

Development of the Basin-scale HWRF Modeling System

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(AOML/HRD)

HFIP Annual Meeting, 11 January 2017

Team

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GFDL

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URI

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Acknowledgement

- Main contributors of web products, analysis and slides:
 - G. Alaka
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 - S. Goldenberg
 - S. Gopalakrishnan
 - P. Reasor
 - R. Rogers
 - K. Sellwood
 - R. St. Fleur
 - B. Thomas
 - J. Zhang
 - X. Zhang

2016 Achievements

- Increased HB16 resolution to 18-6-2 km
- Developed basin-scale MIPOM-TC initialization with RTOFS
- Developed basin-scale HWRF forecast system in operational HWRF framework
- Operated real-time HB16 (4 cycles daily)
- Redesigned basin-scale HWRF product website
- Accelerated web product delivery (near real-time)
 - Available for HFP and Map Discussions at Noon, NPS genesis team

Basin-scale HWRF System

	2016 OPERATIONAL HWRF (H216)	2016 BASIN-SCALE HWRF (HB16)
HORIZONTAL DOMAINS	18 KM: 77.625° X 77.49° 6 KM: 25.875° X 25.83° 2 KM: 8.625° X 8.61°	18 KM: 194.13° X 84.105° 6 KM: 25.875° X 25.83° 2 KM: 8.625° X 8.61°
VORTEX INITIALIZATION/DA	Improved Vortex Initialization Hybrid TDR DA/Improved GSI DA	Improved Vortex Initialization (Improved GSI DA)
OCEAN COUPLING	18-6 KM: POM; 2 KM: No	Static SST(real-time); 18-6 KM: POM; 2 KM: NO (Retro)
CYCLING	Vortex Cycling	
VERTICAL LEVELS & MODEL TOP	61 levels; 2 hPa	
PHYSICS SCHEMES		
MICROPHYSICS	Ferrier-Aligo (High Resolution)	
RADIATION	RRTMG	
SURFACE	GFDL (tuned C_D , C_H)	
PBL SCHEME	2016 GFS (High Resolution)	
CONVECTION	Scale-Aware SAS	
LAND SURFACE	NOAH LSM	

Results:

