Joint Hurricane Testbed (JHT) Program

For the
Environmental Modeling Center/National Centers for Environmental Prediction
5200 Auth Rd
Camp Springs, Md. 20746

Hurricane Model Transitions to Operations at NCEP/EMC

Robert E. Tuleya, Weixing Shen, S. Gopalkrishnan and Hua-Lu Pan (EMC/NCEP)

May (2004) to January (2005) Progress Report

This proposal calls for the continuation of funded work on the GFDL hurricane model upgrades as well as the initiation of a prototype Hurricane forecast system. The second area of work is the commencement of the transition from the GFDL to WRF model that is scheduled to become the next operational hurricane model in ~2007. The progress toward these tasks and goals are indicated in italic directly in the original 2nd year Time Line given for this project. Additional results will be given in more detail at the 59th IHC meeting in March.

Time Line

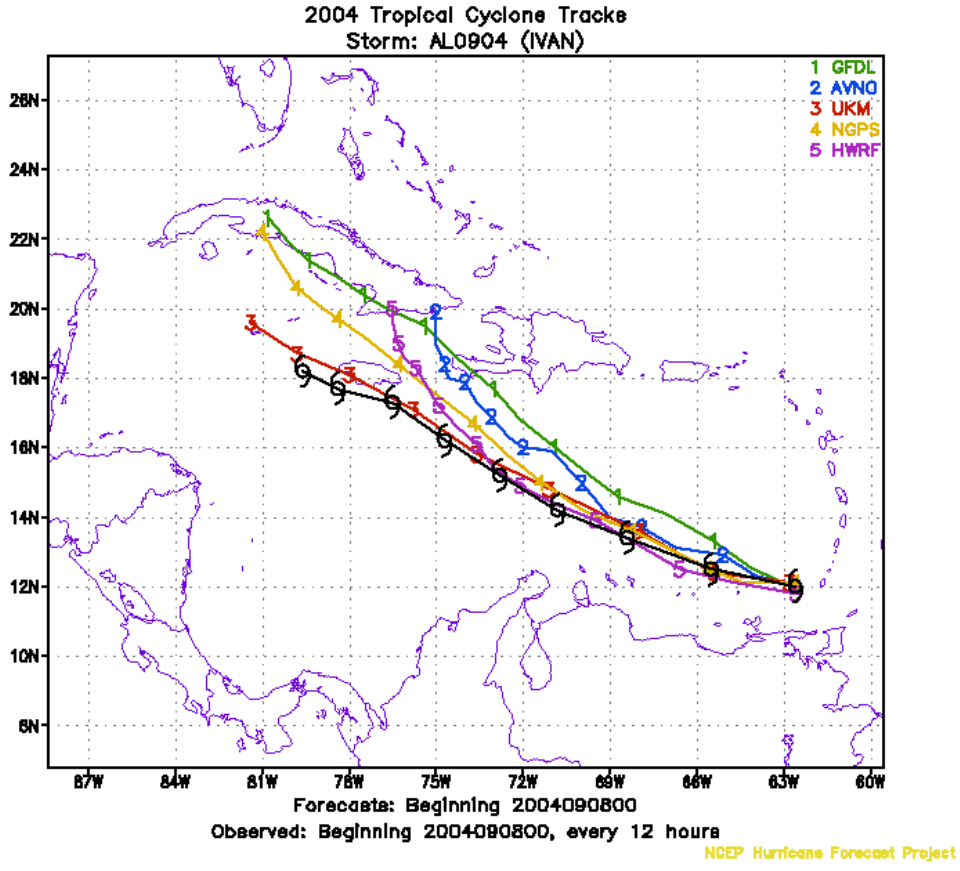
Year Two: July 2004 to July 2005

1) Run bulk microphysics packages for test suite to test forecast performance.

Code has been successfully implemented into GFDL system for the Ferrier scheme. Several cases have been tested including Hurricane Frances. The code was generalized to be able to use either the Lin or the Ferrier scheme. In making comparisons with the Lin scheme it was found that the Ferrier scheme led to stronger storms which should be an advantage. Bender found that cloud microsphysics resulted in a physically more realistic storm, but the intensity and track of the forecsts were somewhat degraded. Since it appears that the high resolution 3-nest GFDL configuration will be operational and consume considerable computer resources, it has been decided that cloud microphysics at the high resolution will be more physically consistent and will be run in test mode this summer. There remains issues implementing microphysics into a nested configuration. Problem areas include how to blend the microphysics package with other convective parameterizations and also with large scale condensation.

