Hurricane Intensity and Structure Research Using NOAA's High Resolution Forecast Model - II

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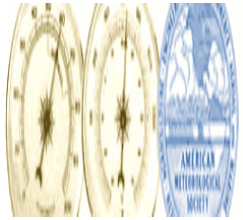
NOAA HURRICANE FORECAST IMPROVEMENT PROJECT

High Resolution Prediction Related Studies

The Experimental HWRF System: A Study on the Influence of Horizontal Resolution on the Structure and Intensity Changes in Tropical Cyclones using an Idealized Framework

S.G. Gopalakrishnan, Frank Marks, Jr, Xuejin Zhang, Jian-Wen Bao,Kao-San Yeh, and Robert Atlas

Monthly Weather Review



Sensitivity of the NOAA Hurricane Research and Forecasting Model (HWRFX) to Various Cloud and Boundary Layer Parameterizations

By J.W.Bao, S.G.Gopalakrishnan and Sara A.Michelson

Presented at AMS 2010- Tuscon

Performance of the experimental HWRF in the 2008 hurricane Season

Yeh, K.-S., X. Zhang, S. Gopalakrishnan, S. Aberson, R. Rogers, F.D. Marks and R. Atlas

Natural Hazards

Toward improving hurricane forecast with high resolution model

Zhang, X, T.S. Quirino, S. Gopalakrishnan, K.S. Yeh, F.D. Marks, Jr., S.B. Goldenberg and S.Aberson

Computing in Science and Engineering

Acknowledgement: HFIP

HWRFX System

High Resolution Research version of the HWRF system geared to compliment operations

2009-2010 milestones:

Model Developments

✓*Development of idealized framework*

✓*Advanced Diagnostic Software for TC analysis to support forecast*

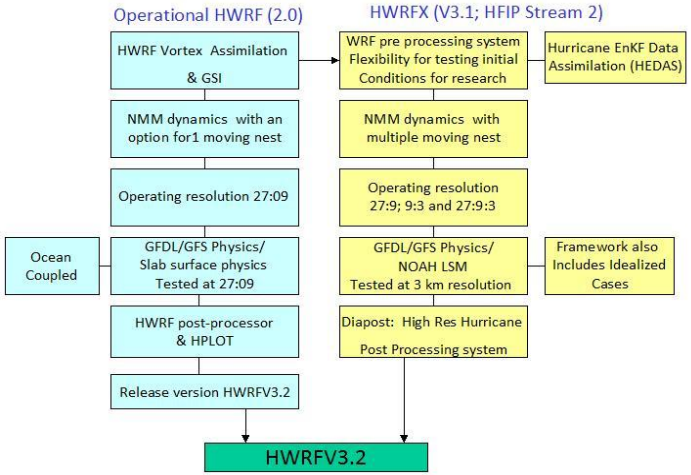
✓*Multiple Moving Nest for prediction down to 3 km (or less) resolution*

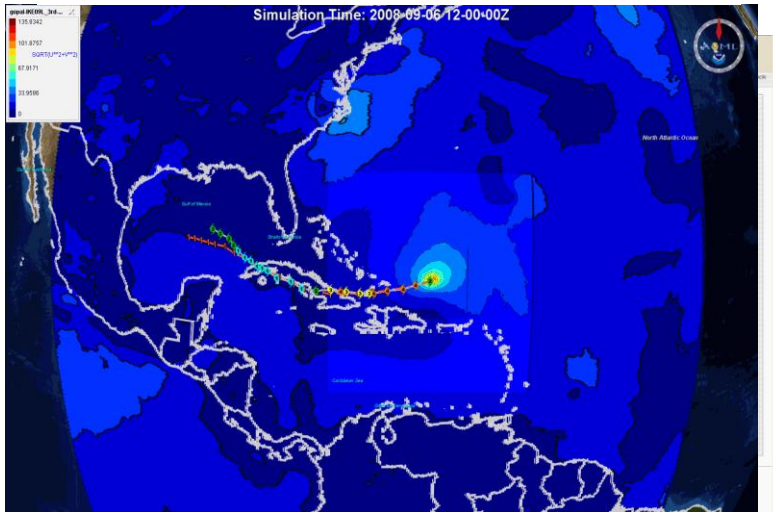
✓HEDAS-HWRFX developments

Forecast Studies (focus on 3 km res)

✓2005, 2007 & 2009 seasons: Sensitivity study on ICs & resolution

✓2010 Demo Project





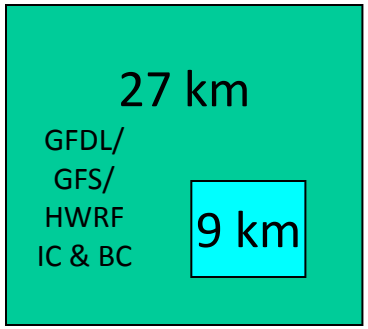
Multiple Moving Domains to Support Operations at 27:09:03