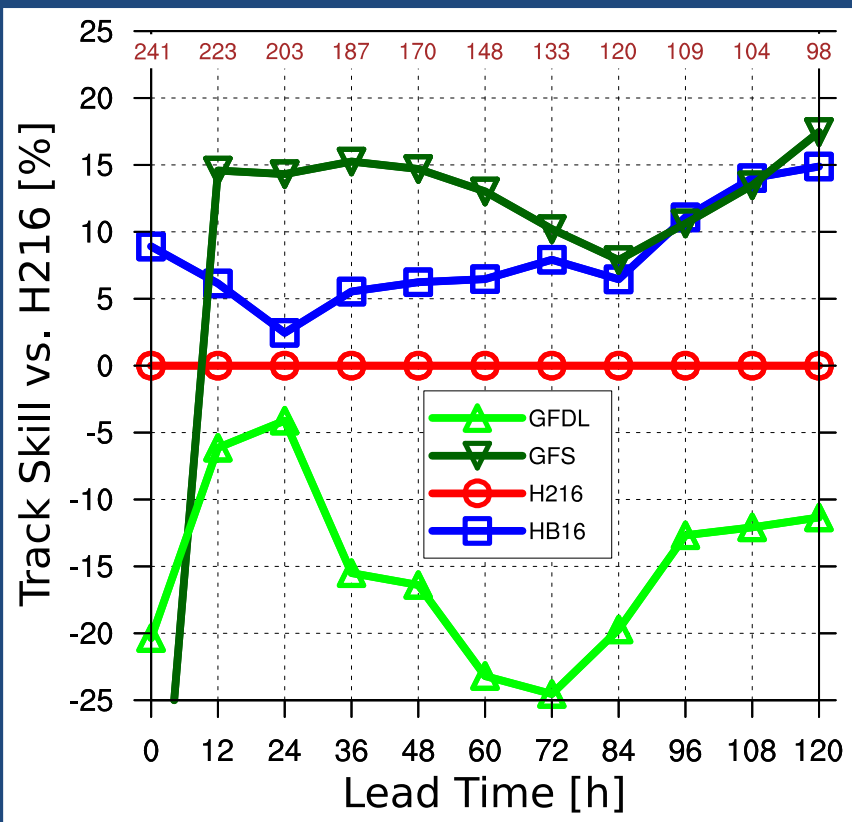
Track/Intensity Verification Statistics

HB16 = 2016 Basin-Scale HWRF

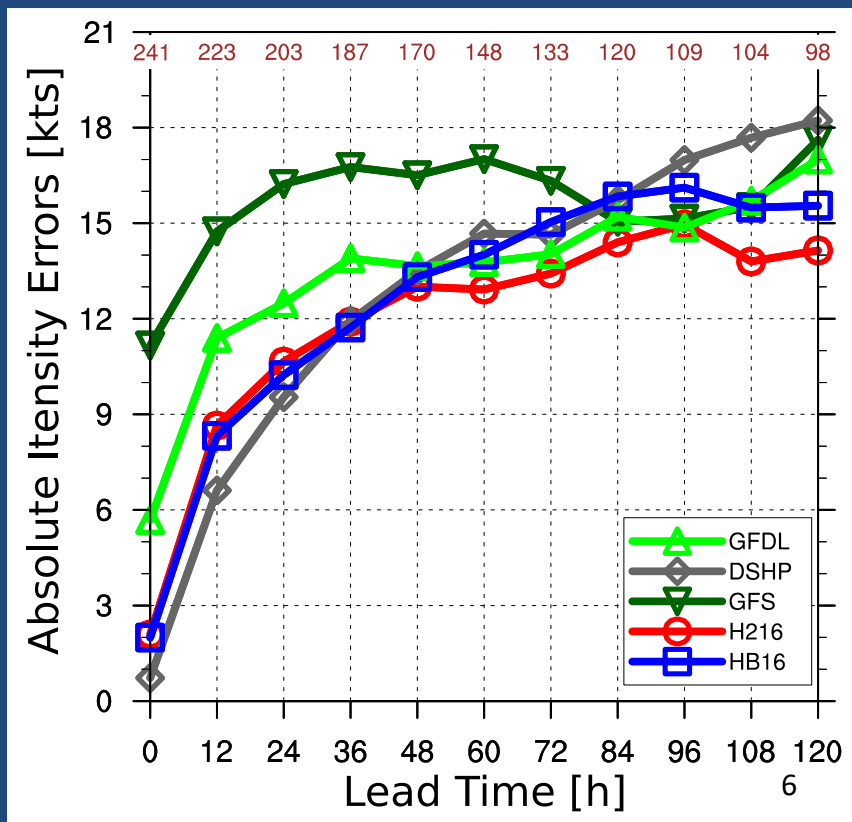
H216 = 2016 Operational HWRF

Atlantic Basin

Track Skill

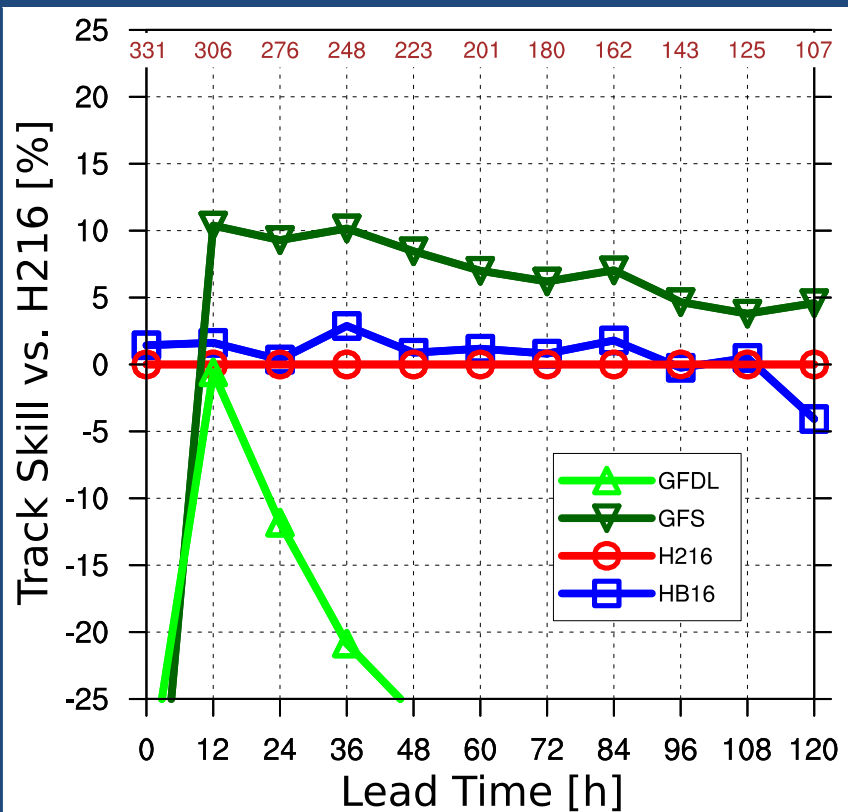


