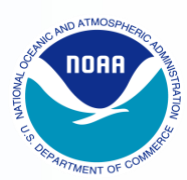




HIWPP/NGGPS Program Status Meeting Feb 9-10, 2016, College Park, MD



A Brief Update on the Hurricane Nest Project

S. G. Gopalakrishnan (Gopal)
NOAA/AOML/HRD, Miami, FL

V. Tallapragada
EMC/NCEP, College Park, MD
&

T. Quirino
NOAA/AOML/HRD, Miami, FL

In collaboration with:

HWRF Team and Meso-Scale Modeling Branch, EMC/NCEP, College Park, MD

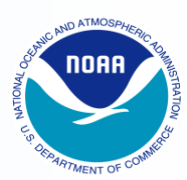
Acknowledgements:

T. Schneider, R. Atlas, F. Marks, G. DiMego and F. Toepfer





The Team



AOML Team

T. Quirino (Nesting)
S. Diaz (Initialization)
X. Zhang (HWRF transitions)
J. Delgado (Software developments)
J. Prusa (Idealized framework)
G. Alaka (Analysis/diagnostics)
S. Goldenberg (verification)
R. St.Fleur (Automation)
S.G.Gopalakrishnan (Analysis/Physics)

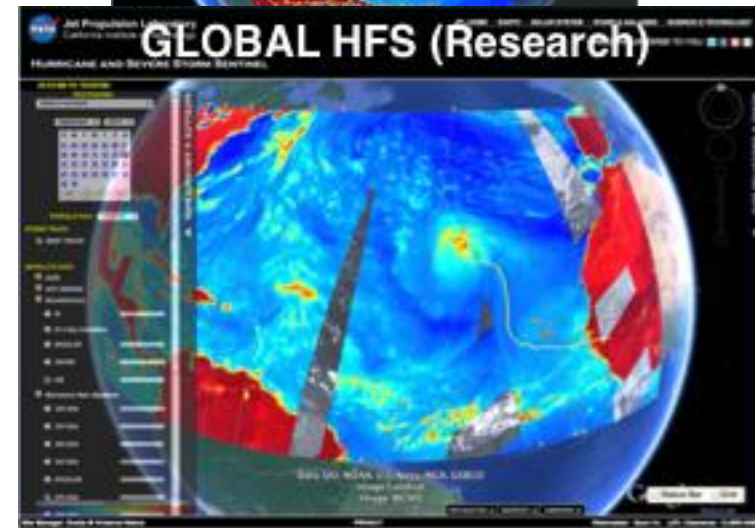
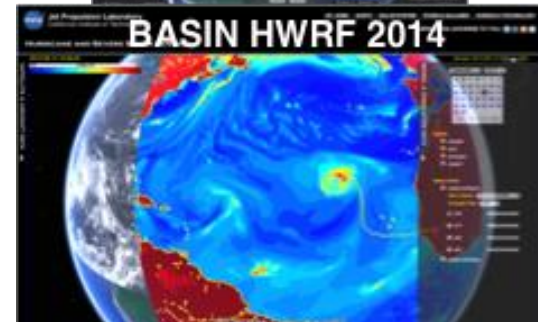
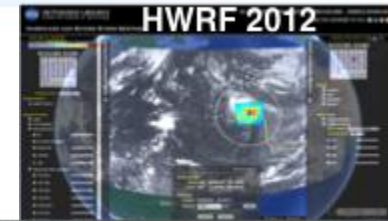
EMC Team

T. Black (Nesting)
M. Pyle (NPS)
Q. Liu (Initialization)
W. Wang (Physics)
S. Trahan (Nesting & Vortex tracker)
L. Zhu (Idealized framework)
B. Liu (Coupling)
M. Tong (Data Assimilation)
V. Tallapragada (Diagnostics)



Project Goals

- Create the next-generation HWRF within NEMS framework (HNMMB) capable of better capture of multi-scale interactions, critical for land fall applications. This modeling system (regional) will have a very high potential to transition to operations
- Proof-of-concept of Global tropical cyclone model with multiple moveable nests placed around all tropical systems in the world
- Options to test HWRF nests in HNMMB/NEMS framework with initial and boundary conditions from different hydrostatic and non-hydrostatic global models being developed in this HIWPP effort will be made available to other collaborators





Milestones



Project Statement: “The success of HWRF in track, intensity and structure forecasting lies not only in its nesting capability but also in its physics package, part of which was advanced at AOML using hurricane core observations and the hurricane initialization technique that was developed at NCEP. All three hurricane-specific components from HWRF (nesting, physics and vortex initialization) will be transitioned to the NMMB/NEMS framework before testing the model for providing improved tropical cyclone track and intensity forecast guidance in a multi-scale environment.”

Milestones	Completed
Configuration & Testing	Dec 2014
HWRF Physics Transitions	Sept 2014
Idealized Framework	April 2015
HWRF Vortex Tracker	Jun 2015
HWRF Vortex Initialization & Cycling	Dec 2015
Semi-Real Time Testing	On-going
Multi-Season Testing, Verification, Rainfall Evaluation	Proposed to be done for single nested configuration at EMC



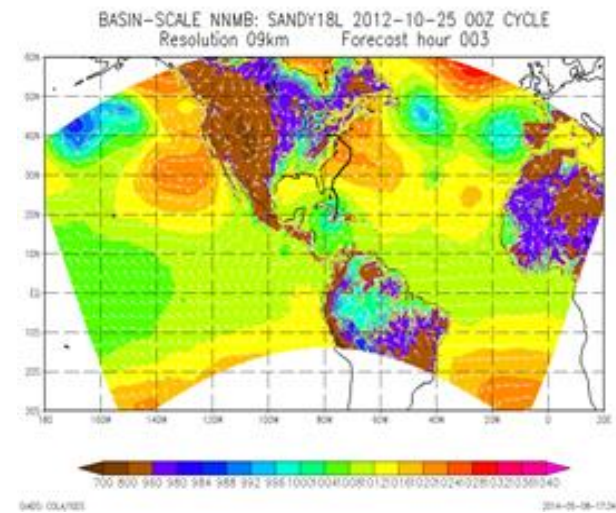
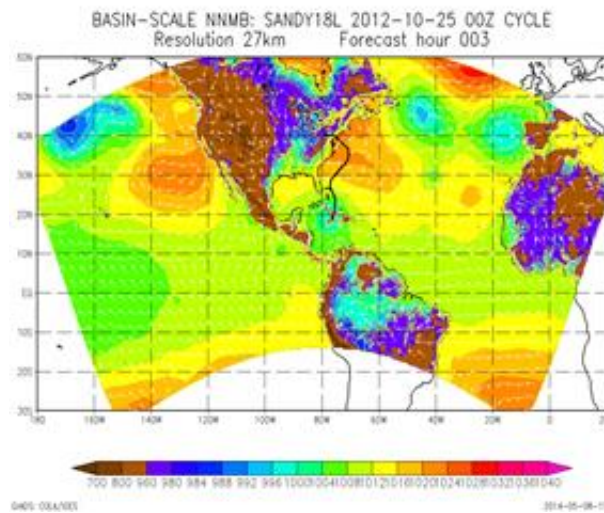
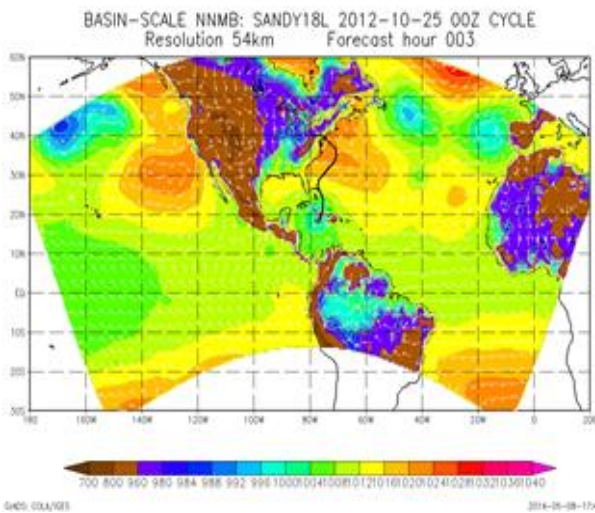
Configuration and Testing (May 2014)