HWRFX-HWRFV3.2 Transitions

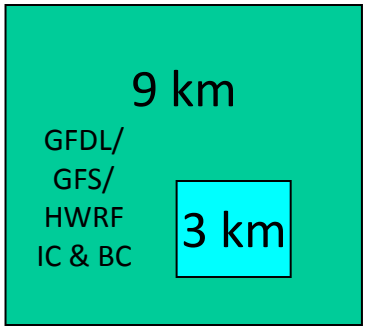
- ✓ Contributions from HRD:
  - ✓ New nest motion algorithm
  - ✓ Advanced diagnostics capability (Diapost)
  - ✓ Third nest capability
  - ✓ Idealized simulations
  - ✓ Improved vortex assimilation products for operations
- ✓ Baseline version testing (without coupling)
  - HRH cases, 2009 and 2010 Atlantic cases
- ✓ Use results from the 2010 Stream 2 demo (9:3 from HWRFX and HWRFV3.2) as the basis for evaluation at 3 km resolution
- ✓ Development of coupler for the third nest (EMC)
- ✓ Improved vortex initialization for the third nest (EMC)
- ✓ Retrospective testing of 27:09:03 as a candidate for Stream 1.5 demo in 2011 and future operational implementation
- ✓ Test new physics suitable for higher resolutions
- ✓ Integrate the modeling component of research and development activities at HRD with operational HWRF
- ✓ Synchronize the developmental efforts with DTC repository for community purpose

Acknowledgement: Vijay Tallapragada

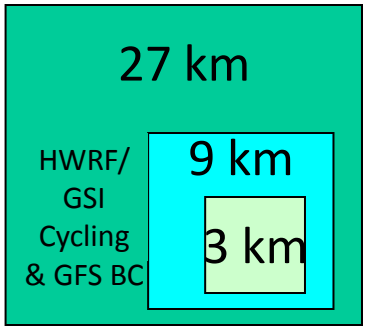
HWRFX configuration & physics



45 minutes/
128 processors



4 hours/
256 processors



2 hours/
128 processors

	Micro-physics	SW Radiation	LW Radiation	Surface	LSM	PBL	Convection	Momentum Mixing
HWRF	Ferrier	GFDL	GFDL	GFDL	GFDL	GFS	SAS	yes
HWRFX	Ferrier	Duhdia	RRTM	GFDL	NOAH	GFS	SAS	no

**Other namelist level changes: lateral diffusion, drag (C_d & C_h) & Z_0*

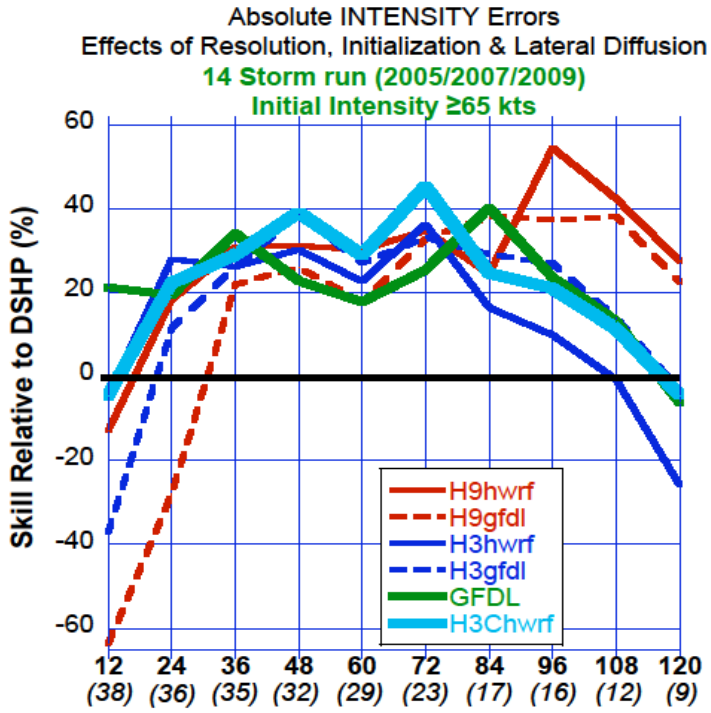
Towards Improving High-Resolution Numerical Hurricane Forecasting: Influence of Model Horizontal Grid Resolution, Initial Conditions and Physics

Sundararaman G. Gopalakrishnan, Stanley Goldenberg, Thiago Quirino, Xuejin Zhang, Kevin Yeh,