Intensity Errors

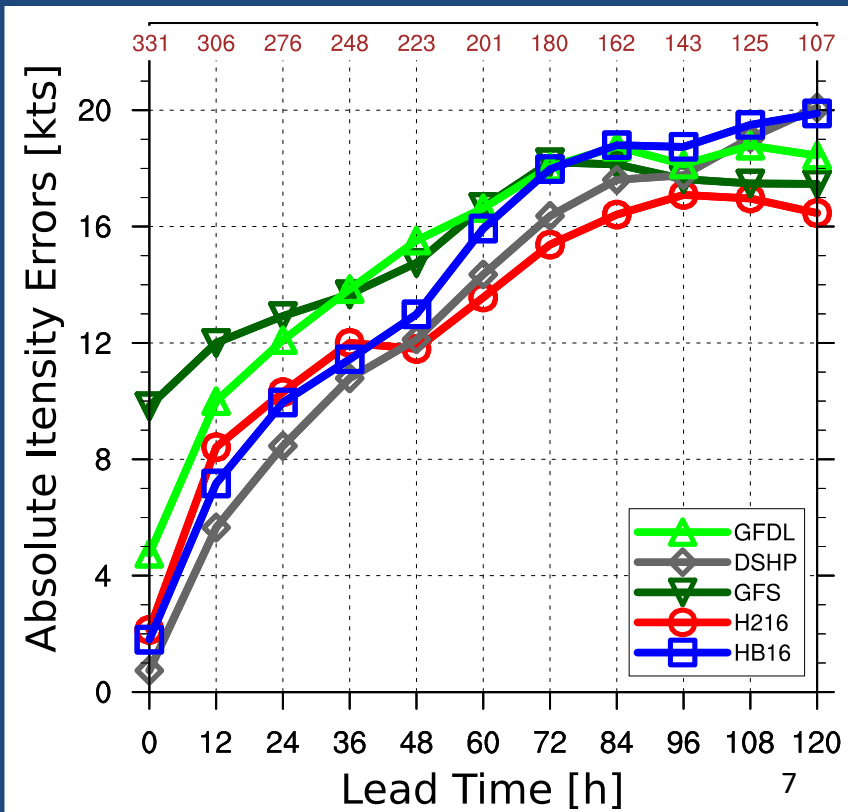


East Pacific Basin

Track Skill



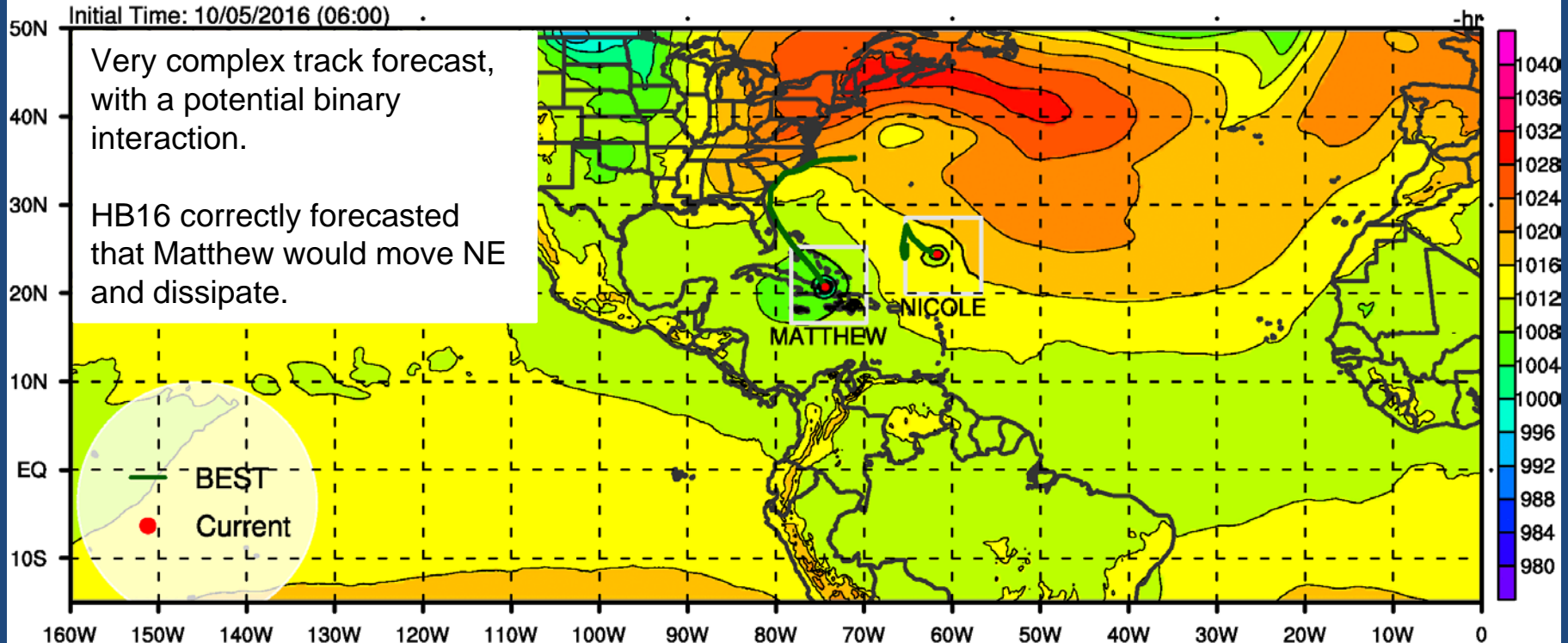
Intensity Errors



Results– Cases Study

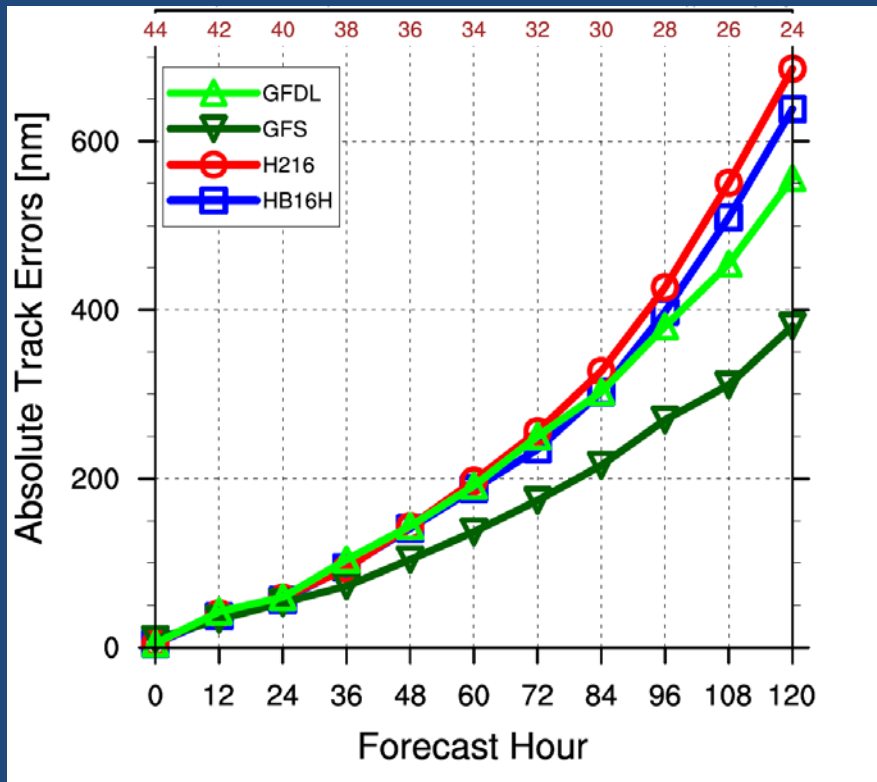
Matthew (14L) & Nicole (15L)

