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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Acknowledgement

- Main contributors of web products, analysis and slides:
  - G. Alaka
  - H. Chen
  - 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 MPIPOM-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	

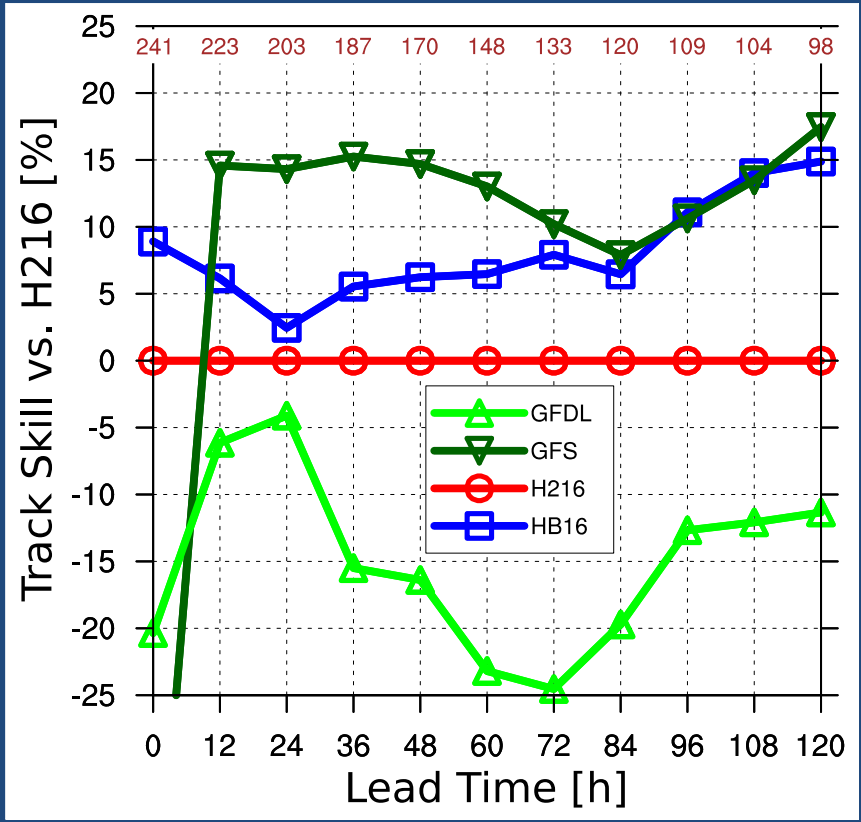
Results:
Track/Intensity Verification Statistics