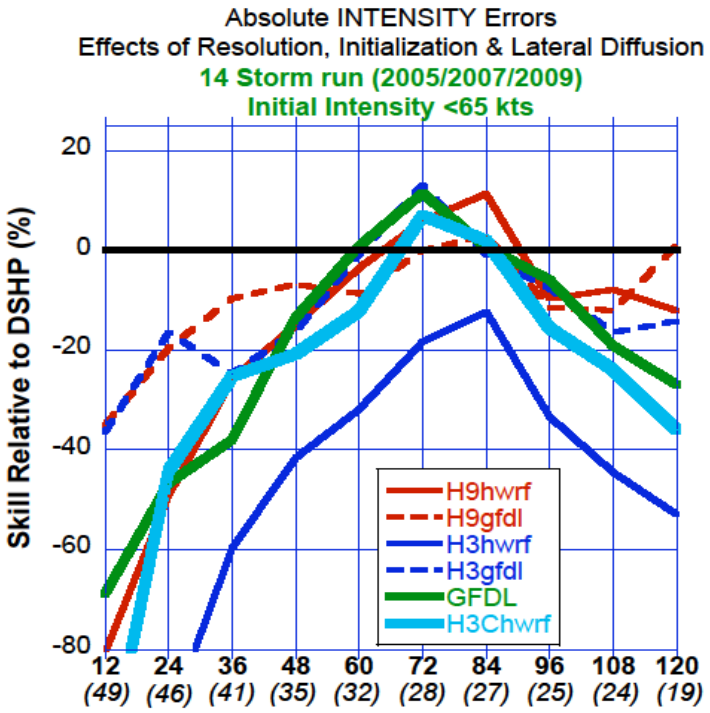
Frank Marks, Jr, Robert Atlas and Vijay Tallapragada

Storms 2005: (1) Emily (2) Katrina (3) Ophelia (4) Phillipe (5) Rita (6) Wilma
Storms 2007: (1) Ingrid (2) Humberto (3) Karen
Storms 2009: (1) Ana (2) Bill (3) Danny (4) Erika (5) Ida