2) Evaluate Hurricane WRF proto-type model and forecast system. Compare Hurricane WRF to GFDL model with WRF physics packages.

A uniform-mesh WRF proto-type system was successfully installed and run at NCEP this past season. Forecasts were made on a routine basis at 00UTC and at other times as well. The system included making 4-day forecasts starting from GFS initial conditions using the NMM dynamic core at a uniform resolution of ~18km with 42 levels. An entire automated system was utilized which monitored NHC storm requests and initiated an HWRF forecast. The system included a post-processing system which had a storm tracker system which generated storm information identical to the operationall atcf-unix format. Over 120 forecasts were made. The system was found to be robust with few failures and competitive with the operational guidance. Most of these runs were with Eta-type physics and GFS initial conditions. Recently progress has been made with using GFDL initial conditions (GFDL specified vortex) and GFDL and GFS physics packages. The figure below shows an example of the comparsion of the HWRF system with some standard operational models. A more objective validation of the HWRF system will be made now that the HWRF can be run from GFDL initial conditions and with a physics package similar to the operational GFDL model.



3) Begin testing nested and movable nest WRF model when available.

Recently, nested integrations have been started with emphasis on one-way interaction between nests. The next tasks in nesting are grid movement and 2-way interaction. Some of these tasks will hopefully be carried over in the upcoming 2005-2005 JHT proposal.

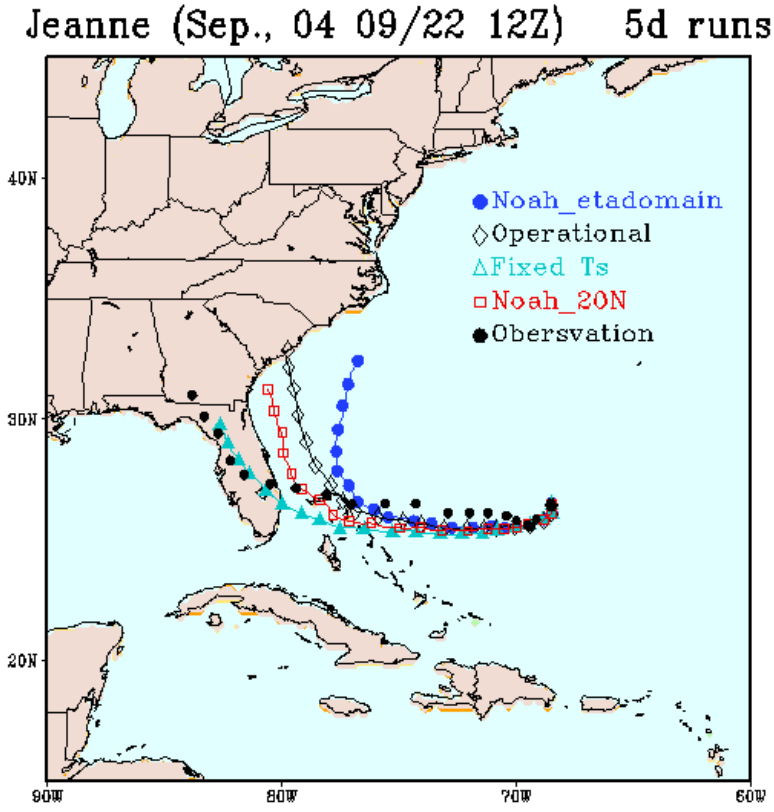
4) In collaboration with Bender, determine feasibility of installing GFDL model upgrades into the 2005 operational suite.