Project Statement: “NMMB/NEMS is the adopted pathway for operational regional scale applications at NCEP. Extending that for multi-scale hurricane forecast applications should provide a seamless pathway towards next generation operations. The strategy to incorporate HWRF capabilities into the NMMB is consistent with recommendations made by the UCACN to consolidate the number of operational modeling systems within NOAA. Also, this project will leverage on NOAA’s success with HWRF and support from HFIP towards creating the next-generation HWRF within NEMS framework.”

54 km: 359 x 157 grid w/61 levels
Runtime: **4 minutes**

27 km: 716 x 313 grid w/61 levels
Runtime: **13 minutes**

9 km: 1988 x 868 grid w/61 levels
Runtime: **2 hours 10 minutes**

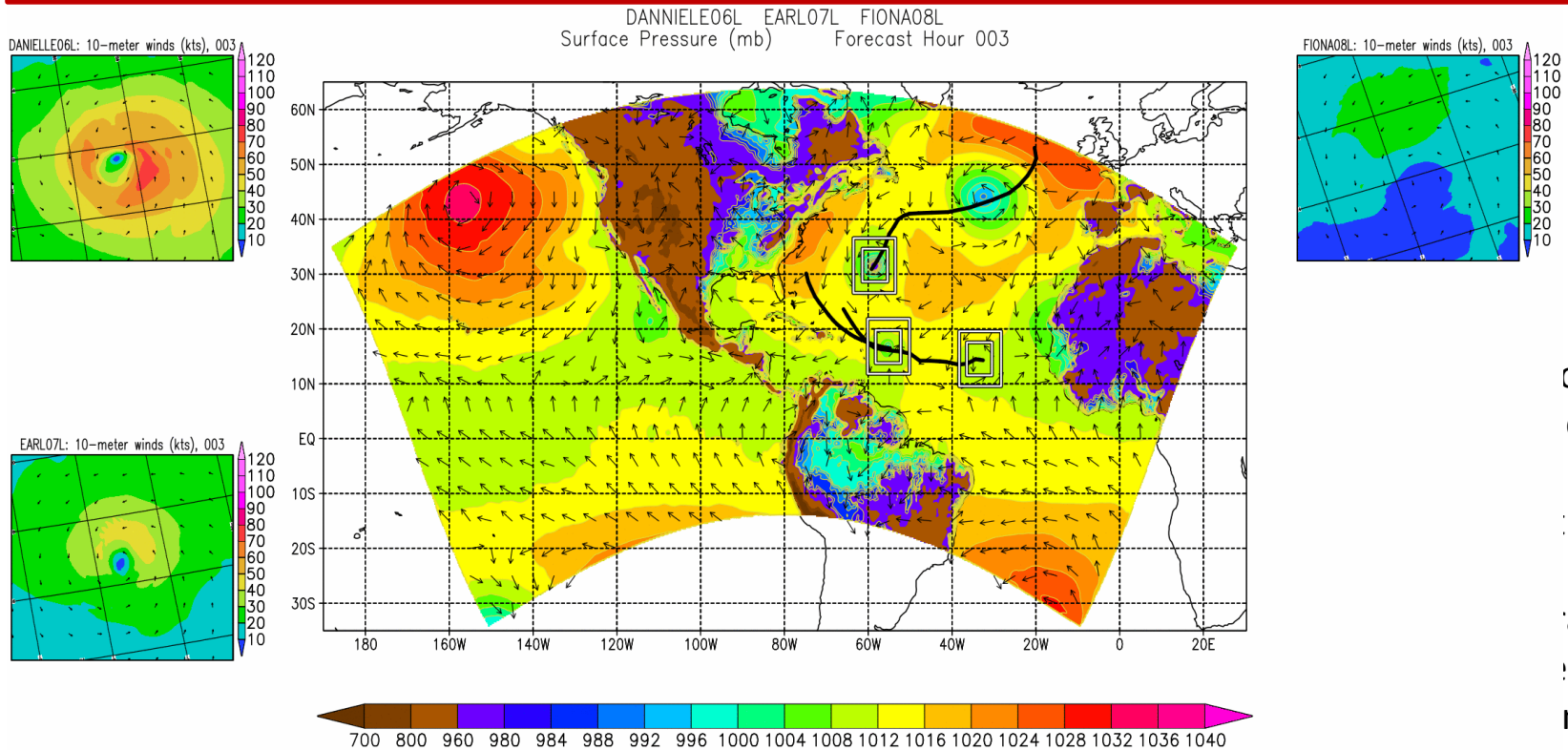


All cases: 7 day fcst on 576 processors; GFDL radiation; MYJ;BMJ; Ferrier; NOAH LSM

- Uniform **3 km** basin scale run in progress – needs more dedicated nodes
- Uniform **3 km** basin scale HNMMBB will be used as base line for testing 2-way interactions