87 Cases

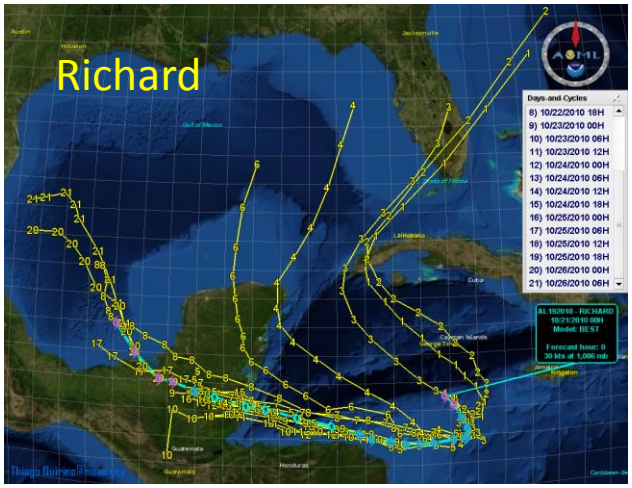


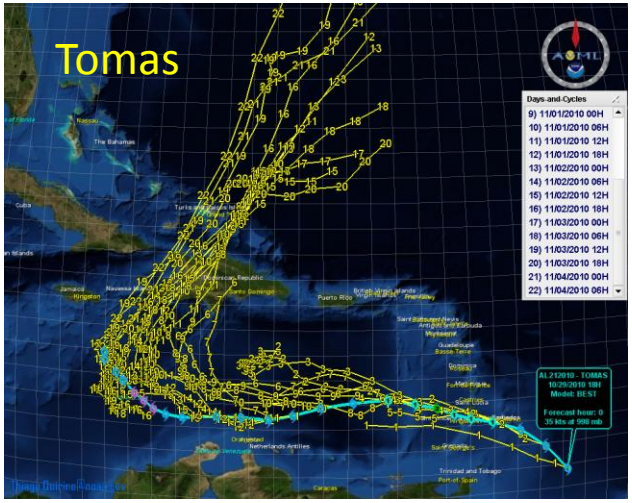
Strong Initial Vortex

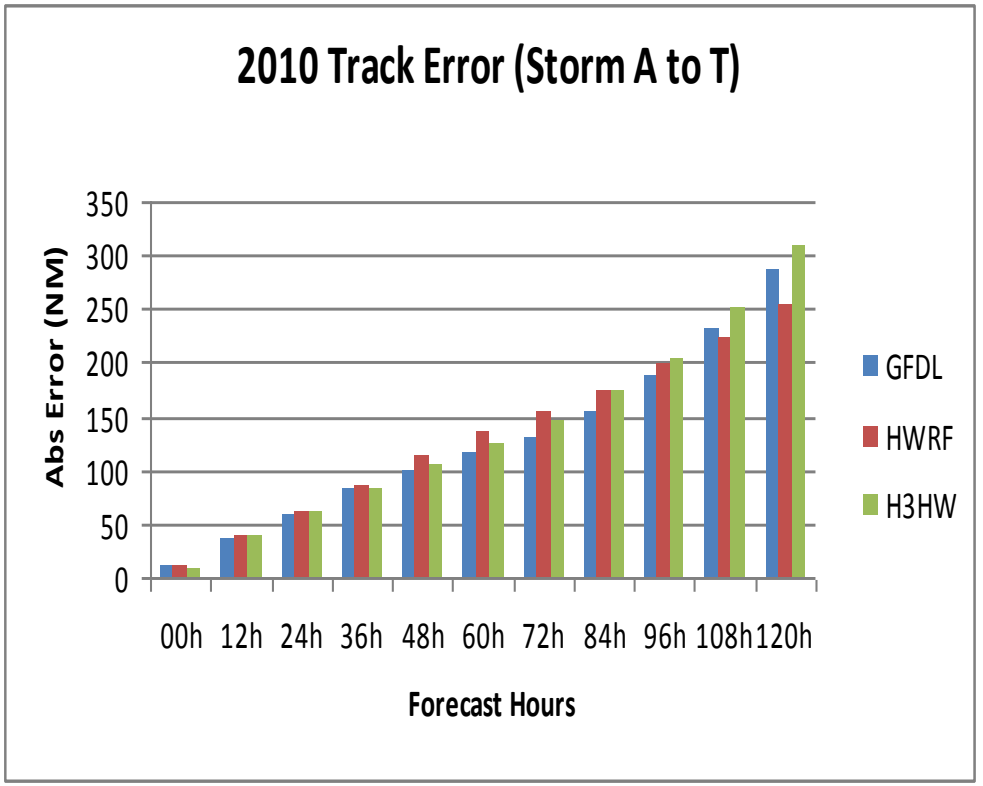


Weak Initial Vortex

Track Statistics

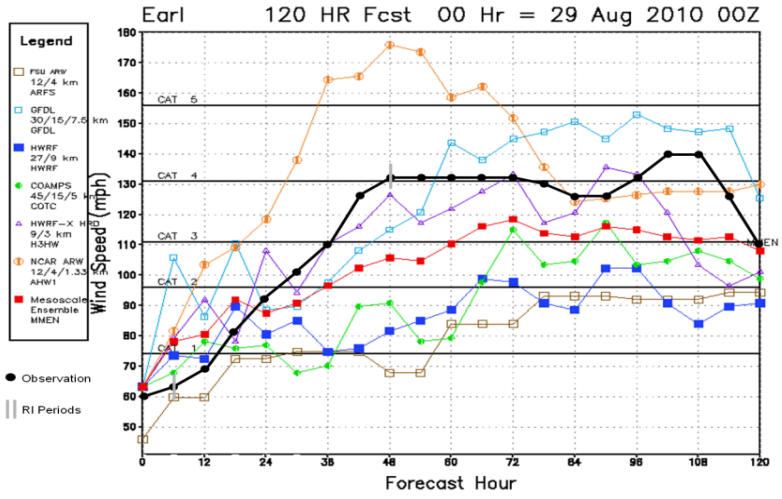