Mean Sea Level Pressure [hPa] in Basin-Scale HWRP

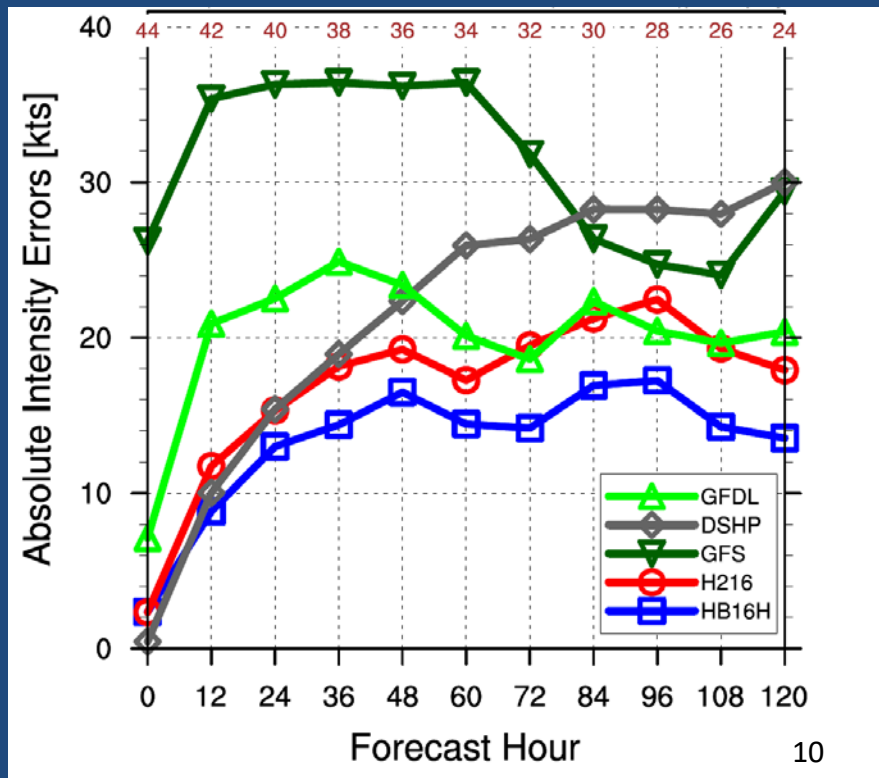


Matthew Verification

Track Errors

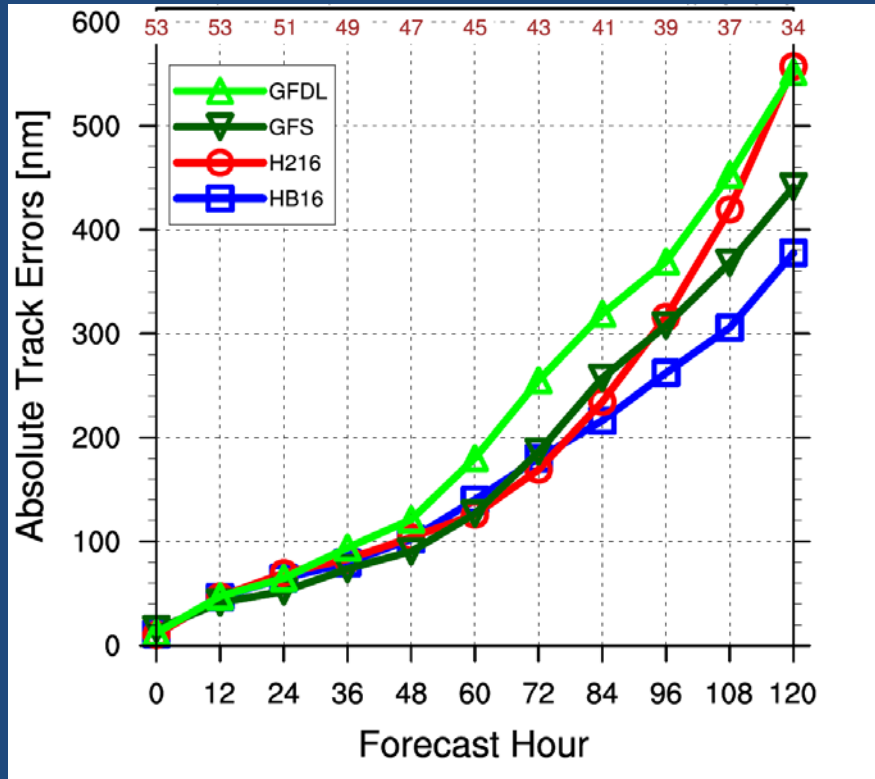


Intensity Errors

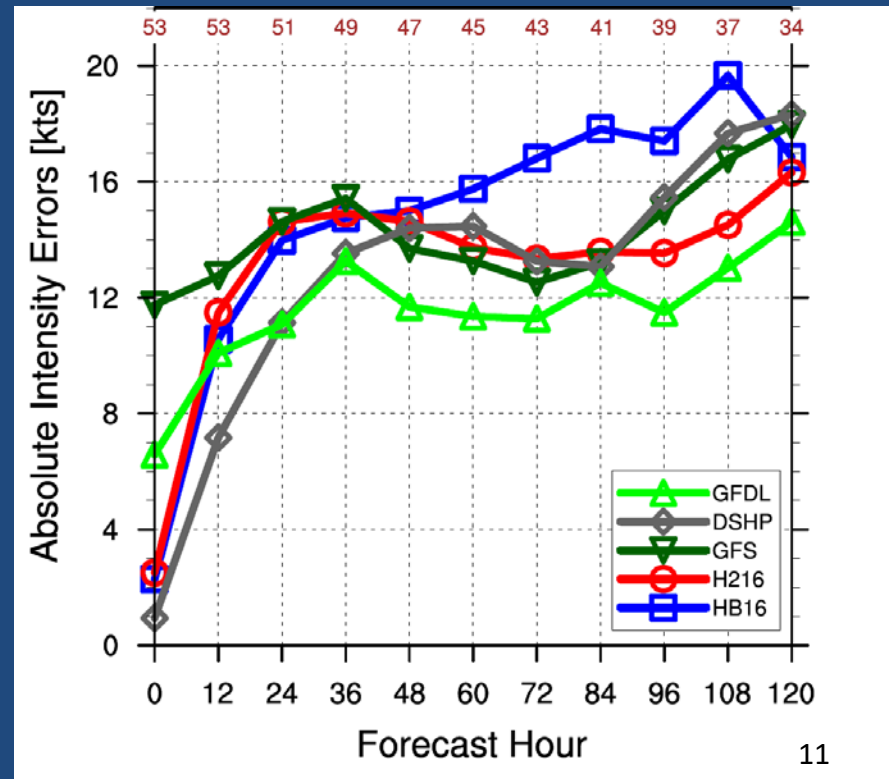


