WRF-NMM: An operational Multiscale Hurricane Forecasting System

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At NCEP we are exploring the possibilities of adopting the WRF-NMM core for hurricane predictions. During the first phase of this effort, based on the existing WRF-NMM model and physics options, we have developed an "end-to-end" hurricane forecasting system that will be tested for this season (2004) at about 18 km uniform horizontal resolution over a “fair-sized” domain for hurricane predictions, spanning about 75^0 x 75^0. The GFDL hurricane prediction system was adopted as the yardstick for this configuration. Some preliminary testing of historical cases for the season-2003, including, Hurricane Claudette, and Hurricane Isabel, in terms of tracks, illustrates satisfactory performance. Figure 1 shows the forecasted stream lines at about 850 mb, 4 days in advance (i.e., valid 00 Z on Sep 19, 2003) for a simulation of Hurricane Isabel, initialized using WRFSI at 00 Z on Sep 15, 2003

As a precursor to nesting, we investigated the impact of resolution on some of the historical cases. Fig. 2, for instance, provides the stream lines and wind speed at 850 mb level for Hurricane Claudette at the end of 24 hours for a simulation starting on July 13, 2004 obtained from a run with horizontal resolution of, respectively, 12 km and 8 km Indeed, as expected (see for instance, Gopalakrishnan et al., 2002 and Liu, et al.,1997), the higher resolution gives a stronger forecast storm.

Further, we are in the process of extending the WRF-nesting capability to the E-grid-based, WRF-NMM core for the hurricane problem. Figure 3 shows a nested E-grid configuration for a nested:parent grid ratio of 1:3. Bi-linear interpolation technique was developed and tested within the framework to interpolate most of the meteorological variables from the Lat-Lon grid of the mother domain on to the corresponding grid of the nested domain. The nearest-neighbor interpolation may be adopted to most of the static fields. Development is continuing in the direction of "force" and "feedback" for communication between the domains. We also propose to use, for future operational application, a 3D variational analysis to provide appropriate initial conditions.

References:

S.G.Gopalakrishnan and co authors: An Operational Multiscale Hurricane Forecasting System, 2002, Mon. Wea. Rev., 2002, Vol. 130, No 7, pp. 1830-1847

Liu, Y., D.-L.Zhang and M.K.Yau, 1997: A multiscale numerical study of Hurricane Andrew (1992): Part I: Explicit simulation and verification. Mon Wea. Rev., 125, 3073-3093

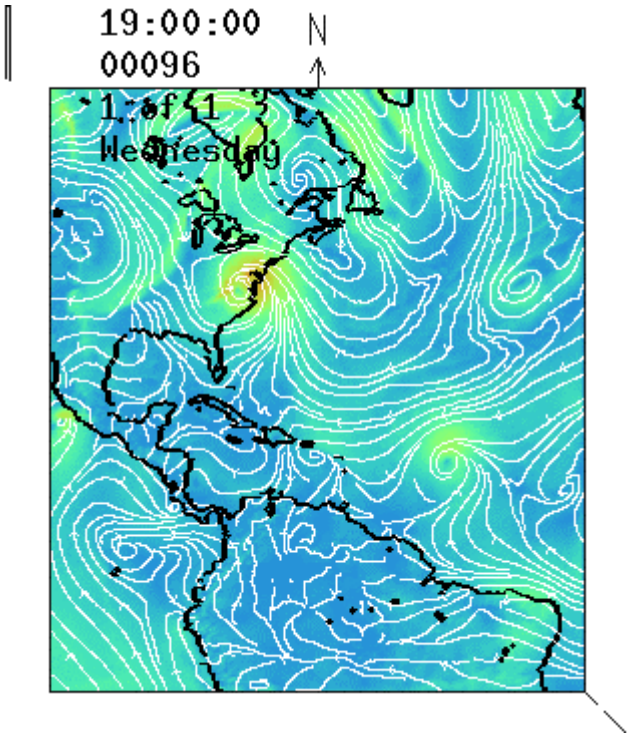

Fig. 1: stream lines and wind speed at about 850 mb level for Hurricane Isabel after four days of forecast for a simulation starting on Sep 15, 2004.