HB16 = 2016 Basin-Scale HWRF

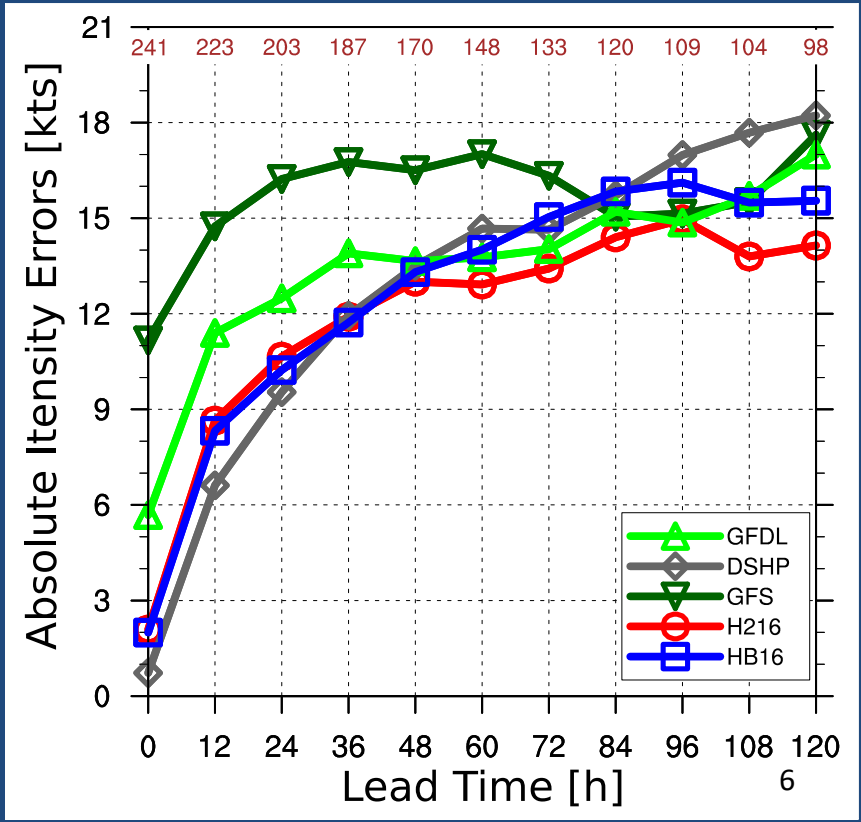
H216 = 2016 Operational HWRF

Atlantic Basin

Track Skill

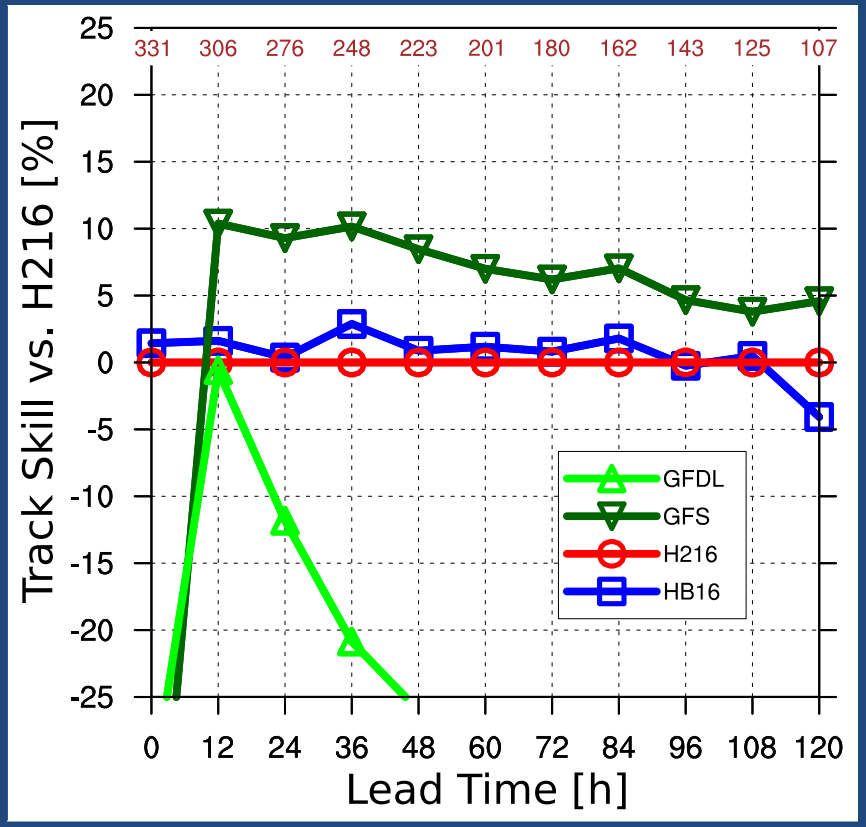


Intensity Errors



East Pacific Basin

Track Skill



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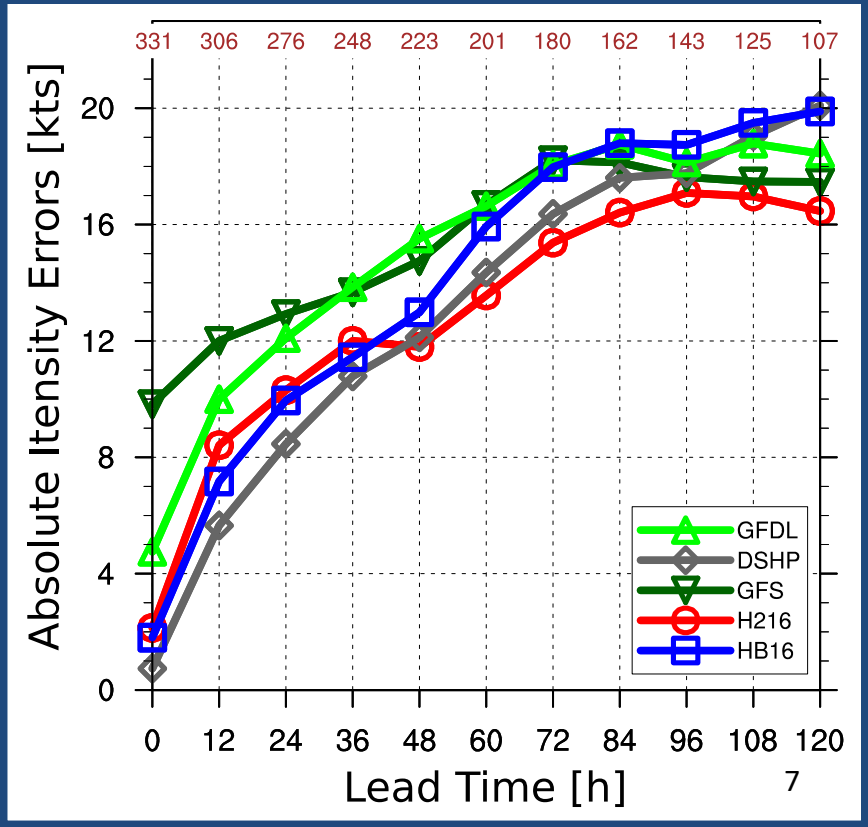
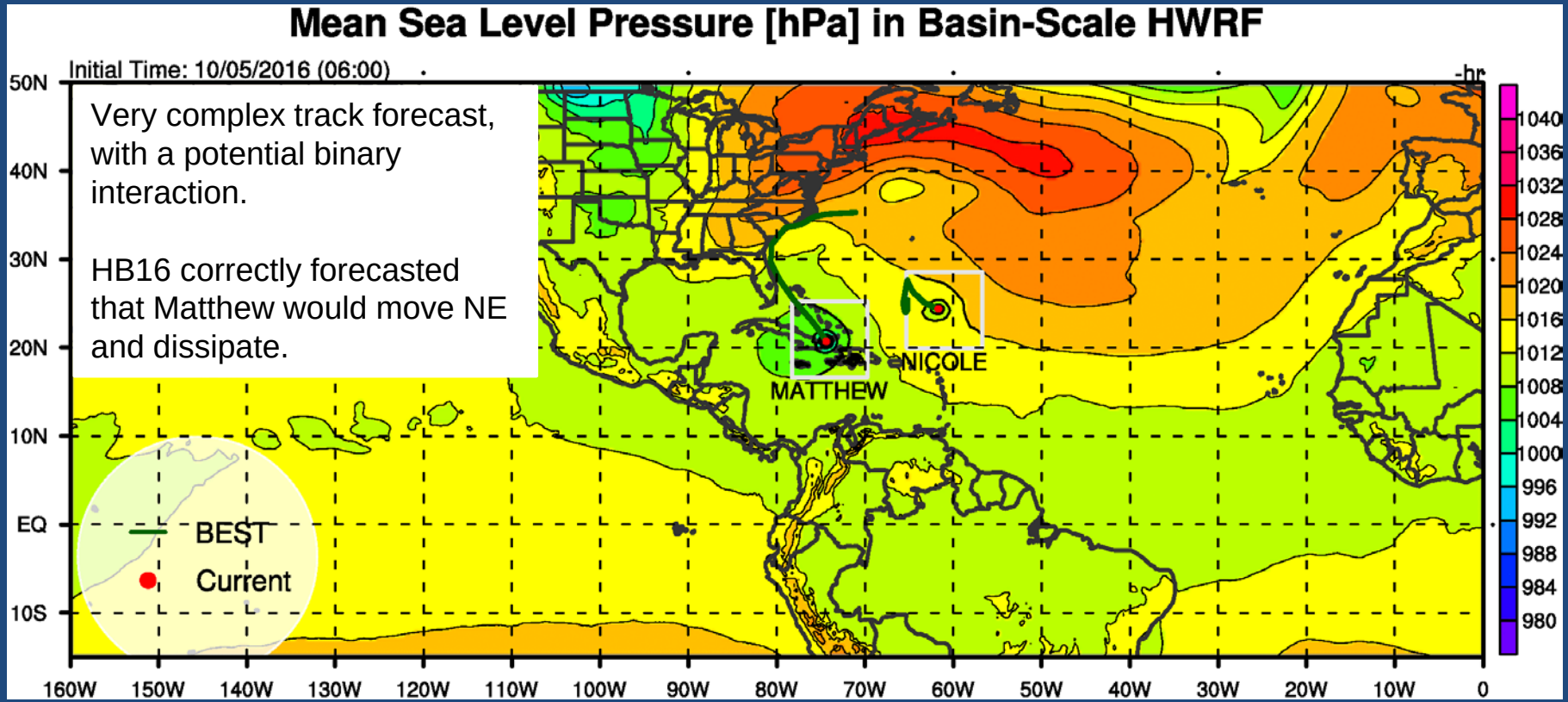