Nicole Verification

Track Errors



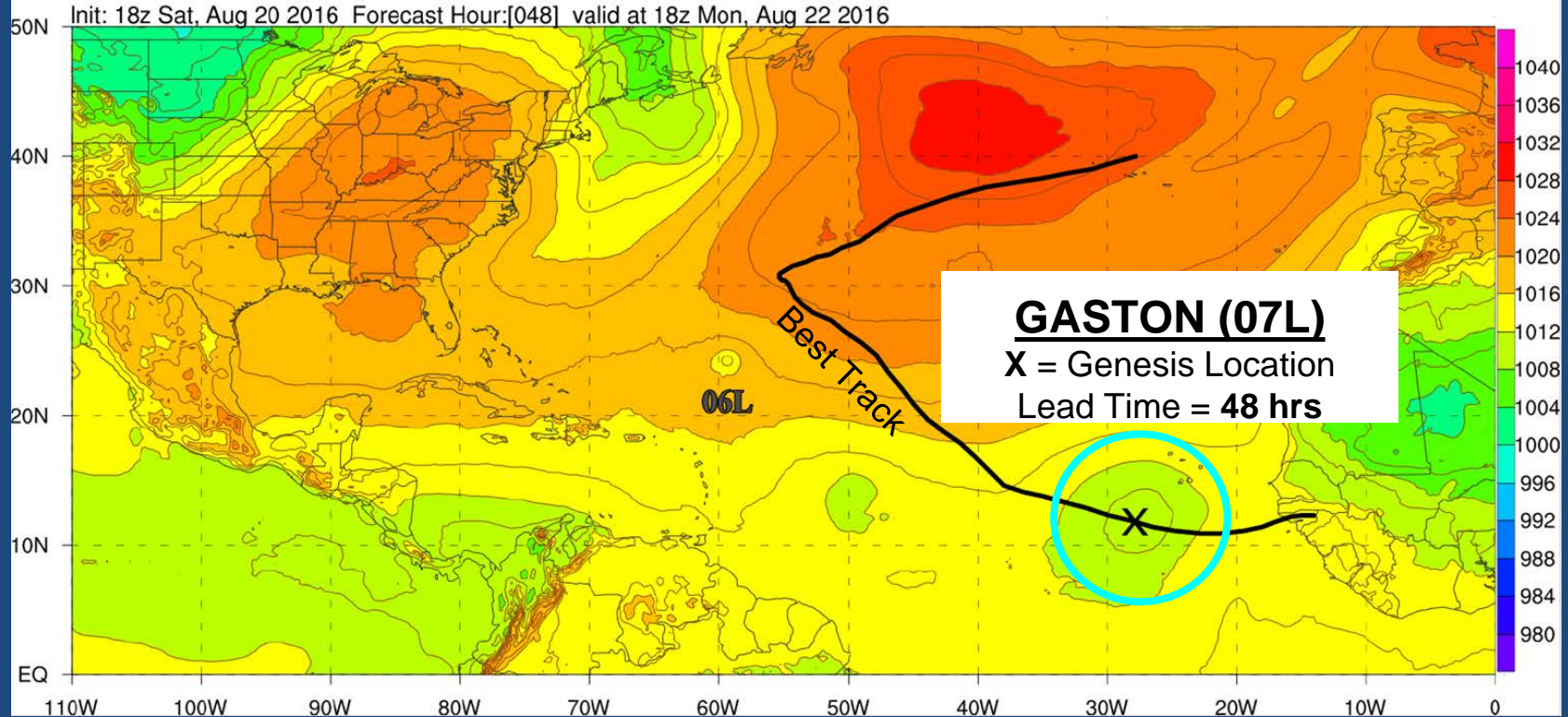
Intensity Errors



TC Genesis

Basin-Scale HWRF

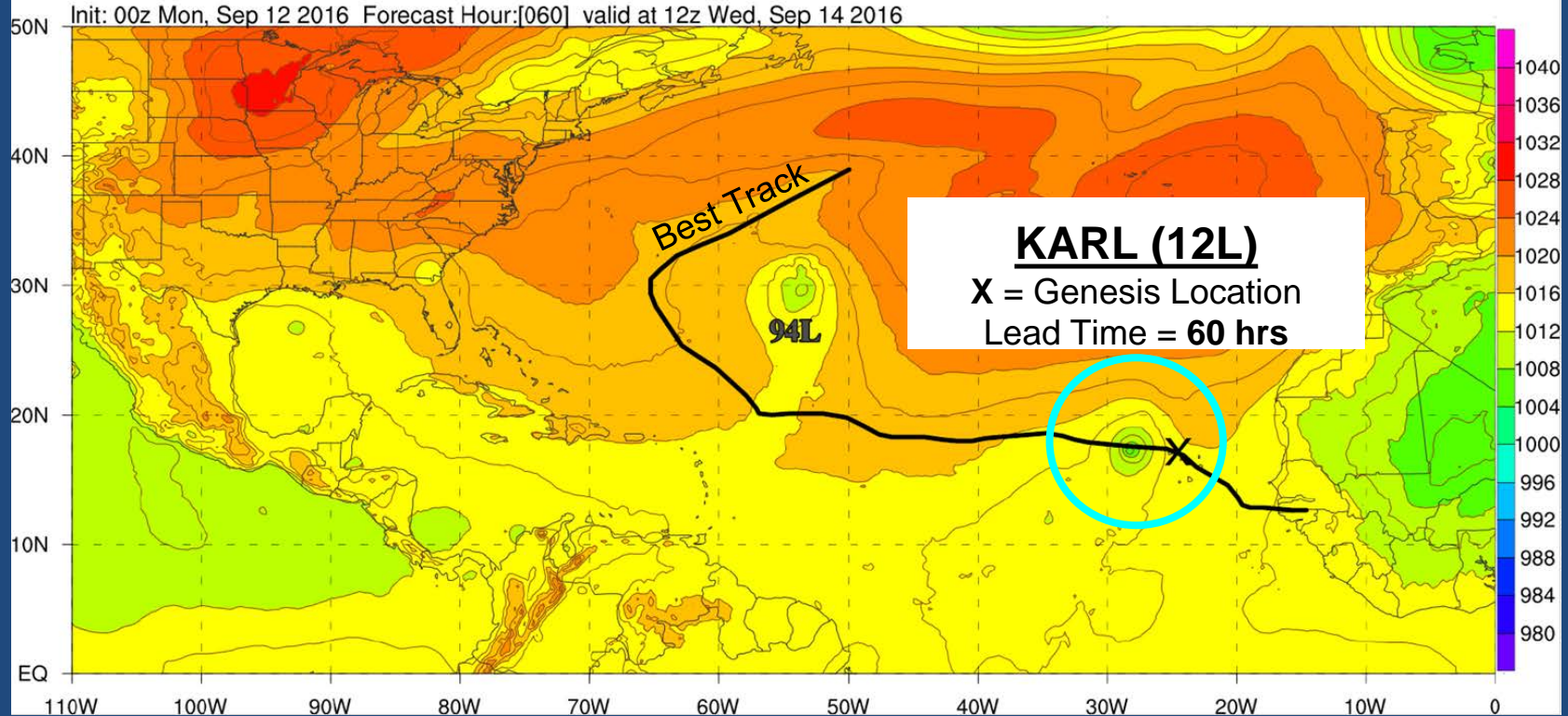
Mean Sea-Level Pressure (hPa; shading and contours)