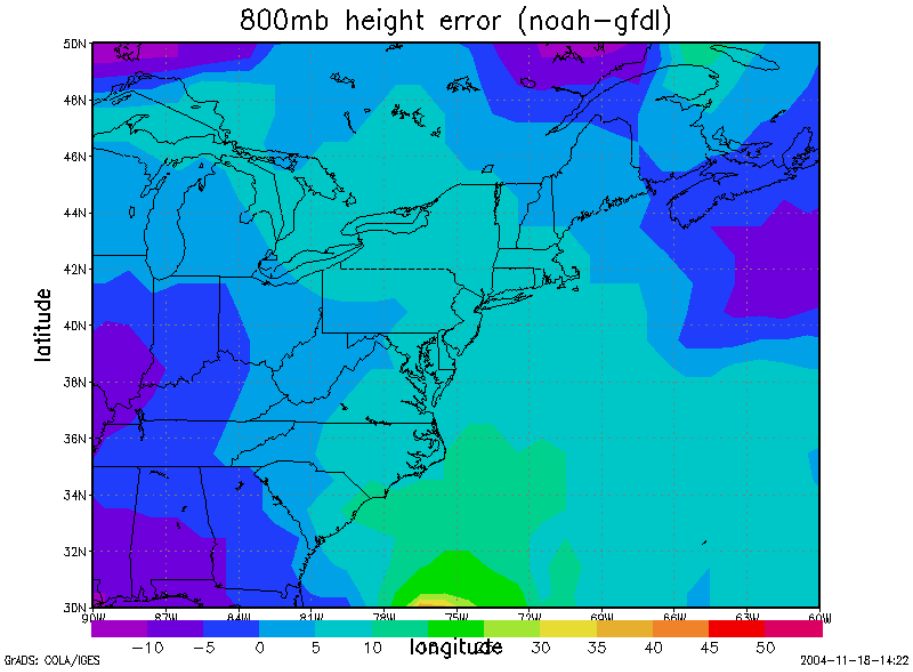
As mentioned, it has been tentatively decided to run the 3-nesed version of the GFDL model next year. Bender has reported impressive improvements in track especially at day 4 and with a high resolution inner nest. Before making this decision, Weixing Shen created an operational version of the coupled NOAH land model for the 2004 GFDL configuration. Earlier preliminary experiments found that precipitation and, to a lesser extent, track forecasts were superior to the operational GFDL model which uses a slab land model. However, these experiments were only run for 3 days. A more complete suite of experiments were run for 5 days forecasts emphasizing landfall cases. Quite surprisingly, degradation was found in the track forecasts in the day four and five day forecast positions. The enclosed table illustrates the track degradation beyond one day.(GLND is the GFDL model coupled with the NOAH land model;GNIT is an upgraded GFDL with improved initial vortex specification.) Considerable time has been spent on diagnosing the reasons. One of the issues is the rather high values of land temperatures predicted with the NOAH LSM. As a whole, there are indications that the overall synoptic forecasts may be at least a good, if not superior, to the operational GFDL forecast. However, shortcomings like spurious ridge breakdown, have led to track deviation, especially at day four and five. Therefore, the operational implementation of the coupled GFDL NOAH LSM has to be delayed. Two enclosed figures show an example of the track degradation for the case of Jeanne. Rather surprisingly an experiment with fixed land surface temperatures gave better results than either the operational GFDL or the test GFDN. A second figure shows the increased 800mb height error of the GLND compared to the operational GFDL. Notice the increase of error in GLND (negative height anomalies) compared to the operational GFDL along the eastern seaboard emanating from Jeanne off the Florida coast. Studies will continue to correct this problem and to verify the GFDL coupled land rainfall fields more objectively using rainfall verification techniques specifically designed for hurricanes.

AVERAGE TRACK ERRORS (NM) FOR HOMOGENEOUS SAMPLE

	00	*12*	*24*	*36*	*48*	*72*	*96*	*120*
GLND	*6.0*	*25.0*	*38.8*	*55.8*	*66.0*	*104.5*	*194.4*	*331.6*
GNIT	*5.6*	*24.8*	*38.8*	*52.6*	*63.1*	*94.8*	*173.6*	*288.4*
GFDL	*6.2*	*24.9*	*41.4*	*54.5*	*65.5*	*103.2*	*180.6*	*289.0*
CLP5	*4.8*	*28.4*	*60.7*	*105.2*	*156.0*	*278.4*	*399.5*	*519.6*
#CASES	*48*	*48*	*48*	*48*	*48*	*48*	*48*	*46*

Noah_etadomain:	Noah lsm on the Edas land + slab over the rest
Operational:	Slab lsm over land
Fixed Ts:	Fixed land surface temperature everywhere
Noah_20N:	Noah lsm above 20N + fixed over the rest





5) Determine the feasibility of running operationally a Hurricane WRF proto-type forecast system for the 2005 season.

Last year's 2004 success of running the proto-type version of HWRF leads to the conclusion that an upgraded version of HWRF will be run this season. Probably several versions will be run including a version with GFDL phsyics and initial conditions. This will likely be run both in uniform and nested mode. Close attetion will be made to the track and intensity results. In additon, some experiments will likely be made using the HWRF data assimilation system which is under development. The HWRF plan calls for HWRF to have its own forecast analysis cycle with the ability to assimulate high resolution data.