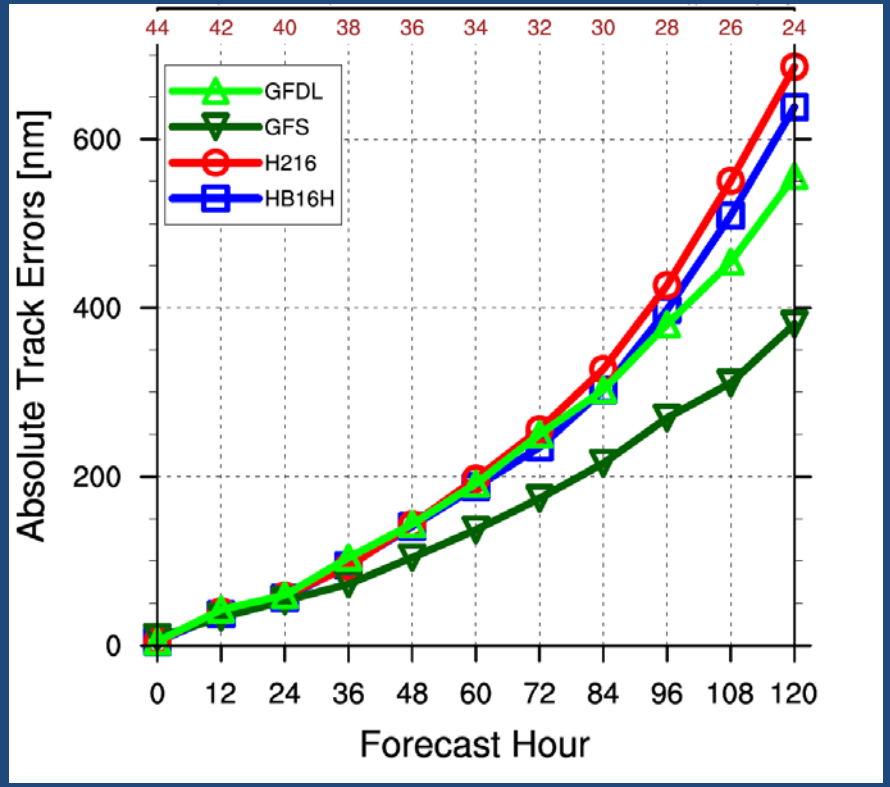
Results– Cases Study

Matthew (14L) & Nicole (15L)