TC Genesis

Basin-Scale HWRP

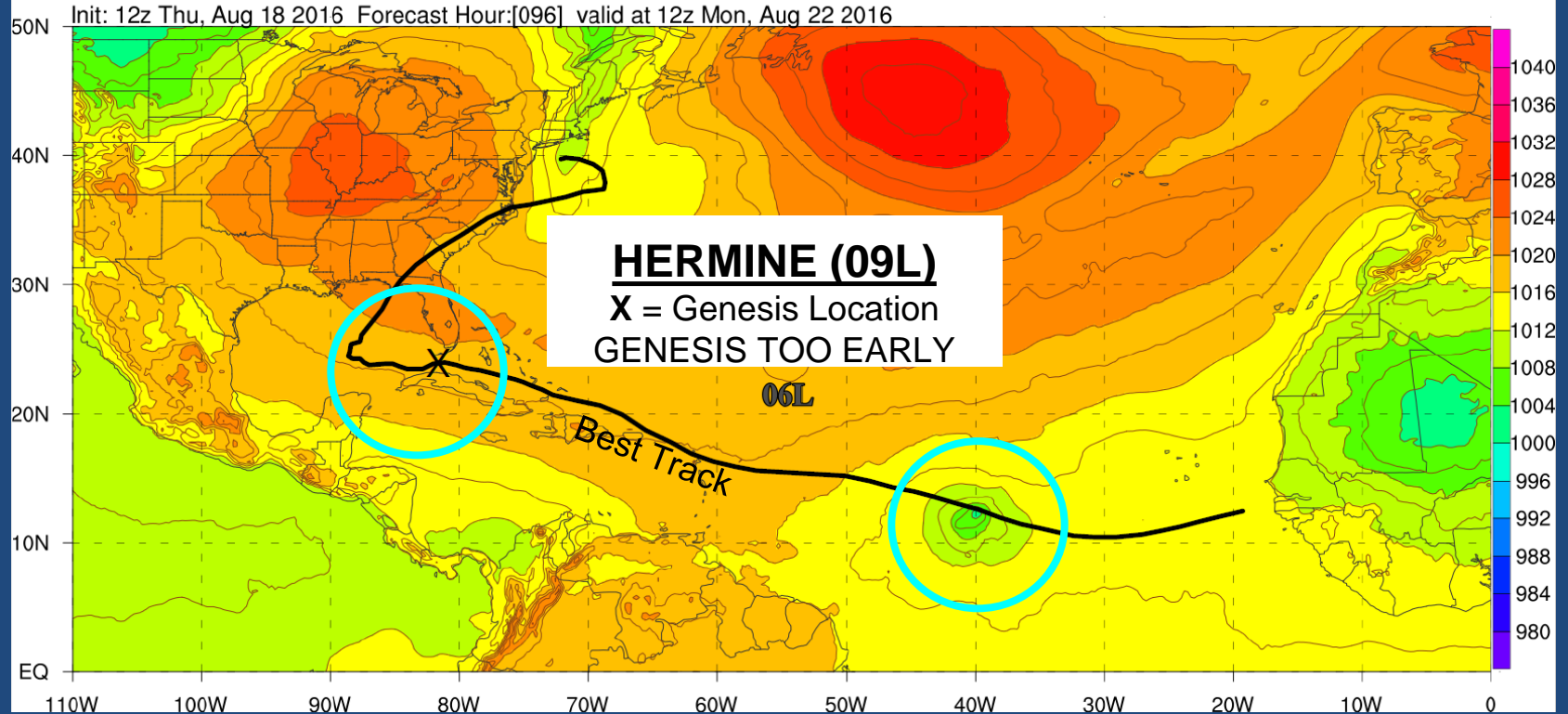
Mean Sea-Level Pressure (hPa; shading and contours)



TC Genesis

Basin-Scale HWRP

Mean Sea-Level Pressure (hPa; shading and contours)



Web Products

Real-time Website

(<http://storm.aoml.noaa.gov>)

- Product delivery accelerated via new graphics package
 - Timing on par with HWRF
 - Used by HFP, Map Discussions, & others
 - On-the-fly analysis
 - Products for:
 - HB16
 - HB15
 - GFS

HWRFB 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).

2016 Tropical Cyclones
2016 (2698 forecasts)

-06H 2016-10-28 06Z

Map Satellite

North Atlantic

- ALEX
- BONNIE
- COLIN
- DANIELLE
- EARL
- FIONA
- GASTON
- EIGHT
- HERMINE
- IAN
- JULIA
- KARL
- LISA
- MATTHEW
- INVEST
- NICOLE

East Pacific

- AGATHA
- BLAS
- BLAS
- DARBY
- DARBY
- ESTELLE
- FRANK
- GEORGETTE
- HOWARD
- IVETTE
- JAVIER
- KAY
- LESTER
- NEWTON
- ORLENE
- PAINÉ
- ROSLYN
- ULIKA
- SEYMOUR

TC-Vitals —
OFCL TRCK —
GFS TRCK —
OFCL FCST - - -
GFDI FCST - - -
GFSI FCST - - -
HB15 FCST - - -
HB16 FCST - - -
LBAR FCST - - -
NVGI FCST - - -

Tracks


Forecast Tracks (clear all)

TC-Vitals GFS OFCL

GFSI GFDI HB15 HB16 LBAR NVGI OFCL

Real-time Website

Choose Forecast
Toggle Cycle
Toggle Multi-Pane



HURRICANE WEATHER
RESEARCH AND FORECASTING
EXPERIMENTAL SYSTEM
EXPERIMENTAL SYSTEM

Toggle Model
Choose Product

Disclaimer: All products in this website are experimental research products created by NOAA's Atlantic Oceanographic and Meteorological Laboratory's Hurricane Research Division (HRD).