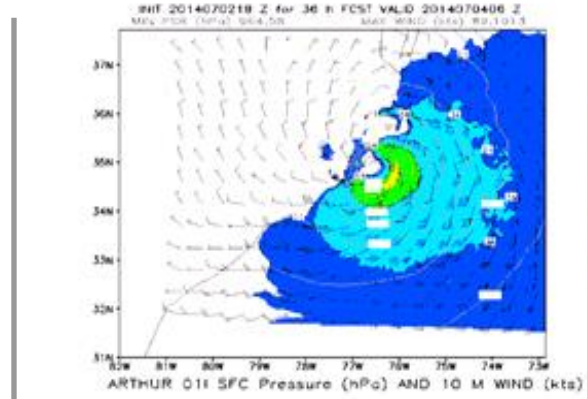
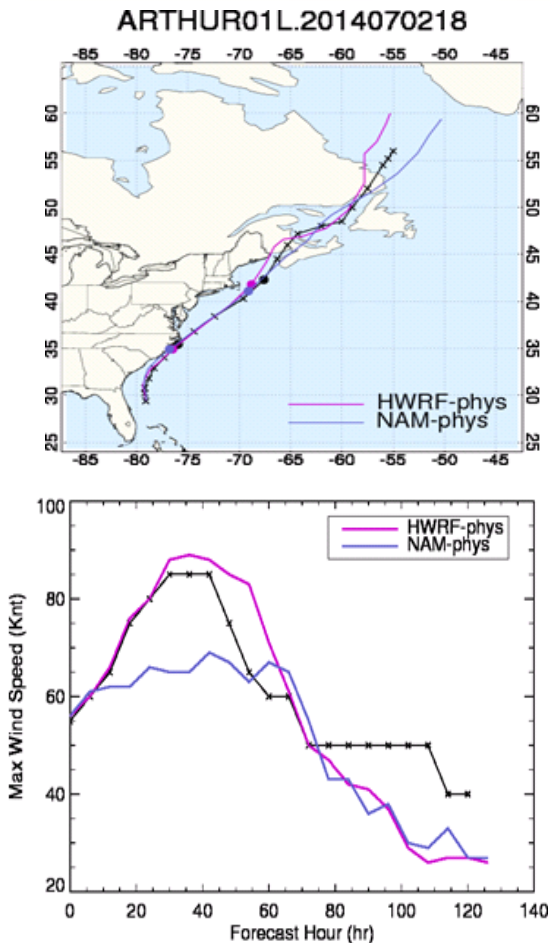
The HNMMB/NEMS system (Oct 2015)

Project Statement: “The current operational HWRf configuration is storm centric, not ideal for representing multi-scale interactions or for post land fall applications, and is greatly limited in extending forecast lead times beyond 5 days. Key for improving near land fall (size) and post land fall applications (rainfall) and for extending forecast lead times beyond 5 days lies in the creation of a multi scale model (eventually covering the entire globe) with **multiple moving nests at 1-3 km resolution covering all the storms in the basin.**”

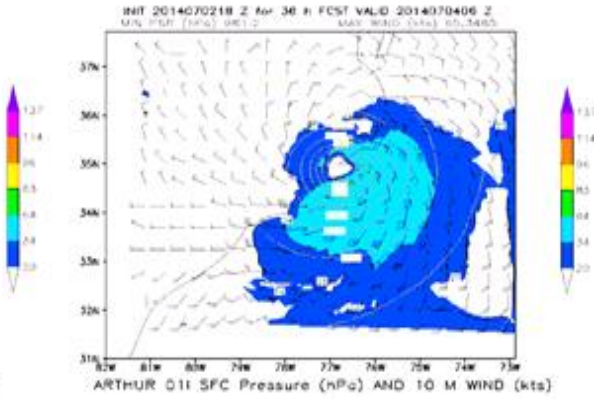
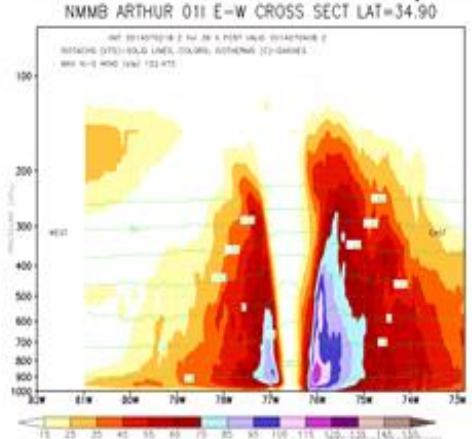


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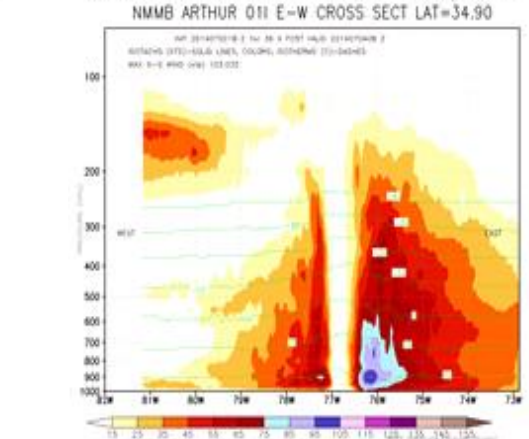
The HNMMB/NEMS system: Transition of HWRF Physics