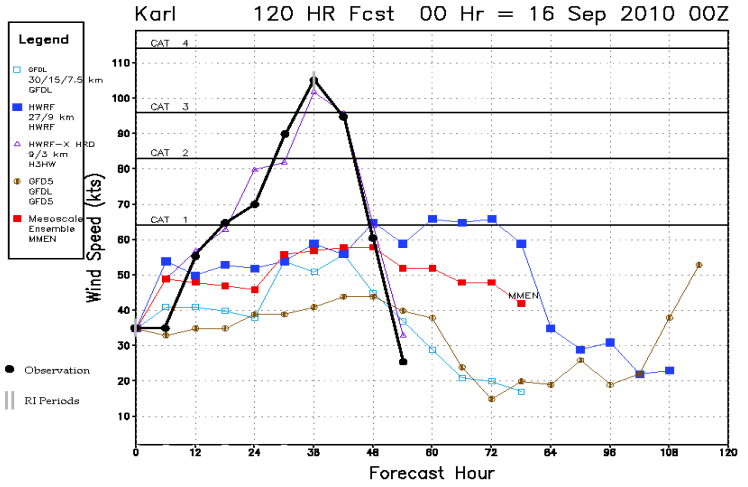


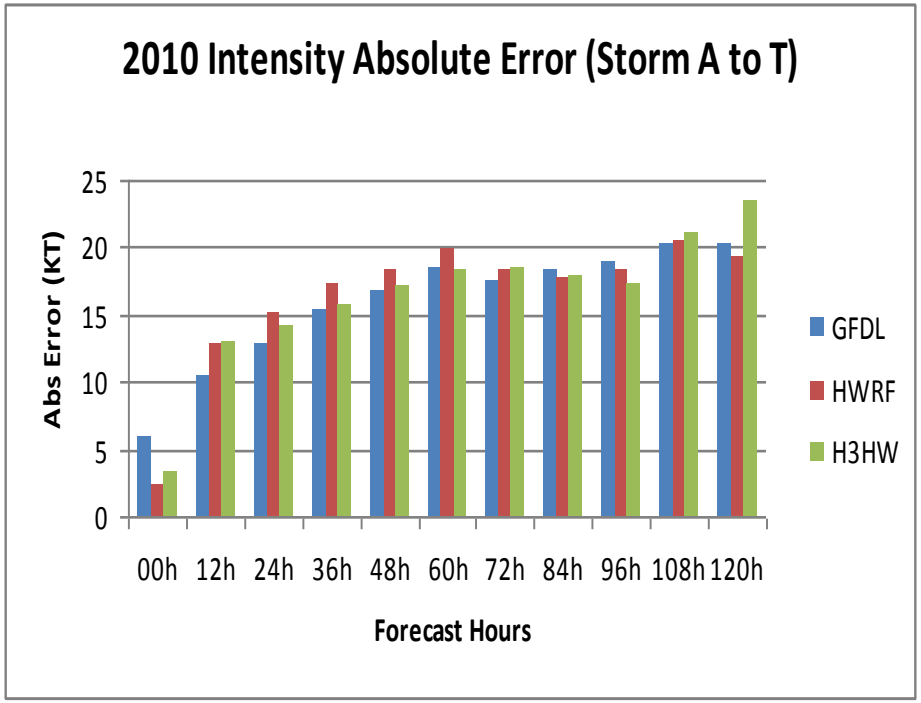


Hours	0	12	24	36	48	60	72	84	96	108	120
Cases	345	317	275	243	213	189	166	145	126	106	90

Intensity Statistics







Hours	0	12	24	36	48	60	72	84	96	108	120