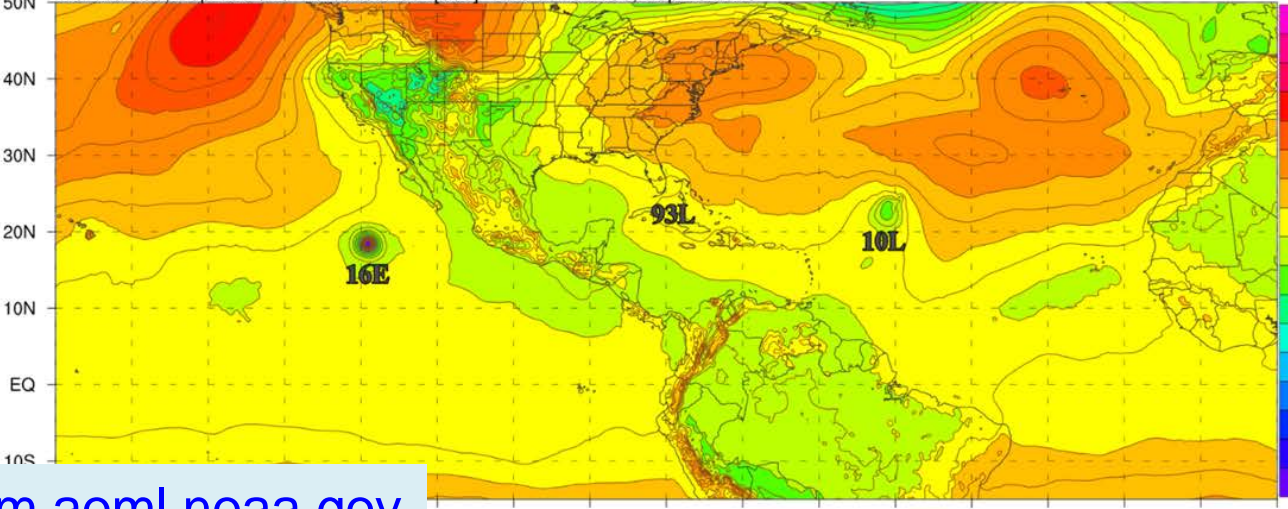
2016-09-13 00Z - 18:06:02km, 18:06:02km, 18:06:02km, Initialization
-06H +06H
[<] [<<] [PLAY] [>>] [>]
HWRF-2016

000	003	006	009	012	015	018	021	024	027	030	033	036	039	042	045	048	051	054	057	060	063
066	069	072	075	078	081	084	087	090	093	096	099	102	105	108	111	114	117	120	123	126	

Basin-Scale HWRF

Mean Sea-Level Pressure (hPa; shading and contours)

Init: 00z Tue, Sep 13 2016 Forecast Hour:[000] valid at 00z Tue, Sep 13 2016



Policies:
[HRD's Dam Policy](#)
[NOAA Disclaimer](#)
[NOAA Privacy Policy](#)

For Official Products:
[National Hurricane Center](#)
[National Weather Service](#)

Related Links
[Operational HWRF](#)
[GWS Tropical Cyclones](#)

- [Shear Plots](#)
- [Steering Plots](#)
- [NRL Tropical Cyclone](#)

Large-Scale

Full Domain

DYNAMIC - Basin-scale

- Z500 + MSLP
- 10-m Wind + Streamflow
- Vort850 + Wind200
- Wind850 + Streamflow
- Vort200 + Z200 + Wind200
- Vort500 + Z500 + Wind500
- Vort700 + Z700 + Wind700
- Vort850 + Z850 + Wind850
- MSLP
- 850-200mb Wind Shear
- 850-500mb Wind Shear
- 850-700mb Wind Shear

THERMODYNAMIC - Basin-scale

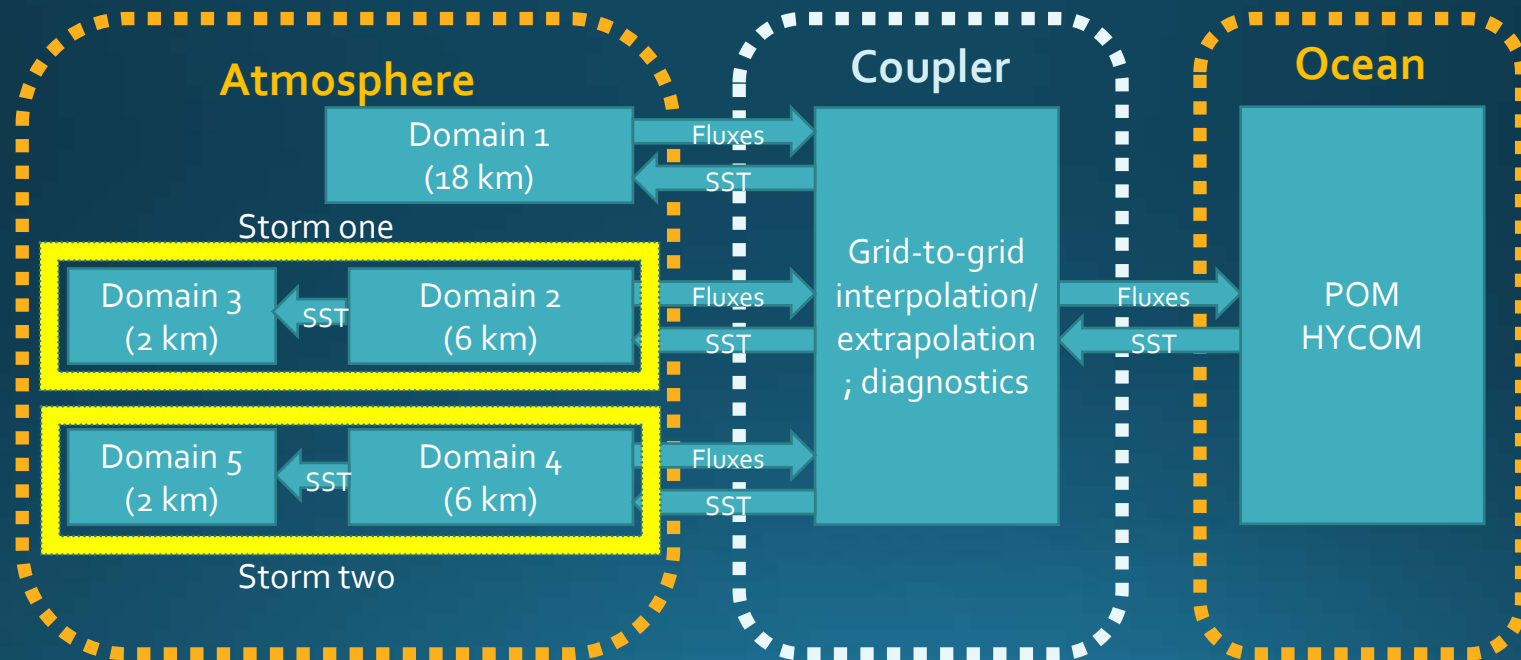
- CAPE + Helicity
- Reflectivity
- Total Precip
- Precip Rate
- Precip Rate + Z1000-500
- RH700-400 + Wind700-400
- RH700 + Wind700
- TPW