NMMB w/HWRF Physics



NMMB w/NAM Physics



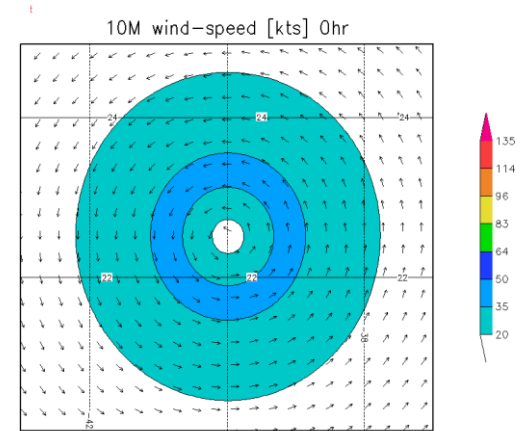
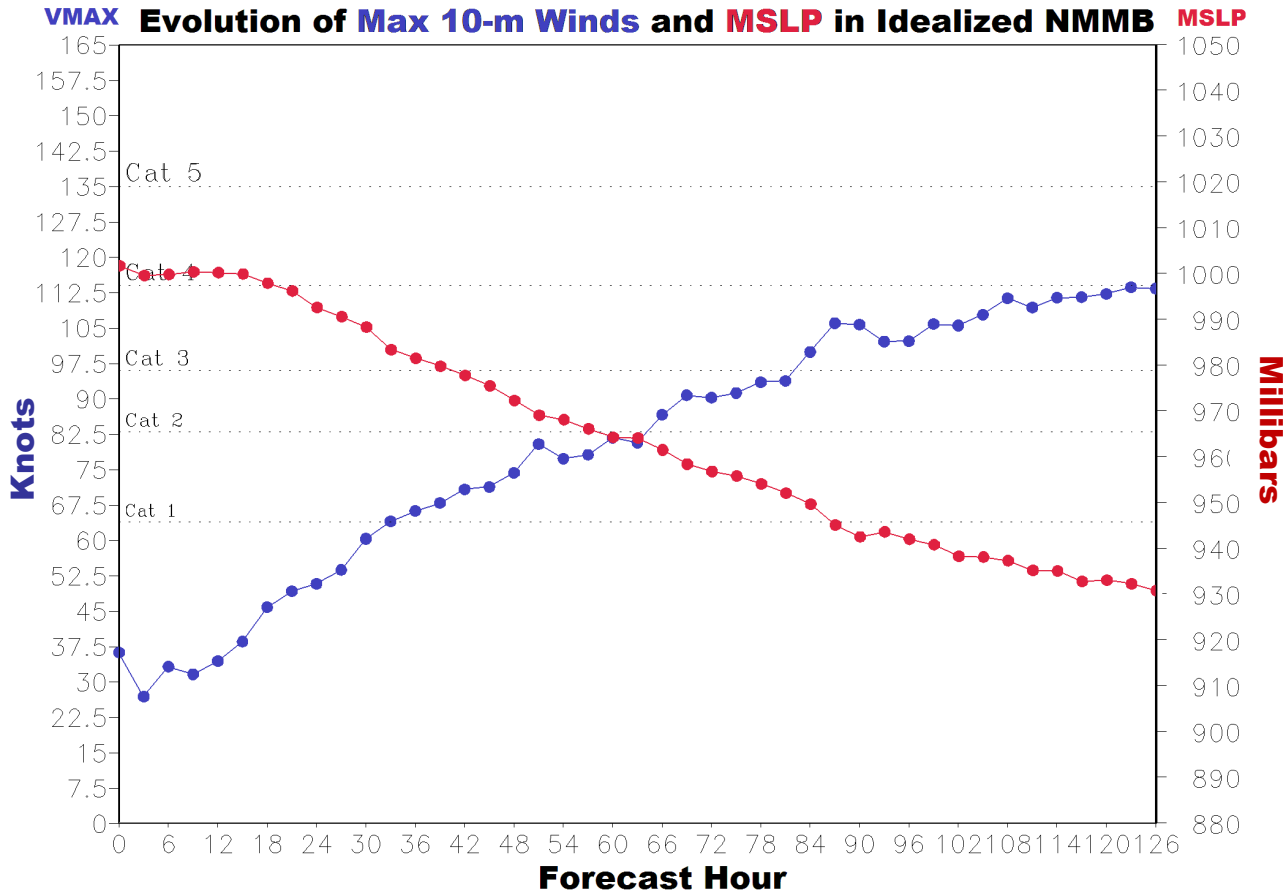
NMMB with HWRF physics showed track, intensity, and landfall characteristics similar to the operational HWRF (not shown) and closer to the observations than NMMB with NAM physics.



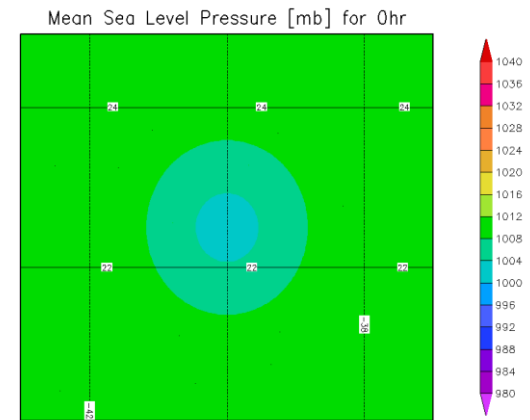
Transition Idealized TC Framework for HNMMB



Project Statement: Develop Idealized & Semi-Idealized capability for hurricane simulations in HNMMB.



Initial date: 2010082618



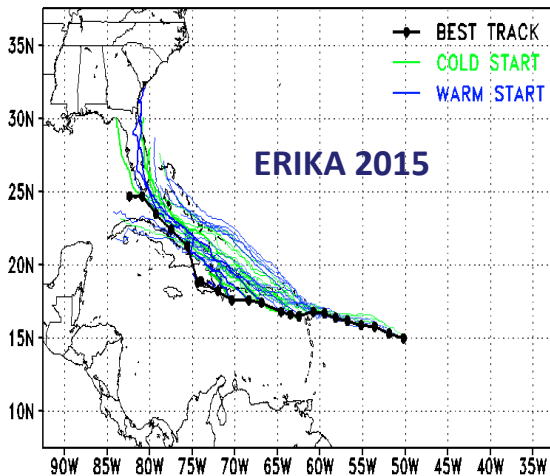
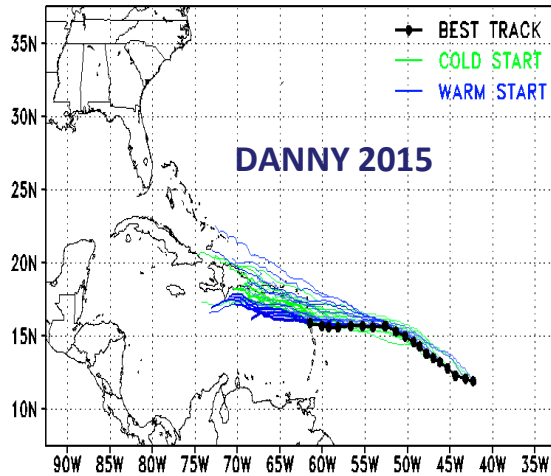
Initial date: 2010082618

SVN Repository path: https://svnemc.ncep.noaa.gov/projects/hnmm/branches/{nmmb_init,nems}



The HNMMB/NEMS system: Transition of HWRF Vortex Initialization & Cycling

TRACK



Vortex-cycling:
Modification/relocation of the 0-hr GFS vortex, based on the previous 6-hr HWRF-B forecast and observed conditions.

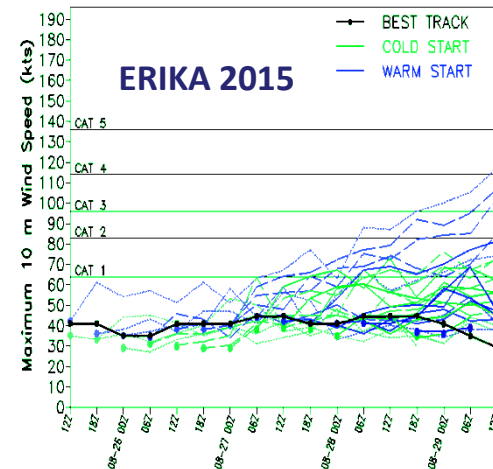
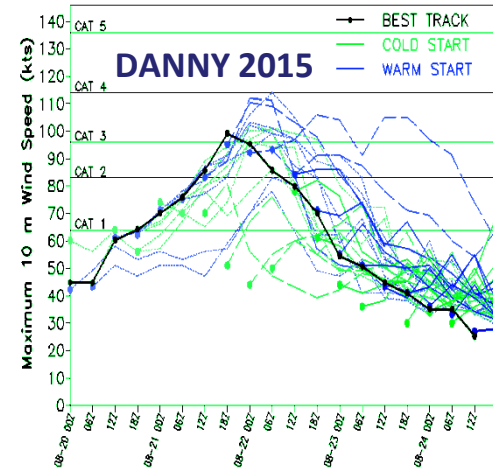
Successes