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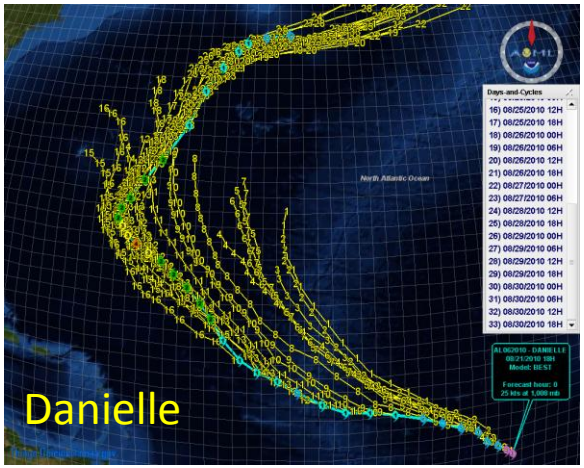
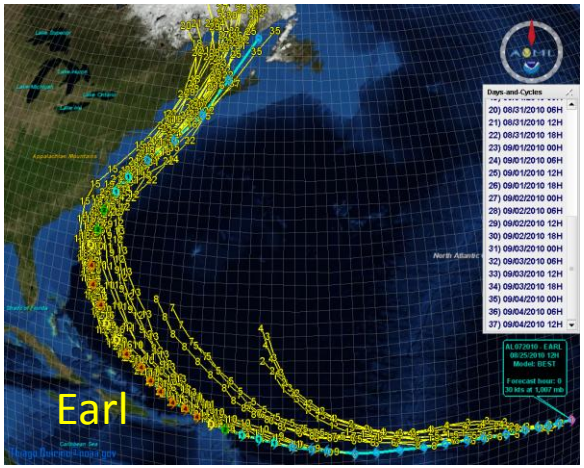
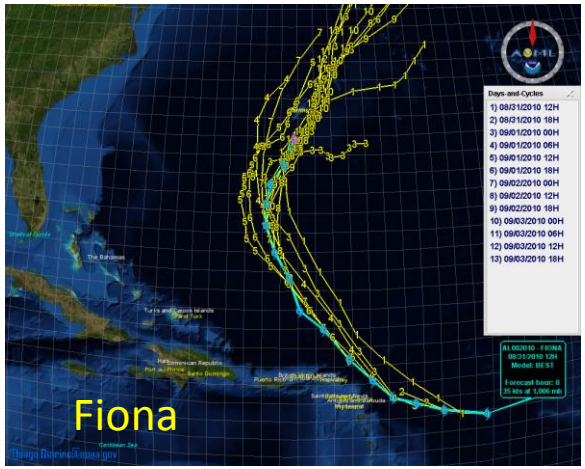
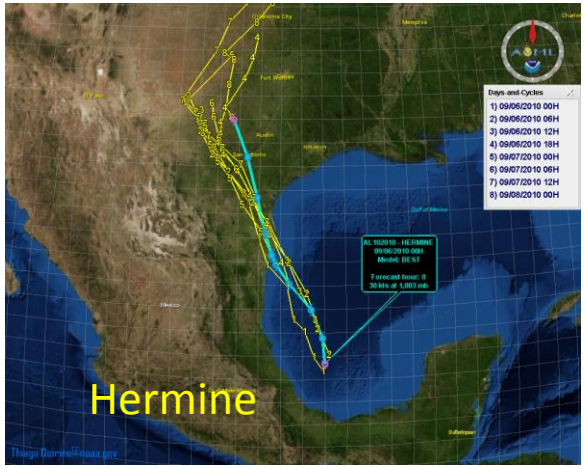
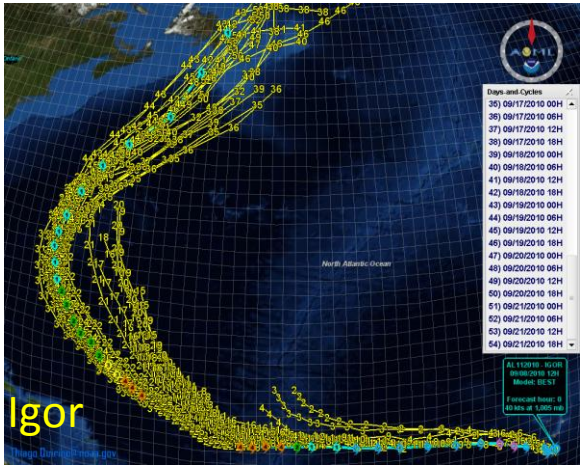
2010 HWRFX TRACKS

