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Hazardous weather prediction using the WRF NMM

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The NCEP Nonhydrostatic Mesoscale Model (NMM) has been developed building on NWP experience within the WRF effort. The dynamical core of the model was designed following the so called mimetic approach first introduced by Arakawa. With this approach important properties of the continuous equations and differential operators are preserved in the discrete system. The conservation of energy and enstrophy improves the accuracy of the model's nonlinear dynamics. Despite the complexity of the formulation, the computational efficiency of the model has been significantly higher than the computational efficiency of most nonhydrostatic models. The NMM is one of the two models that are currently within the Weather Research and Forecasting (WRF) Model infrastructure.

The NMM has been run operationally in NCEP with single digit horizontal resolution and 60 unequally spaced levels in the vertical. In addition, the model is used for fire weather forecasting and other purposes on call. In terms of performance, statistical scores and numerous examples indicate that the NMM adds value to the forecasts of the driving model. Despite promising results, prameterization of moist convection suitable for high horizontal resolutions that are still insufficient for explicit simulation of this process remains an outstanding issue.

A major effort has been under way aimed at preparing an end to end operational meso scale data assimilation and forecasting system based on the WRF NMM. The WRF NMM is scheduled to replace the Eta as the main operational regional forecasting model for North America in the early summer of 2006. Further developmental work on the Eta model has been terminated.

In addition to operational forecasting the model has been tested in many case studies and several validation campaigns. Further evidence has been gathered during the

exceptionally active tropical storm season of 2005 about the WRF NMM ability to predict tropical storms realistically, and efforts are under way to implement it operationally as the Hurricane WRF in 2007. The WRF NMM participated again in 2005 in a carefully controlled springtime experiment in which the model was run at near-cloud resolving horizontal resolution of 4.5 km without parameterized convection. As in a similar test the previous year, the model demonstrated ability to spin-up severe convective systems on the 24 hour time scale more frequently, and with stronger signal, than if this were happening only by chance. This added weight to earlier results that indicated that further improvements in deterministic forecasting of severe weather phenomena may be achieved with increased resolution. Due to high interest, the model in the described configuration has been run throughout the year providing additional information in severe weather events other than springtime convective activity. It remains to be seen in what way and how much further increase in resolution may be able to improve the forecasts of severe weather.