouds, a multi-layer planetary boundary layer, convective precipitation and internal diffusion. The spatial finite difference forms of the governing equations are fourth-order. A split-explicit scheme with a time-averaging filter is used for temporal integration.

A nesting ratio of 1:3 is used for the fully-staggered Arakawa C grids in the model. A relaxation method is used for both the exterior and interfacial lateral boundaries. The result shows that perturbations at larger grid propagate smoothly into the small grid and it is not necessary to apply additional horizontal diffusion at grid interfaces. The small grid always resolve better mesoscale features and predict lower minimum pressures of cyclones, even with the same terrain smoothness as the coarse grid.

Research efforts associated with the uniform and nested-grid versions of the NRL limited-area prediction model will be discussed. These include simulation studies of winter storms, simulation of hurricane with dropsonde data, and numerical experiment with SSM/I observed rainfall rates.