- ✓ Improves initial intensity forecasts
- ✓ Appears to improve track forecasts for developed storms

Opportunities

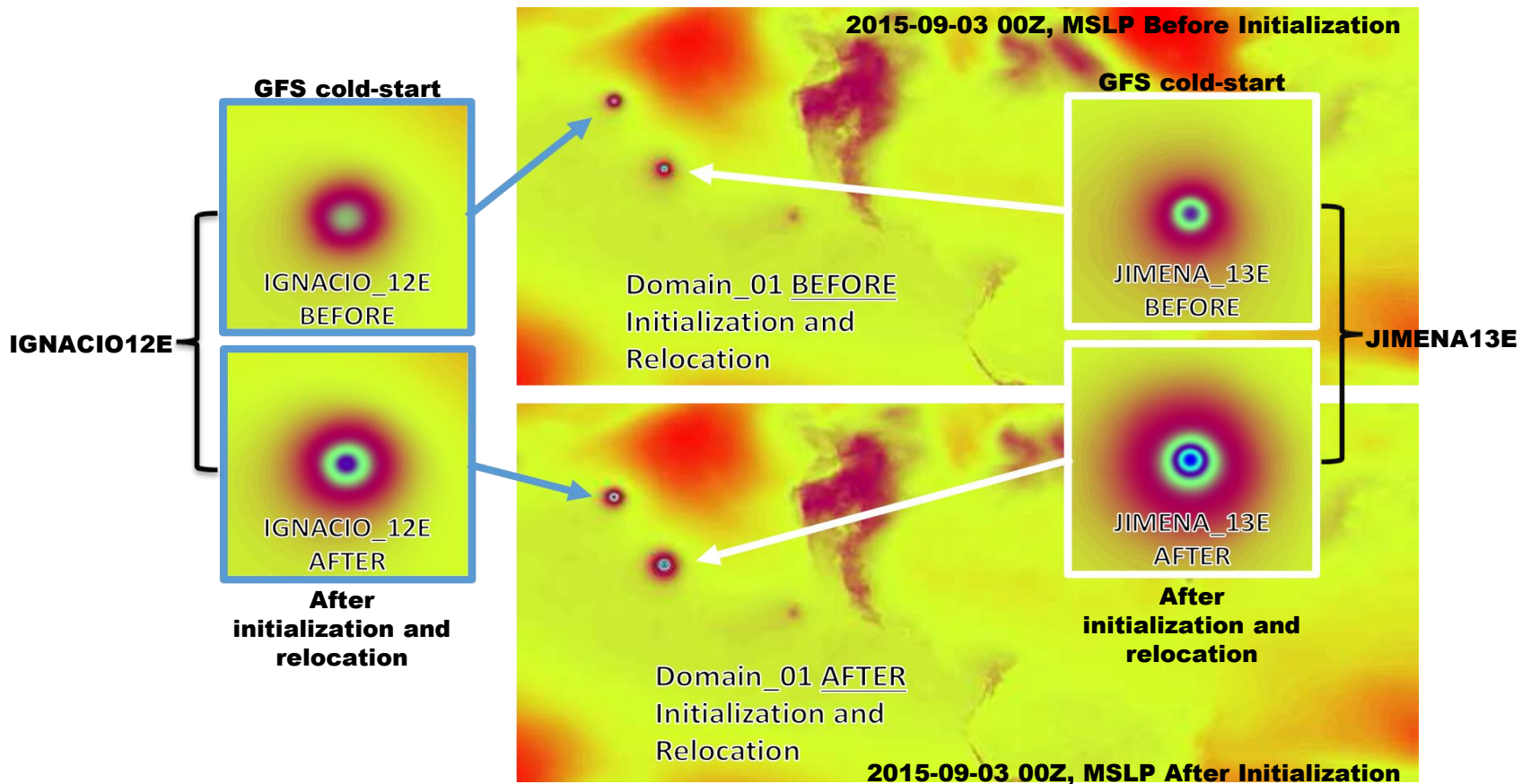
- Early forecasts tend to 'over-intensify' long-term forecasts of weak storms, regardless of vortex-cycling

INTENSITY



The HNMMB system: Vortex Cycling for multiple-storms

Project Statement: “Test and evaluate the Basin-scale HWRf’s multi-storm initialization capabilities in the NMMB/NEMS framework and assess potential for demonstrating the initialization real-time in FY16 and implementing it in FY17.”



SVN Repository path: https://svnemc.ncep.noaa.gov/projects/hnmm/trunk/sorc/util/vortex_init_b



HNMMB Experimental Web-Site/Products

<http://storm.aoml.noaa.gov/hnmmmb>

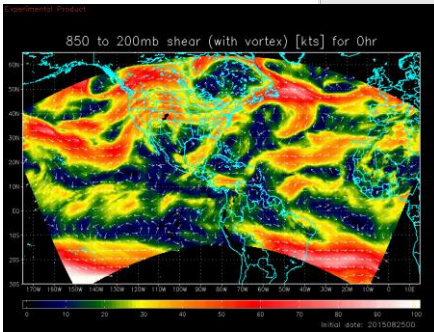
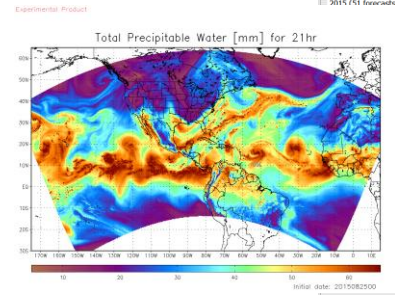
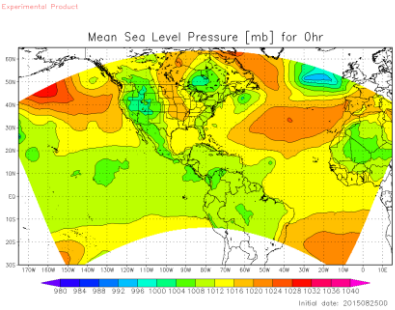


HNMMB Products:

Large-scale (18 km): Track, Int., Shear, Steering, Pred., TPW, MSLP, Winds, etc.

Vortex-scale (2 km): Warm core, Hovemoller, Vorticity, Winds, RH, etc.