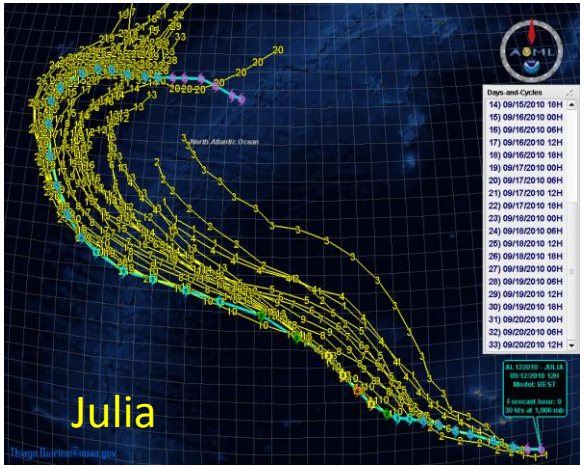


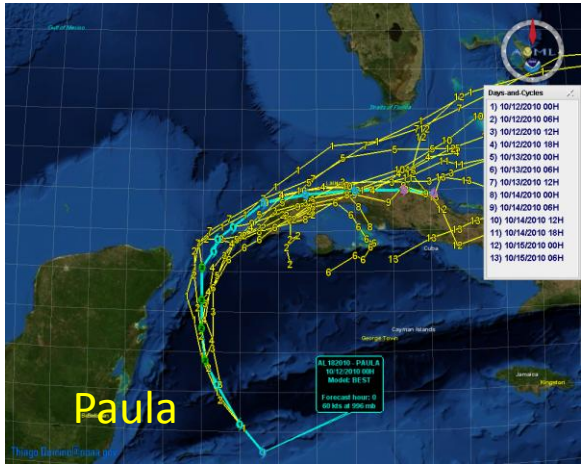




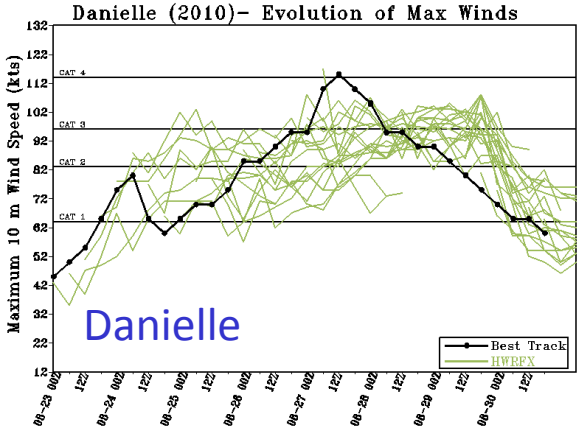


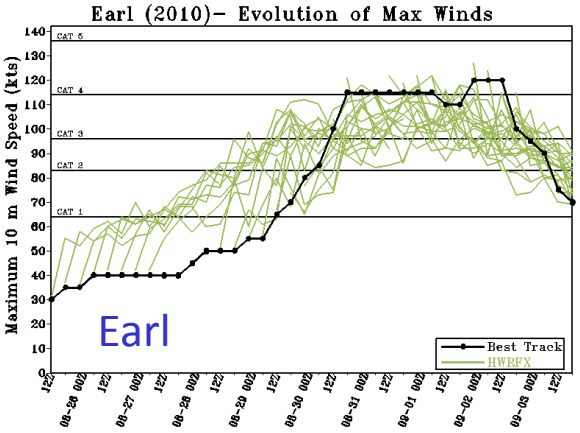


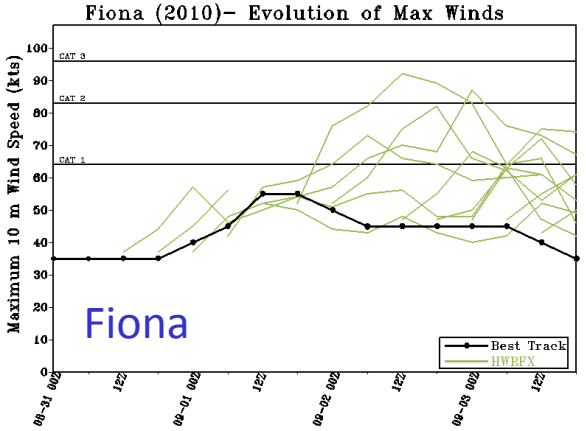


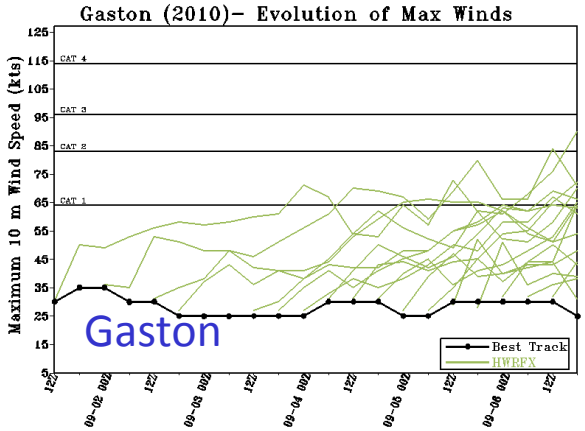


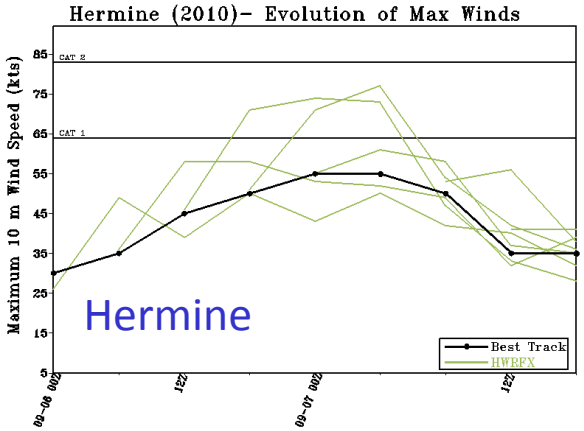
2010 HWRFX INTENSITIES

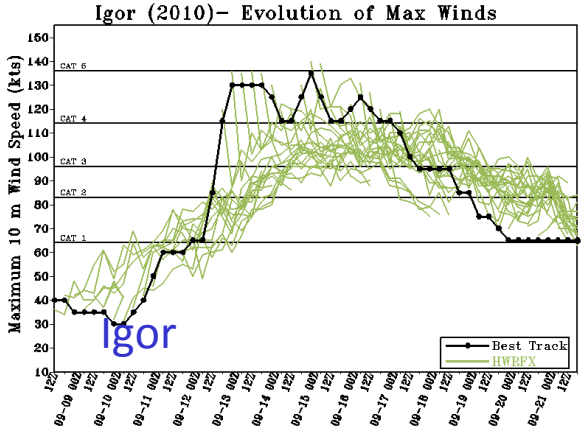


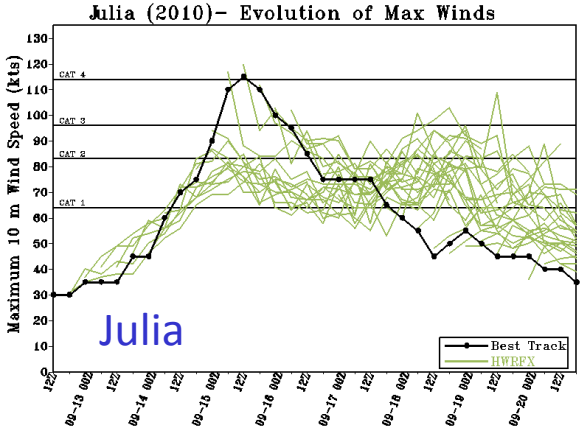


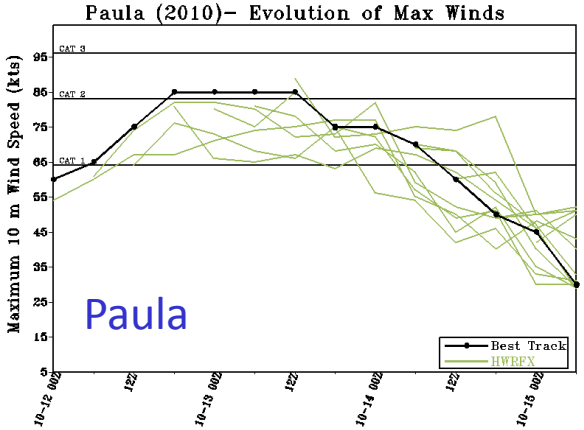












Model Development Team

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In collaboration with
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Jian-Wen Bao, PSD, ESRL, Boulder