Vortex-Scale

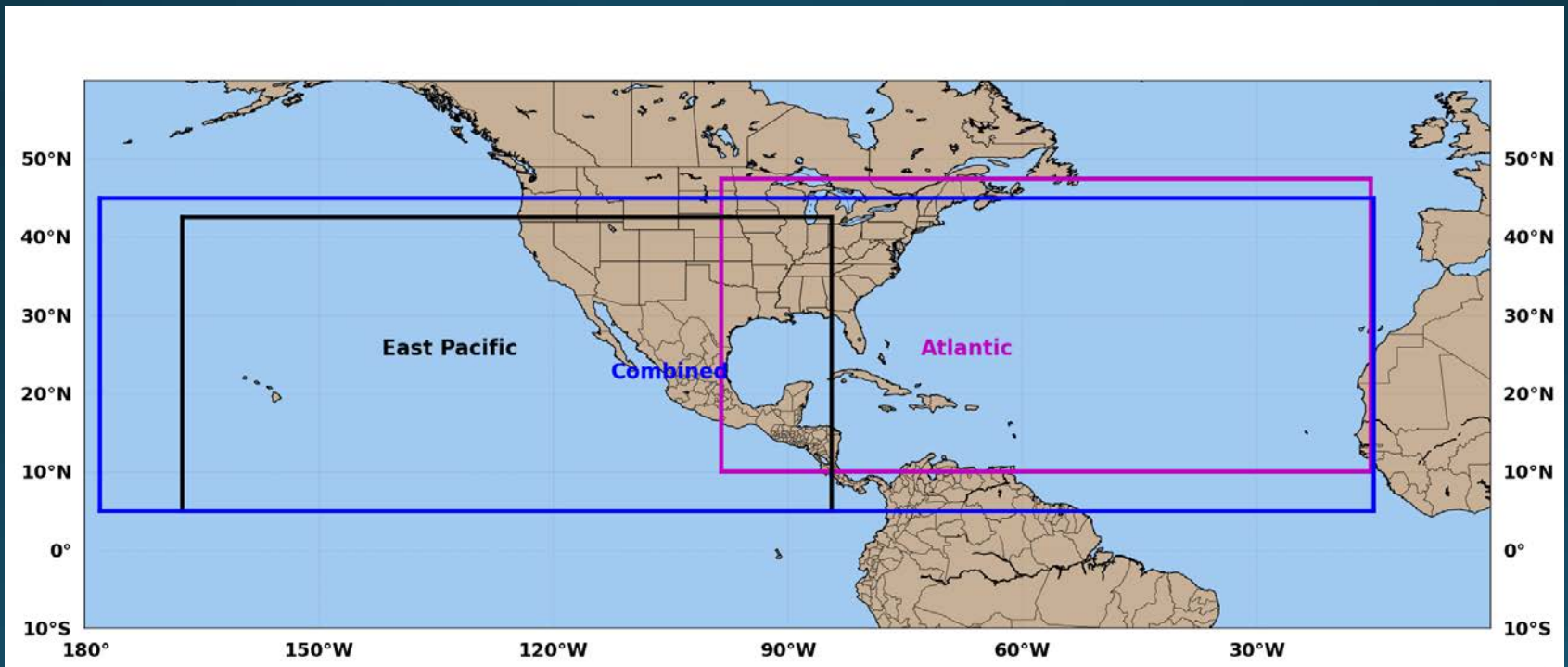
Multi-Model

Model Development

HWRF-B Ocean-Atmosphere Coupled System



HWRF-B Oceanic Component (MPIPOM-TC)



Basin-scale HWRF Features and Forecast Applications

- The unique features of the basin-scale HWRF:
 - Static outer domain spanning nearly $\frac{1}{4}$ of the globe
 - Multiple sets of movable nests targeting multiple storms
 - Independent parallel integration on outer domain and each set of movable domains
 - Coarse and fine resolution two-way interactions and vortex-vortex interactions
 - RTOFS ocean initialization
- Forecast applications:
 - Basin-scale HWRF as a genesis forecast model like global model, i.e. run every cycle, even if no TCs
 - Proof of concept for FV3, i.e. spawn nests in the basin-scale HWRF when TC genesis occurs (or earlier)
 - Independent hybrid DA for both large-scale (satellite) and vortex-scale (flight)
 - Ensemble forecasts

Target R2O Transition

- Create a new development branch (**Done**)
- Complete multi-storm coupler (**Improving efficiency**)
- Complete ocean initialization merging (**Done**)
- Start full coupled system retrospective forecasts for multiple seasons (**Ongoing, need resource, due April 15**)
- Form an operational/implementation transition plan (**TBD**)
- Test on operational machine configuration and scalability (**TBD**)

Extra Slides

Forecast Counts (Atlantic)

STORM	TOTAL	HB16
01L - ALEX	8	0
02L - BONNIE	24	24
03L - COLIN	9	9
04L - DANIELLE	6	6
05L - EARL	16	16
06L - FIONA	27	27
07L - GASTON	46	26
08L - TD-EIGHT	15	1

STORM	TOTAL	HB16
09L - HERMINE	23	3
10L - IAN	16	12
11L - JULIA	23	7
12L - KARL	44	6
13L - LISA	22	0
14L - MATTHEW	46	46
15L - NICOLE	53	53
16L - OTTO	16	16

Forecast Counts (East Pacific)

STORM	TOTAL	HB16
01E - TD-ONE	7	7
02E - AGATHA	13	13
03E - BLAS	31	28
04E - CELIA	37	33
05E - DARBY	57	35
06E - ESTELLE	29	29
07E - FRANK	29	29
08E - GEORGETTE	24	24
09E - HOWARD	12	12
10E - IVETTE	24	21
11E - JAVIER	10	10

STORM	TOTAL	HB16
12E - KAY	20	20
13E - LESTER	56	17
14E - MADELINE	29	6
<i>15E - NEWTON</i>	13	0
16E - ORLENE	24	14
<i>17E - PAINE</i>	12	0
18E - ROSLYN	16	8
19E - ULIKA	8	8
20E - SEYMOUR	21	21
21E - TINA	5	5
22E - OTTO	7	7

HB16 Forecast Breakdown

BASIN	TOTAL	HB16	%
ATLANTIC	395	252	63.8%
EAST PACIFIC	482	347	72.0%
TOTAL	877	599	68.3%

Note: 1. Invest cycles NOT included

2. 2016 forecast gaps, due to Jet data issues, are currently being filled