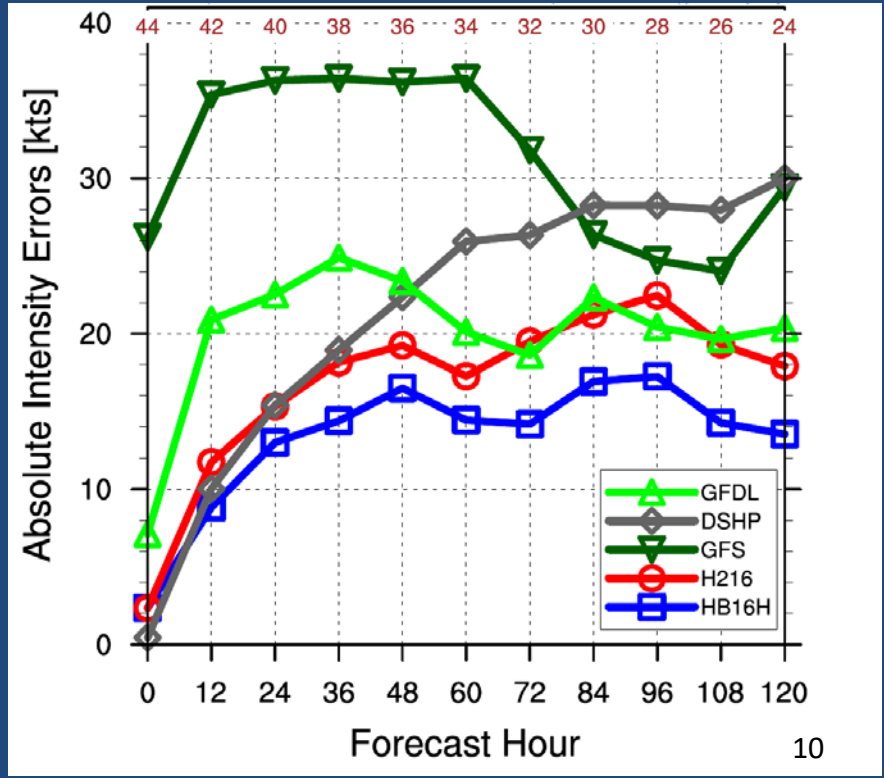


Matthew Verification

Track Errors

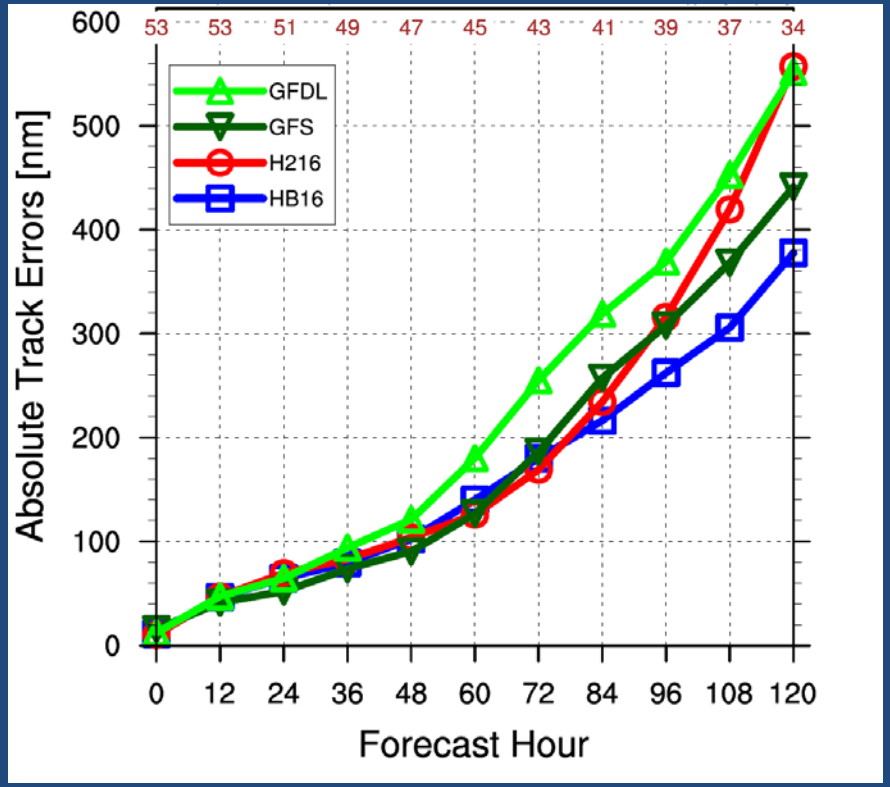


Intensity Errors

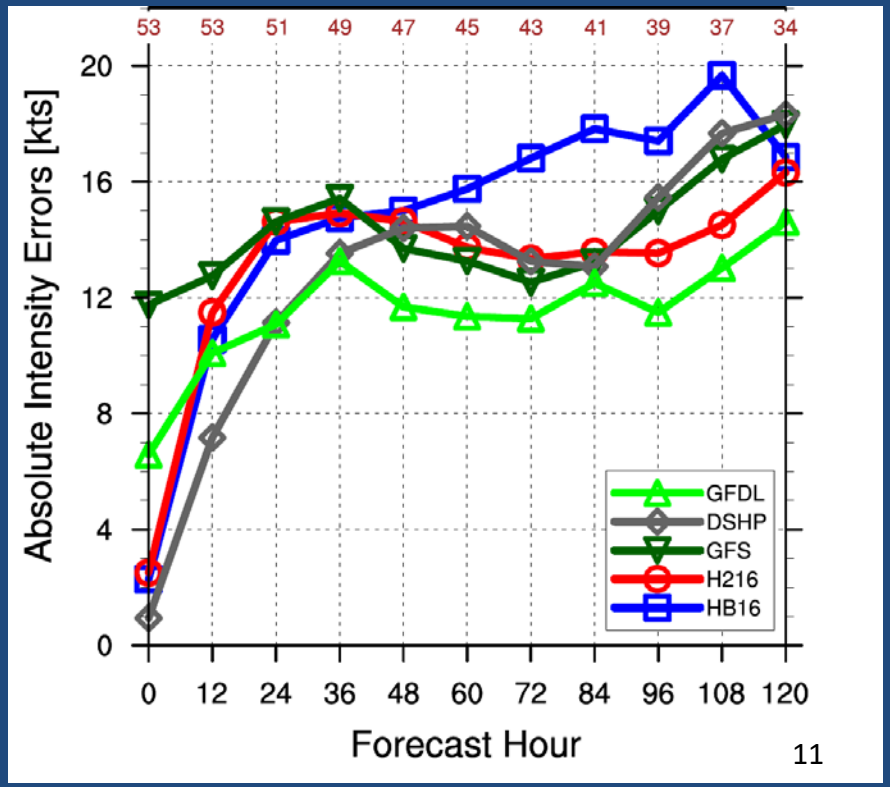


Nicole Verification

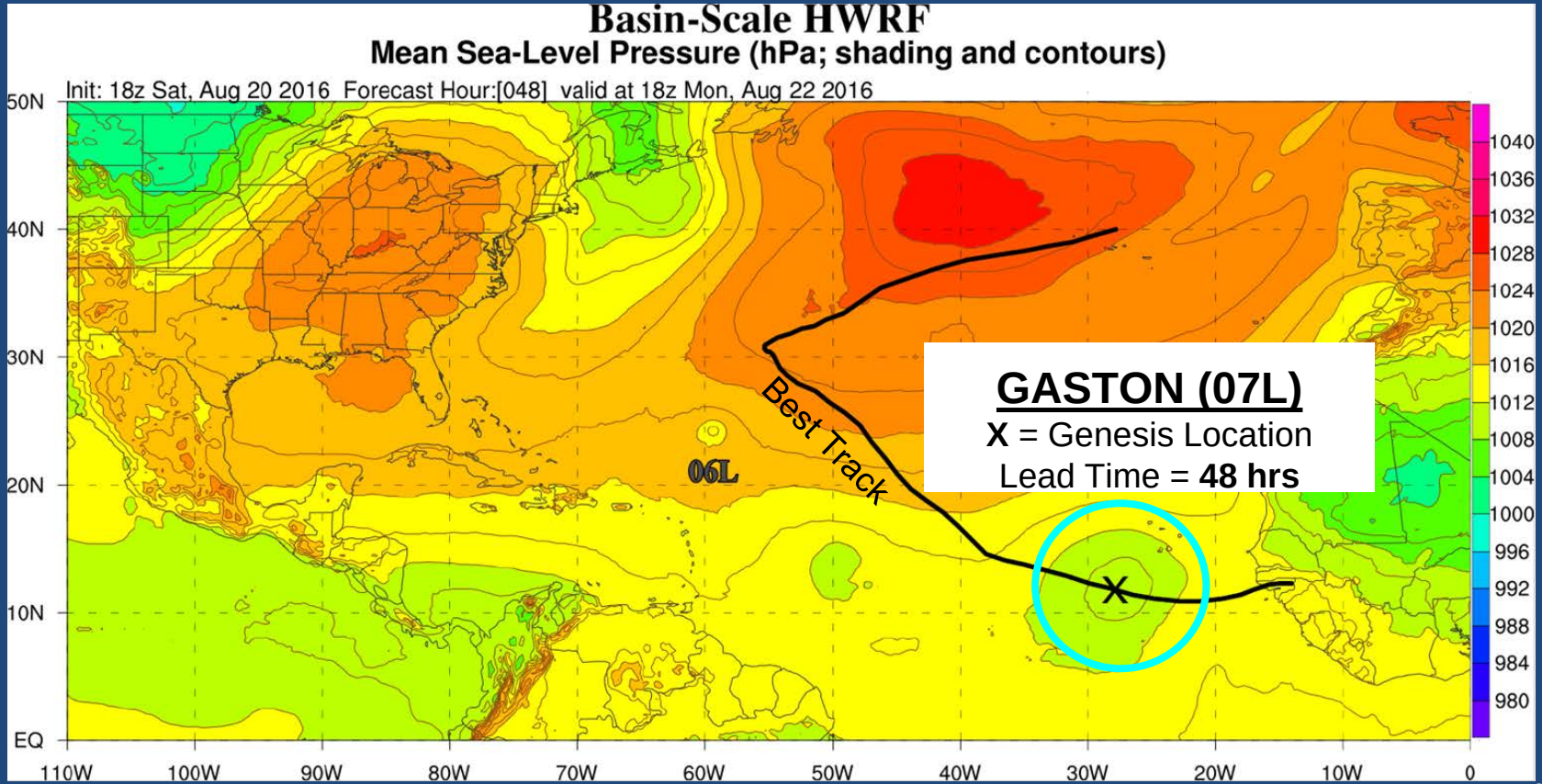
Track Errors



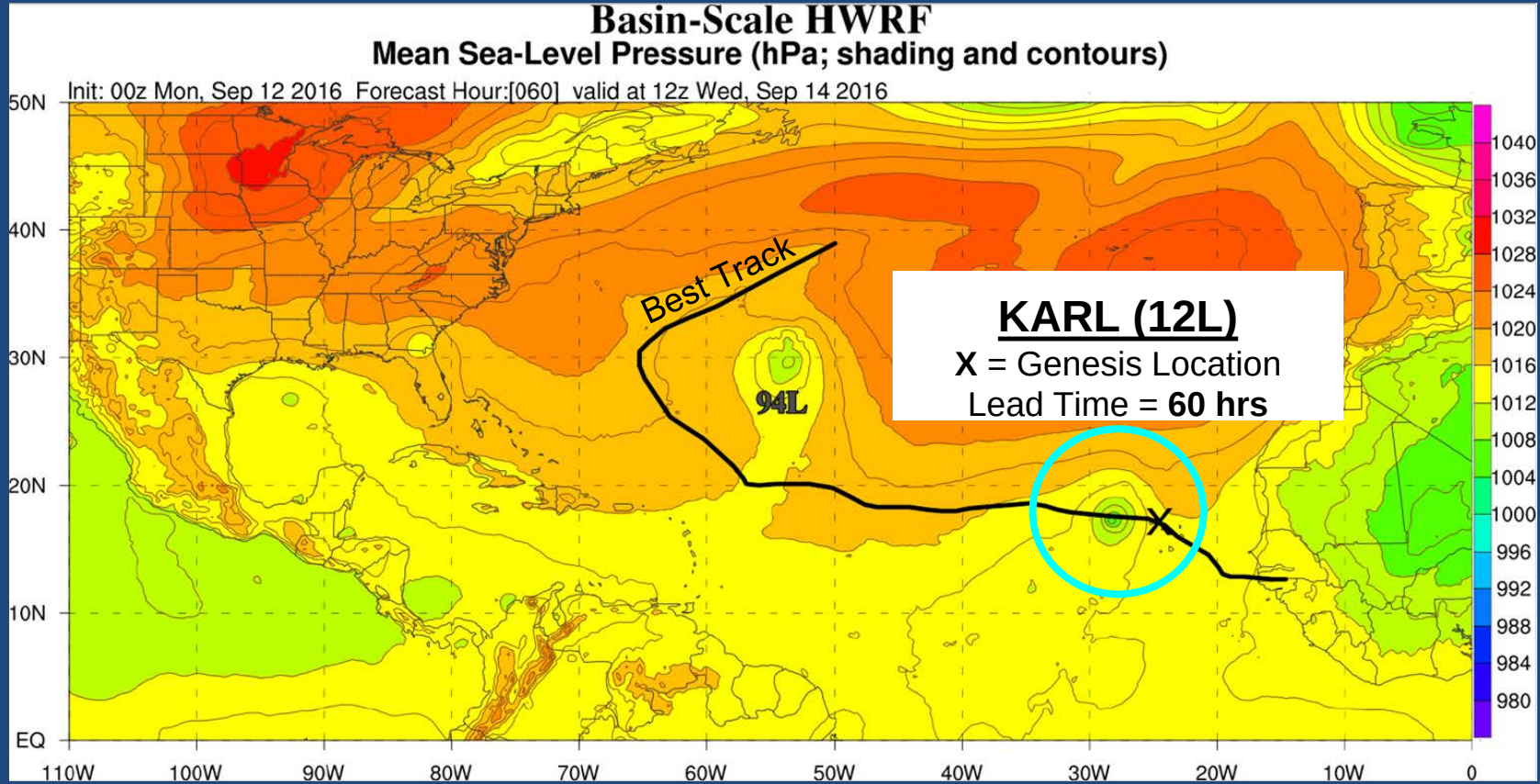
Intensity Errors



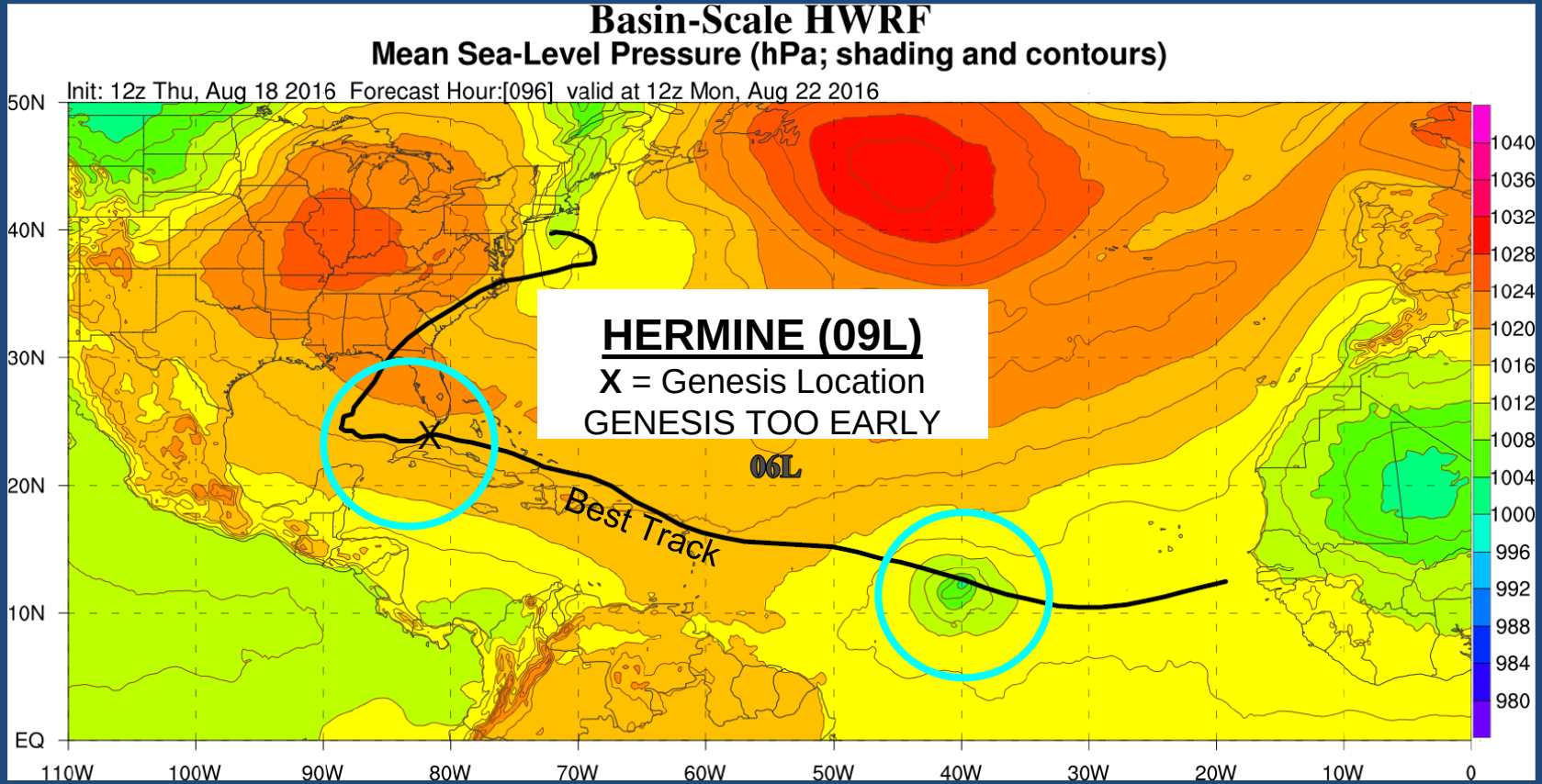
TC Genesis


Basin-Scale HWRF
Mean Sea-Level Pressure (hPa; shading and contours)
Init: 18z Sat, Aug 20 2016 Forecast Hour:[048] valid at 18z Mon, Aug 22 2016
50N
40N
30N
20N
10N
EQ
110W
100W
90W
80W
70W
60W
50W
40W
30W
20W
10W
0
1040
1036
1032
1028
1024
1020
1016
1012
1008
1004
1000
996
992
988
984
980
06L
Best Track
GASTON (07L)
X = Genesis Location
Lead Time = 48 hrs

TC Genesis


Basin-Scale HWRF
Mean Sea-Level Pressure (hPa; shading and contours)
Init: 00z Mon, Sep 12 2016 Forecast Hour:[060] valid at 12z Wed, Sep 14 2016
50N
40N
30N
20N
10N
EQ
110W
100W
90W
80W
70W
60W
50W
40W
30W
20W
10W
0
1040
1036
1032
1028
1024
1020
1016
1012
1008
1004
1000
996
992
988
984
980
Best Track
94L
KARL (12L)
X = Genesis Location
Lead Time = 60 hrs