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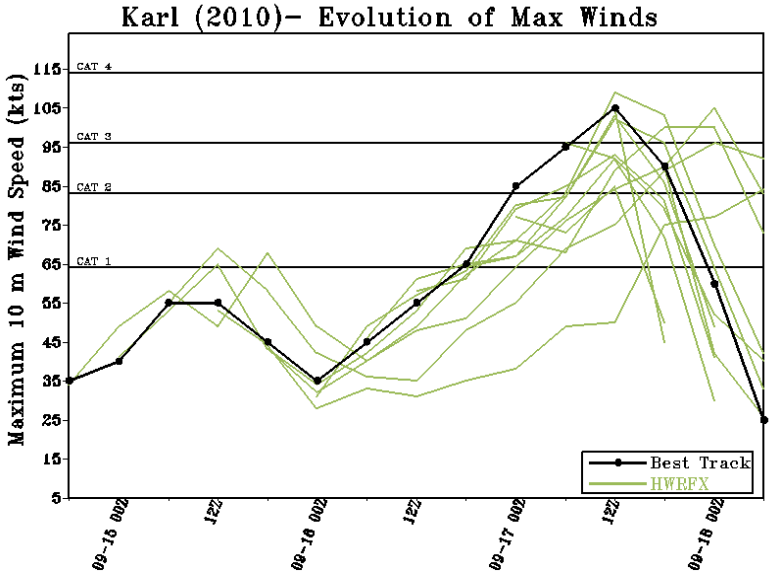
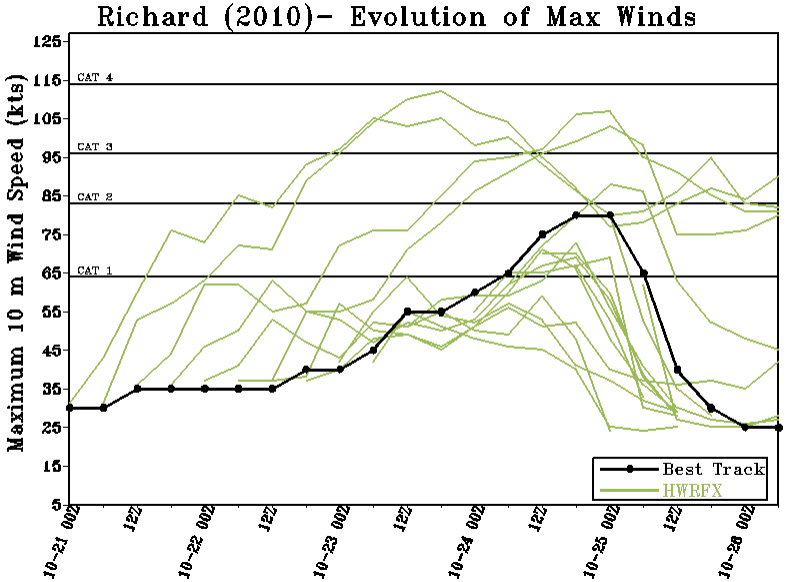
Questions ?


Karl (2010)– Evolution of Max Winds
Maximum 10 m Wind Speed (kts)
CAT 4
CAT 3
CAT 2
CAT 1
Best Track
HWRFX


Richard (2010)– Evolution of Max Winds
Maximum 10 m Wind Speed (kts)
CAT 4
CAT 3
CAT 2
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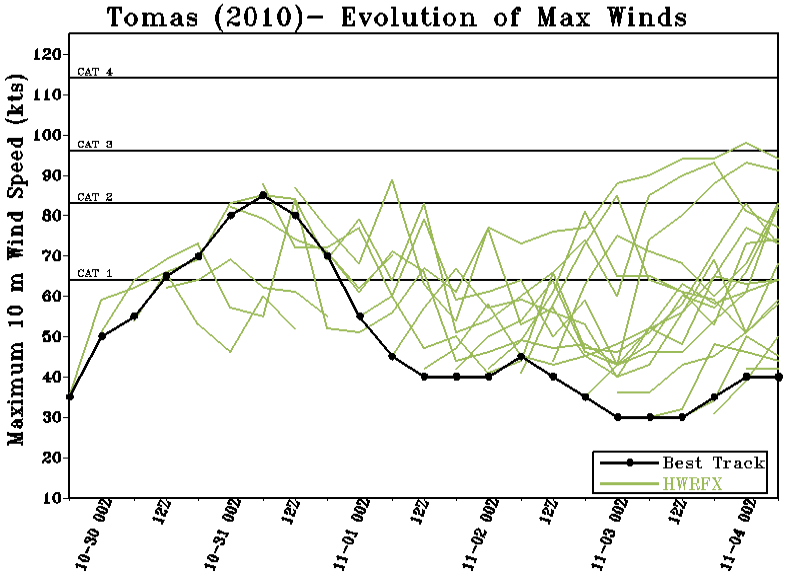
Best Track
HWRFX


Tomas (2010)– Evolution of Max Winds
Maximum 10 m Wind Speed (kts)
CAT 4
CAT 3
CAT 2
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