~5000 graphics are produced per run! Capacity available at HRD through HFIP



object: New Tab

aa.gov/basin/projectName=TEST-NMNB-AUTOMATION

ing Started | Suggested Sites

HWRF_x HURRICANE WEATHER RESEARCH AND FORECASTING EXPERIMENTAL SYSTEM

Disclaimer: All products in this website are experimental research products created by NOAA's Atlantic Oceanographic and Meteorological Laboratory's Hurricane Research Division (HRD). For official National Weather Service products visit the National Hurricane Center website. Click here to view HRD's data usage policy.

Mean Sea Level Pressure Multi-model Tracks Multi-model VMAX Multi-model MSLP Ships Predictors Total Precipitable Water Vorticity at 850mb

Experimental Product

Multi-Model Hurricane Tracks (6-hourly)

Initial date: 2015082012

Experimental Product

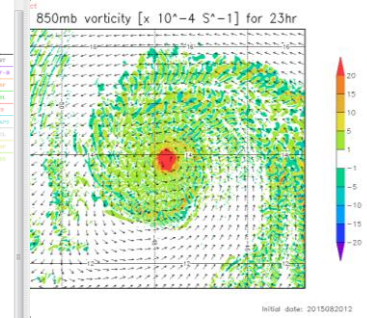
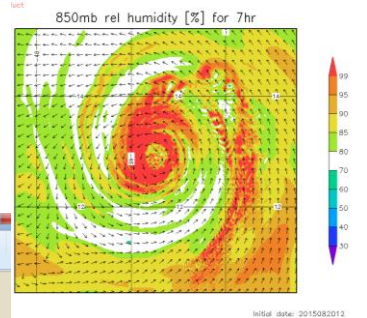
VMAX (kts) forecast for DANNYO4L 2015082012Z

Experimental Product

MSLP (mb) forecast for DANNYO4L 2015082012Z

Experimental Product

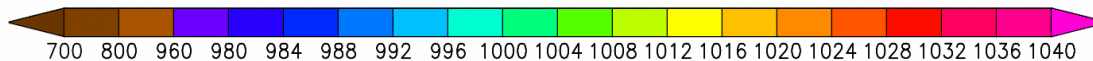
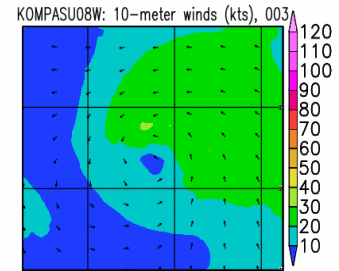
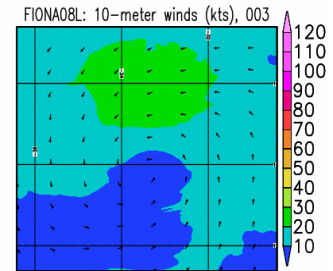
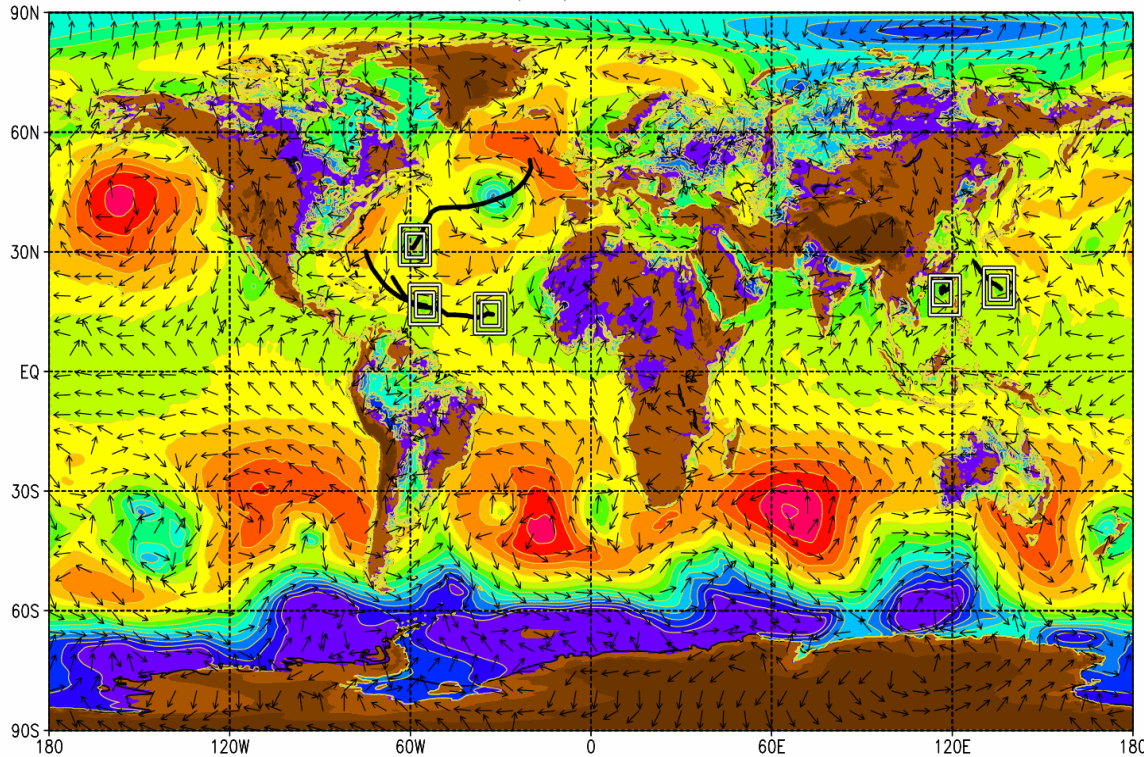
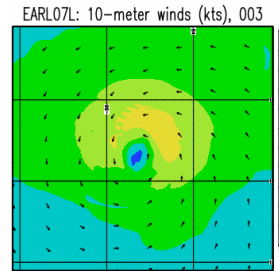
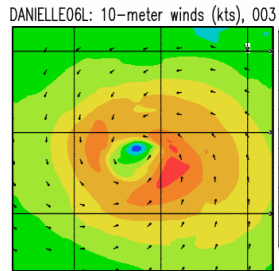
Mean RH profile [%] following system