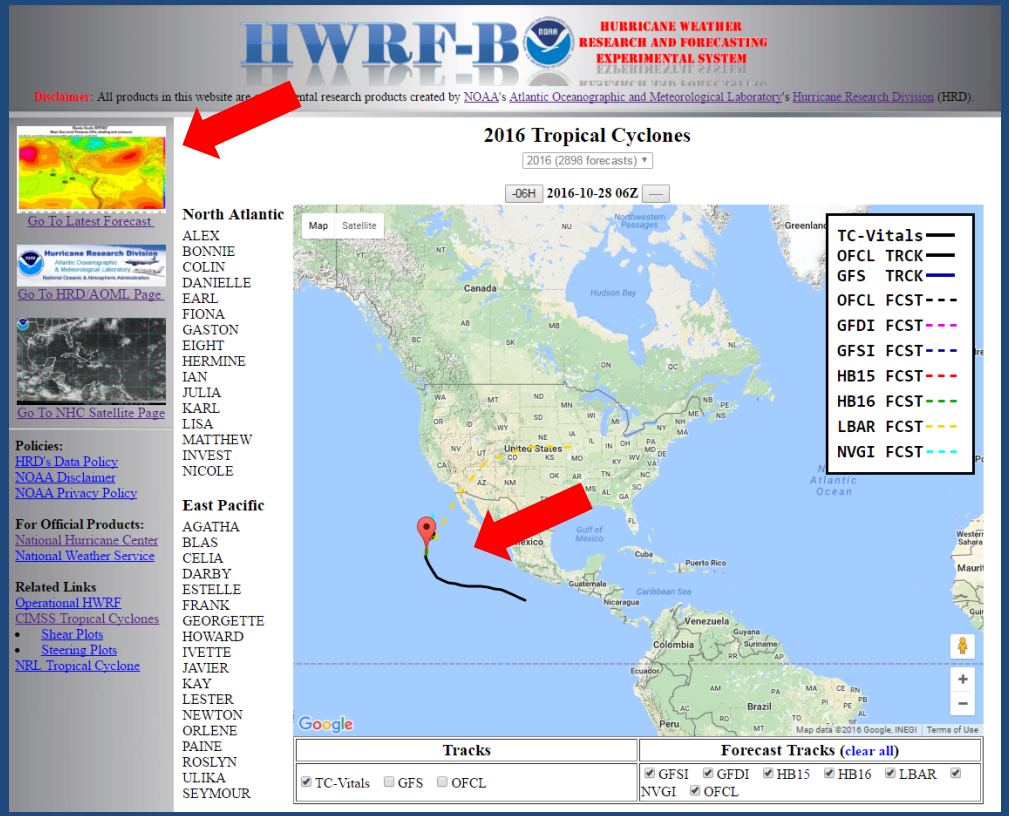
TC Genesis


Basin-Scale HWRF
Mean Sea-Level Pressure (hPa; shading and contours)
Init: 12z Thu, Aug 18 2016 Forecast Hour:[096] valid at 12z Mon, Aug 22 2016
50N
40N
30N
20N
10N
EQ
110W
100W
90W
80W
70W
60W
50W
40W
30W
20W
10W
0
1040
1036
1032
1028
1024
1020
1016
1012
1008
1004
1000
996
992
988
984
980
HERMINE (09L)
X = Genesis Location
GENESIS TOO EARLY
X
06L
Best Track