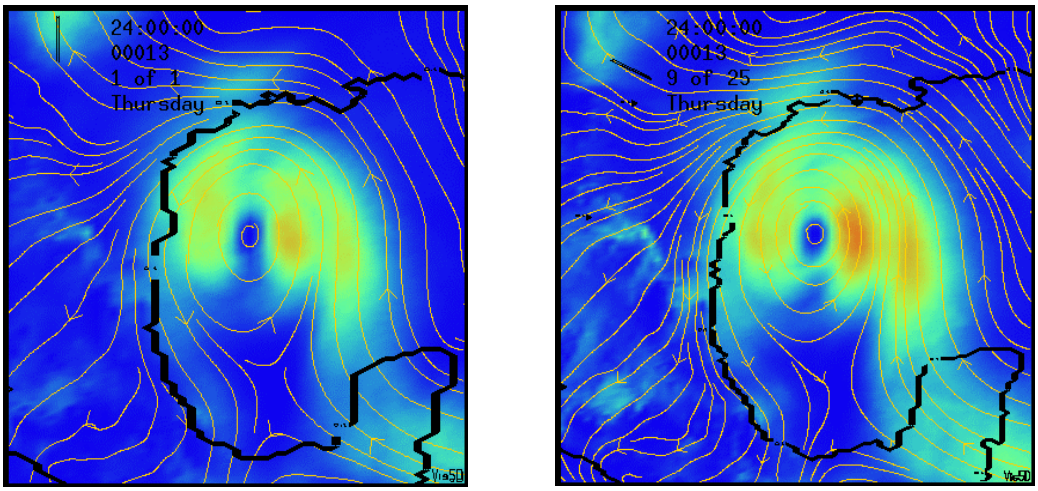

Fig. 2: stream lines and wind speed at about 850 mb level for Hurricane Claudette at the end of 24 hours for a simulation starting on July 13, 2004 obtained from a run with horizontal resolution of, respectively, 12 km and 8

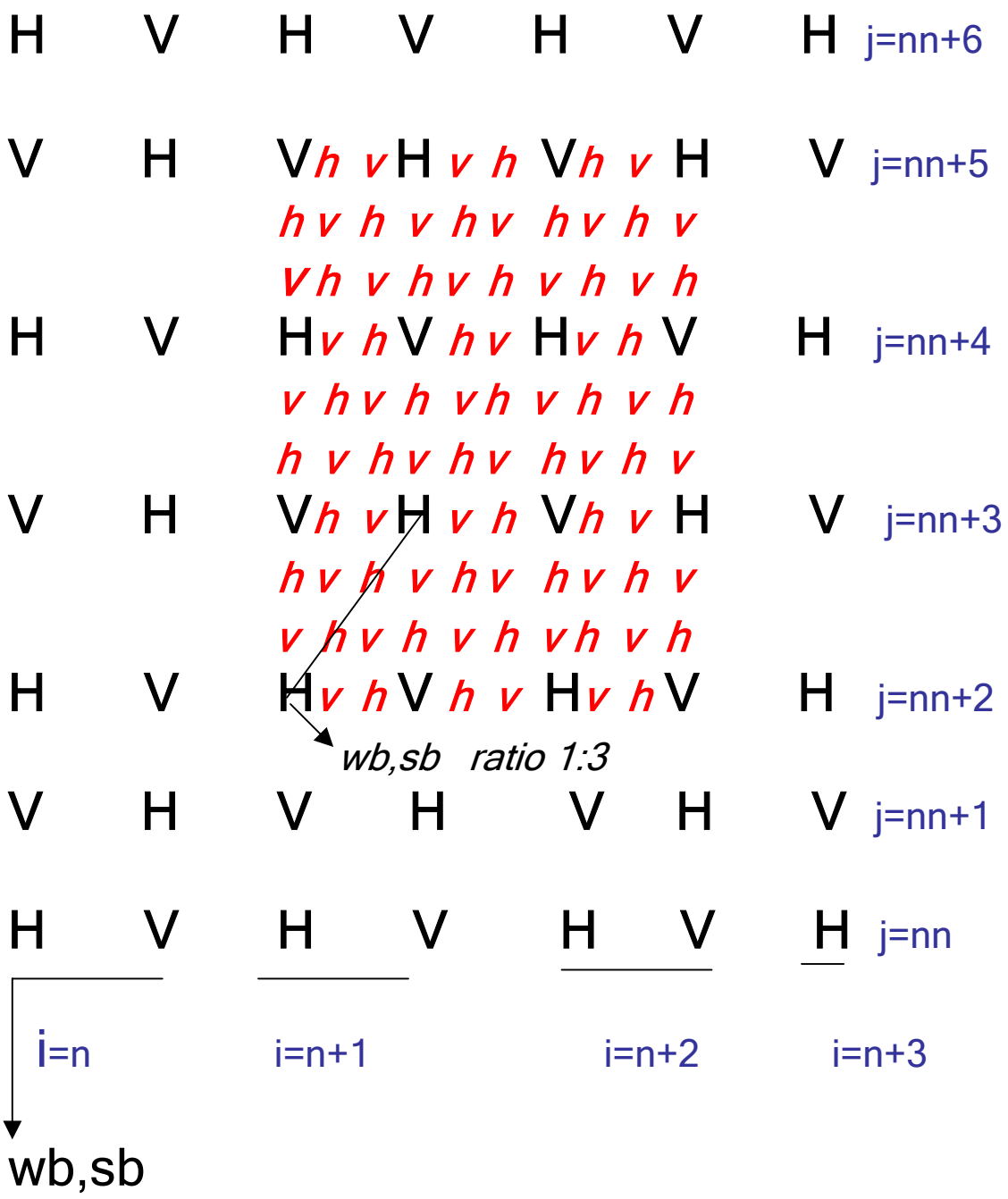

Figure 3: Structure of a nested E-grid for a parent to nest ratio of 3:1