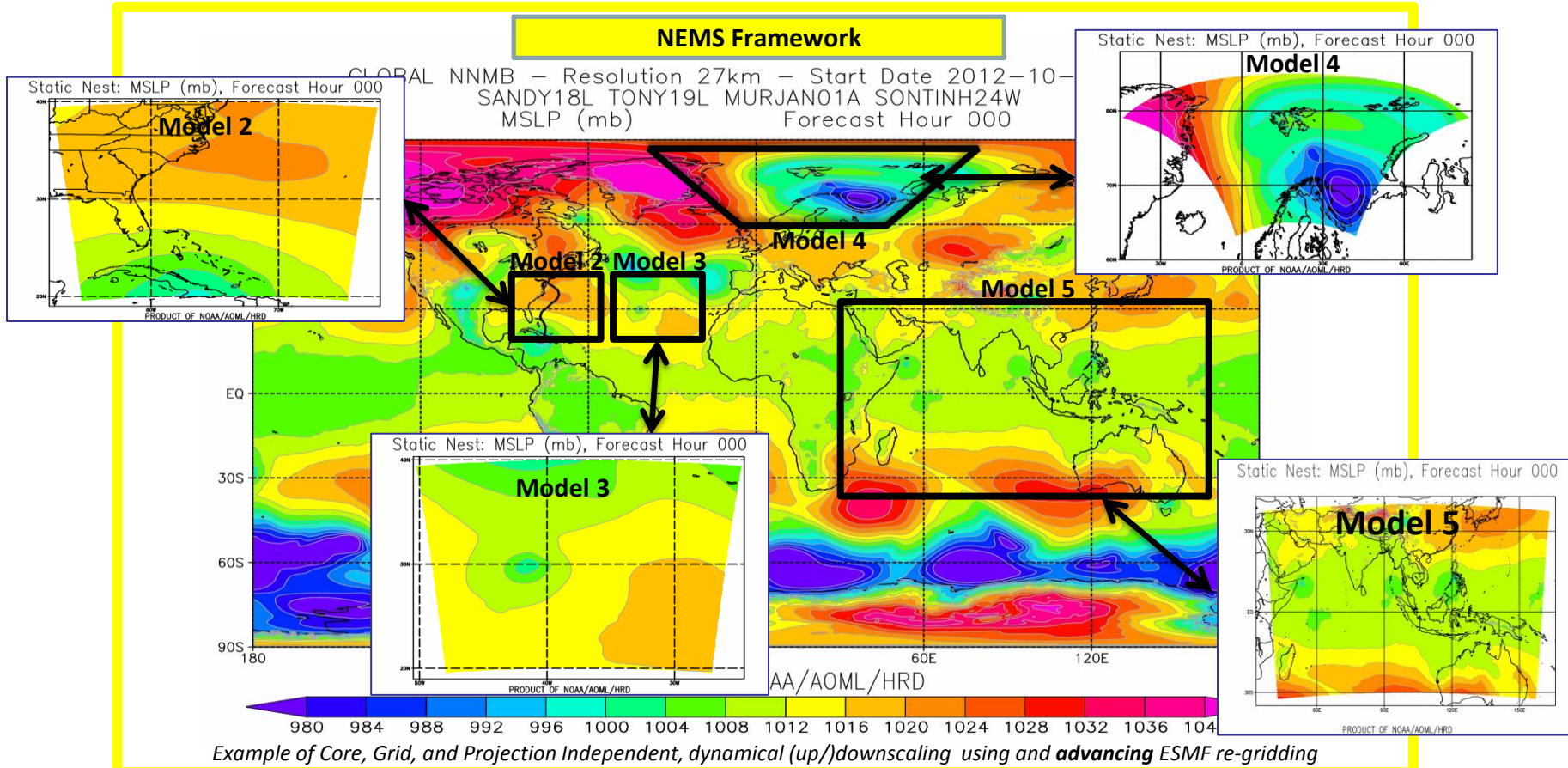
Global Nesting

This is perhaps the first of its kind!
Two-way Interactive Moving Nests for Global Tropical Cyclones Problem

GLOBAL NNMB – Resolution 27:09:03km – Start Date 2010-08-29 00Z
 DANNIELE06L EARL07L FIONA08L LIONROCK07W KOMPASU08W
 Surface Pressure (mb) Forecast Hour 003



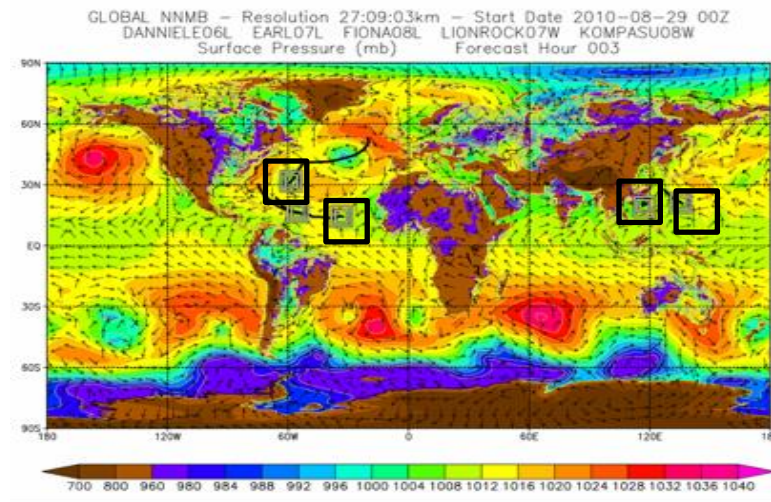
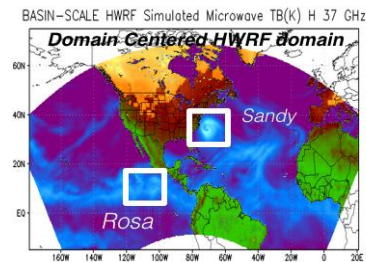
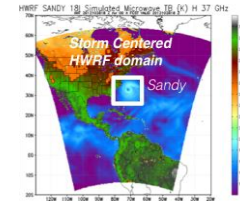
Next Generation Global Model is expected to be run at about 8-10-km resolution. AOML in partnership with EMC and other OAR labs is building a model core independent, Next Generation Generalized Nesting Framework (NGGNF) within NEMS to advance global-to-local scale modeling for hurricanes for NGGPS.