Web Products

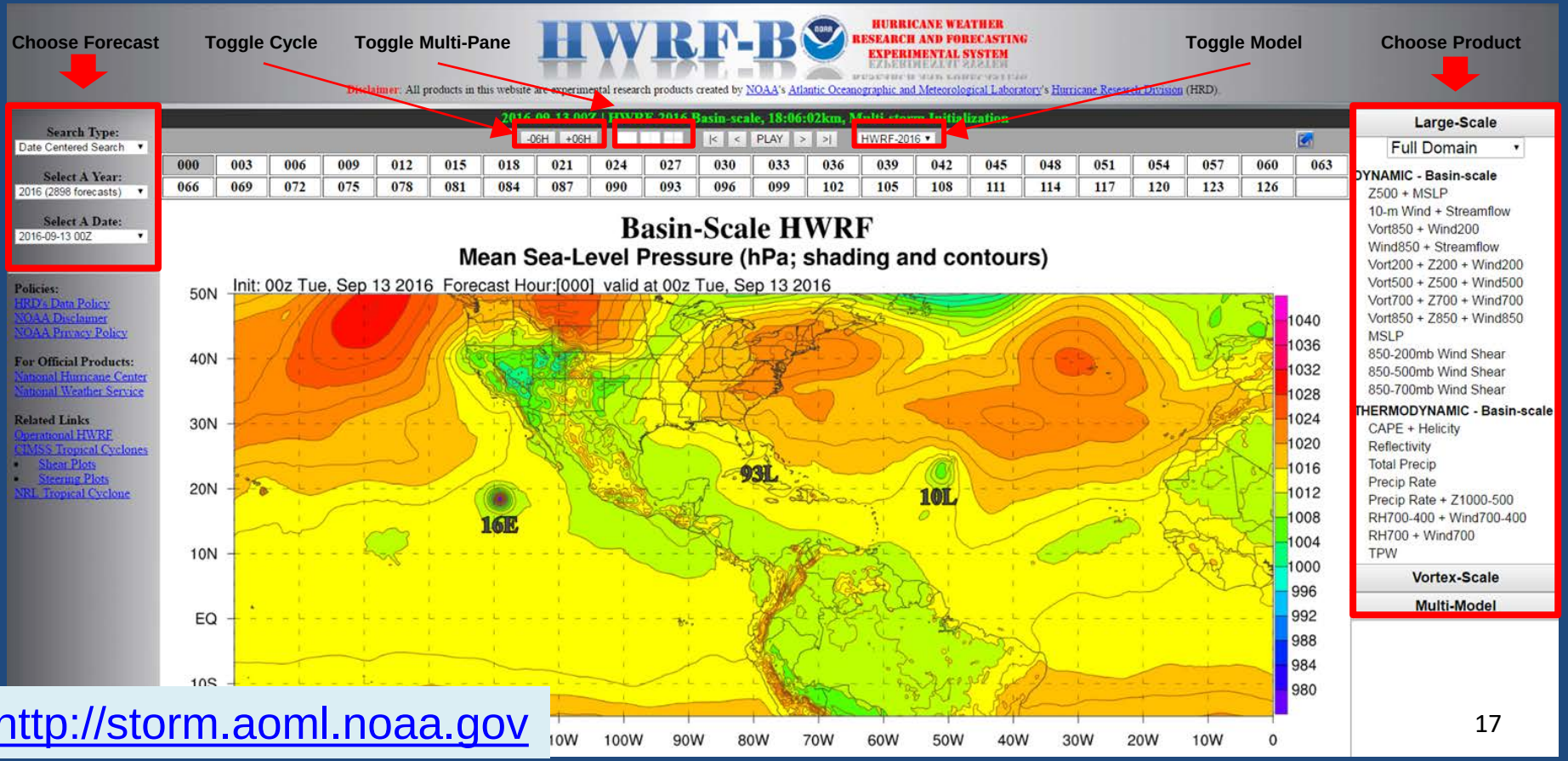
Real-time Website

(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

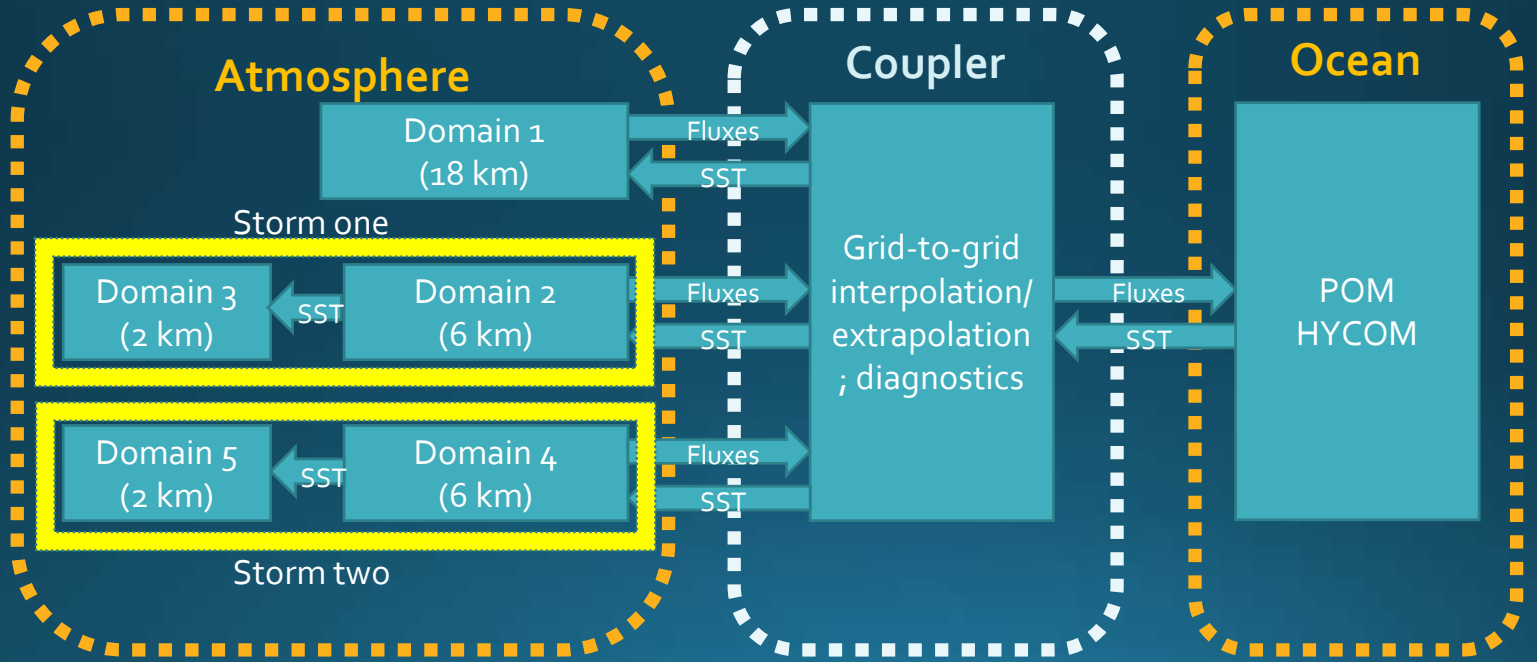
Real-time Website



http://storm.aoml.noaa.gov

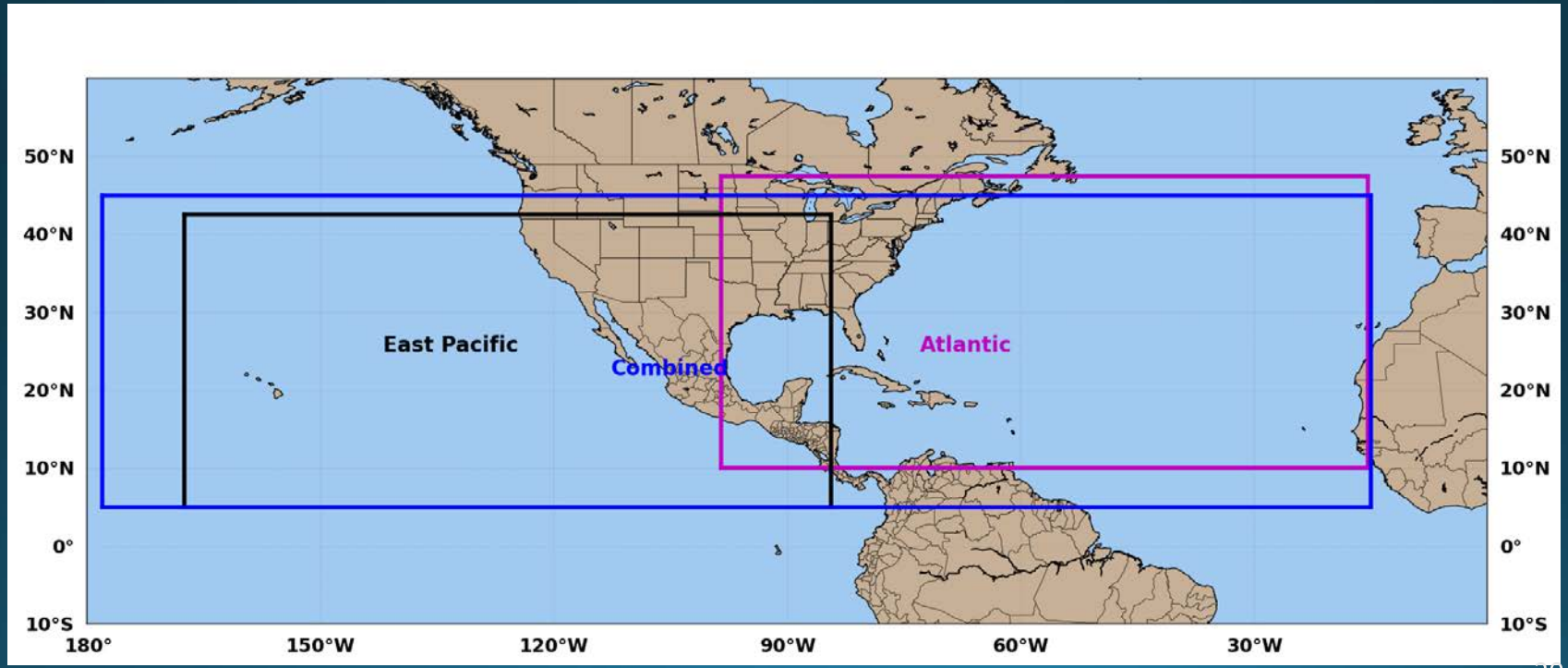
Model Development

HWRF-B Ocean-Atmosphere Coupled System



Modified from 2015 HWRF tutorial talk by Dmitry A. Sheinin, NCEP/EMC

HWRF-B Oceanic Component (MPIPOM-TC)



Credit to Biju Thomas & Isaac Ginis, URI

Basin-scale HWRF Features and Forecast Applications

- The unique features of the basin-scale HWRF:
  - Static outer domain spanning nearly ¼ 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
15E - NEWTON	*13*	*0*
16E - ORLENE	24	14
17E - PAINE	*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