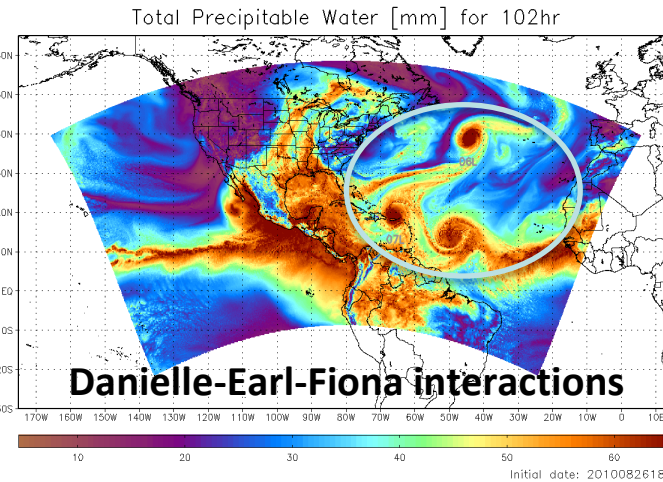
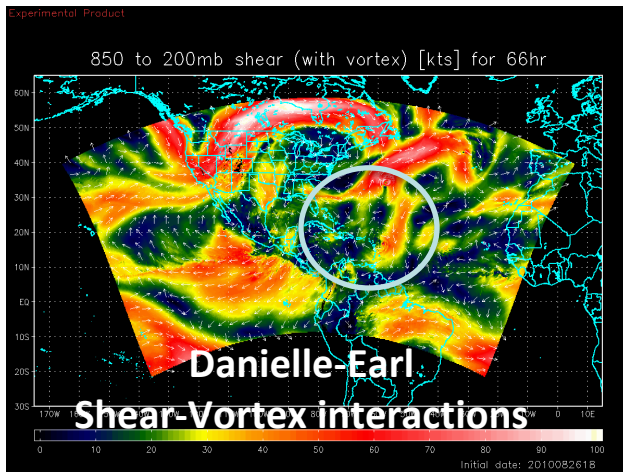
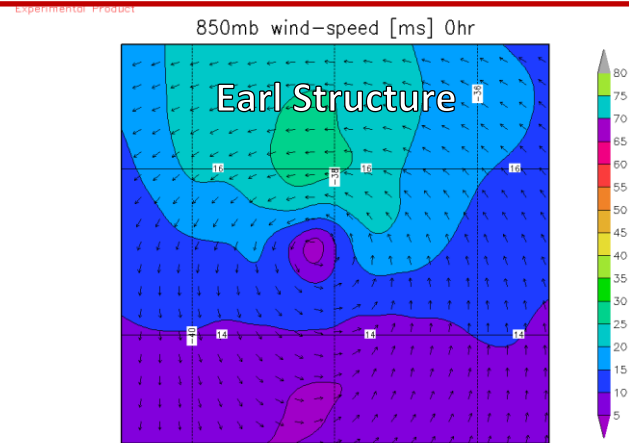
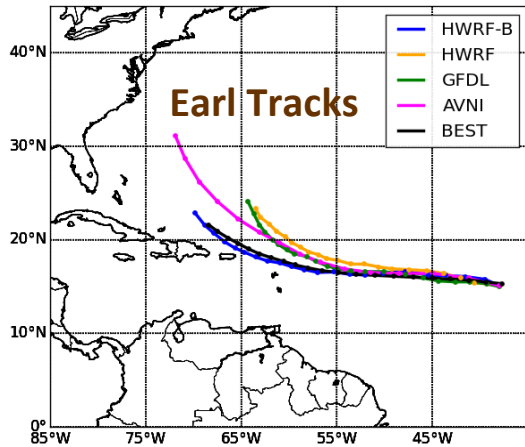
SVN Repository path: <https://svnnc.ncep.noaa.gov/projects/hnmmb/branches/AOML-HRD/NGGNF>

Summary and Path Forward

- Basin scale HNMMB in NEMS framework for Hurricanes was successfully developed under HIWPP.
- The project is at Readiness Level 6.
- Future advancements to include Ocean coupling, DA, Physics improvements and T&E.
- Further support from HFIP and R2O efforts is critical for success of this effort.
- Proof-of-concept of Global-to-local scale Hurricane Prediction System was demonstrated.
- NOAA will soon be running NGGPS at 8-10 km resolution. The generalized, core independent nesting approach proposed here may be useful to test the model at cloud permitting resolutions (1-3 km) rapidly.
- A generalized nesting technique is being developed for NGGPS by AOML in collaboration with EMC and ESRL.
- Key to further improving TC predictions may lie in modeling the multi-scale interactions better, which requires global domain with two-way interactive, high-resolution nests at 1-3 km horizontal resolution.
- Significant research and development may be required for advancing high resolution global model with nests.
- Sustained partnership between NOAA research and operations and other agencies and universities hold the key to our future success.



*Use of HWRF-B for OSSE Nature Run and Hurricane Research (Baseline for evaluating multi-scale interactions)
Uniform 3 km Basin Scale Simulation of Danielle-Earl-Fiona Interactions*



Presentations and Publications

1. “The global to local scale hurricane weather research and forecasting (HWRF) system”, presentation by Sundararaman Gopalakrishnan, World Weather Open Science Conference (WWOSC), Montreal, Canada, 16-21 August 2014.
https://www.wmo.int/pages/prog/arep/wwrp/new/wwosc/documents/Gopal_WWOSC_2014_v6.pdf
2. “The Research HWRF system: Looking beyond the 10-m Wind Speed for Improved Storm Predictions”, presentation by Sundararaman Gopalakrishnan, 31st Conference on Hurricanes and Tropical Meteorology. San Diego, CA, March 30-April 4, 2014. <https://ams.confex.com/ams/31Hurr/webprogram/Paper243845.html>
3. “Impacts of physics, resolution, and nesting on hurricane simulation with regional NMMB”, presented by Bin Liu, AMS 27th Conference On Weather Analysis And Forecasting/23rd Conference On Numerical Weather Prediction, Chicago, 28 June – 3 July, 2015. <https://ams.confex.com/ams/27WAF23NWP/webprogram/Paper273852.html>
4. “Towards High-Resolution NMM-B Nature Run Weather Forecasts for Hurricane”, presentation by Javier Delgado, The AMS 96th Annual Meeting, New Orleans, LA, 10–14 January, 2016.
<https://ams.confex.com/ams/96Annual/webprogram/Paper289114.html>
5. “The capability of regional NMMB for rapid intensification forecast: Insights from Hurricane Patricia”, presentation by Weiguo Wang, 32nd Conference on Hurricanes and Tropical Meteorology, San Juan, PR, April 18-22, 2016, San Juan, PR.
<https://ams.confex.com/ams/32Hurr/webprogram/Paper293373.html>
6. “Progress on the High Impact Weather Prediction Project - A Mid-Project Update”, presentation by Timothy Schneider, AMS 96th Annual Meeting, New Orleans, LA, 10–14 January, 2016.
<https://ams.confex.com/ams/96Annual/webprogram/Paper289114.html>
7. “HNMMB: Weaving the Proven Successes of HWRF into the NEMS Framework”, presentation by Steven Diaz, 32nd Conference on Hurricanes and Tropical Meteorology, San Juan, PR, April 18-22, 2016, San Juan, PR.
<https://ams.confex.com/ams/32Hurr/webprogram/Paper293537.html>
8. “Evaluation of Uniformly High-Resolution Hurricane Forecasts Using NMM-B”, presentation by Javier Delgado, 32nd Conference on Hurricanes and Tropical Meteorology, San Juan, PR, April 18-22, 2016,
<https://ams.confex.com/ams/32Hurr/webprogram/Paper293895.html>
9. “HNMMB: A potential operational modeling system for Hurricane Predictions”, Steven Diaz et al. (under preparation for peer review Journal)



End of Presentation



Questions ?

