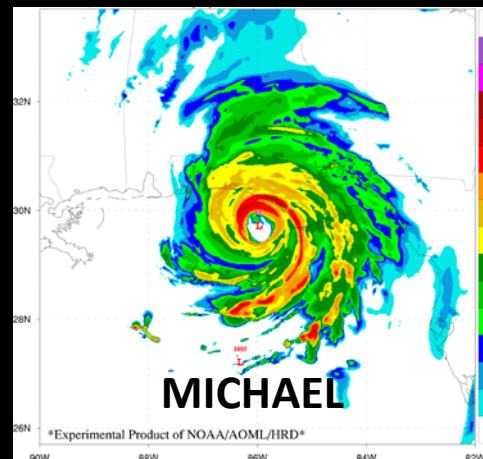
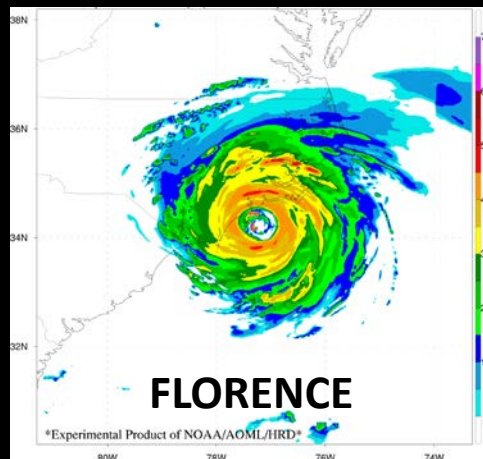


Evaluation of 2018 Real-Time Forecasts



Presented by
Ghassan Alaka^{1,2}

¹Cooperative Institute for Marine and Atmospheric Studies, University of Miami

²NOAA/AOML/Hurricane Research Division

Basin-Scale HWRF is a Team Effort!

HRD Team:

Xuejin Zhang^{1,2}, Jonathan Poterjoy³, Mu-Chieh Ko^{1,2}, Andrew Hazelton^{1,2}, Russell St. Fleur^{1,2},
Hui Christophersen^{1,2}, S. Gopalakrishnan², Frank Marks²

¹*Cooperative Institute for Marine and Atmospheric Studies, University of Miami*

²*NOAA/AOML/Hurricane Research Division*

³*University of Maryland*

Collaborators:

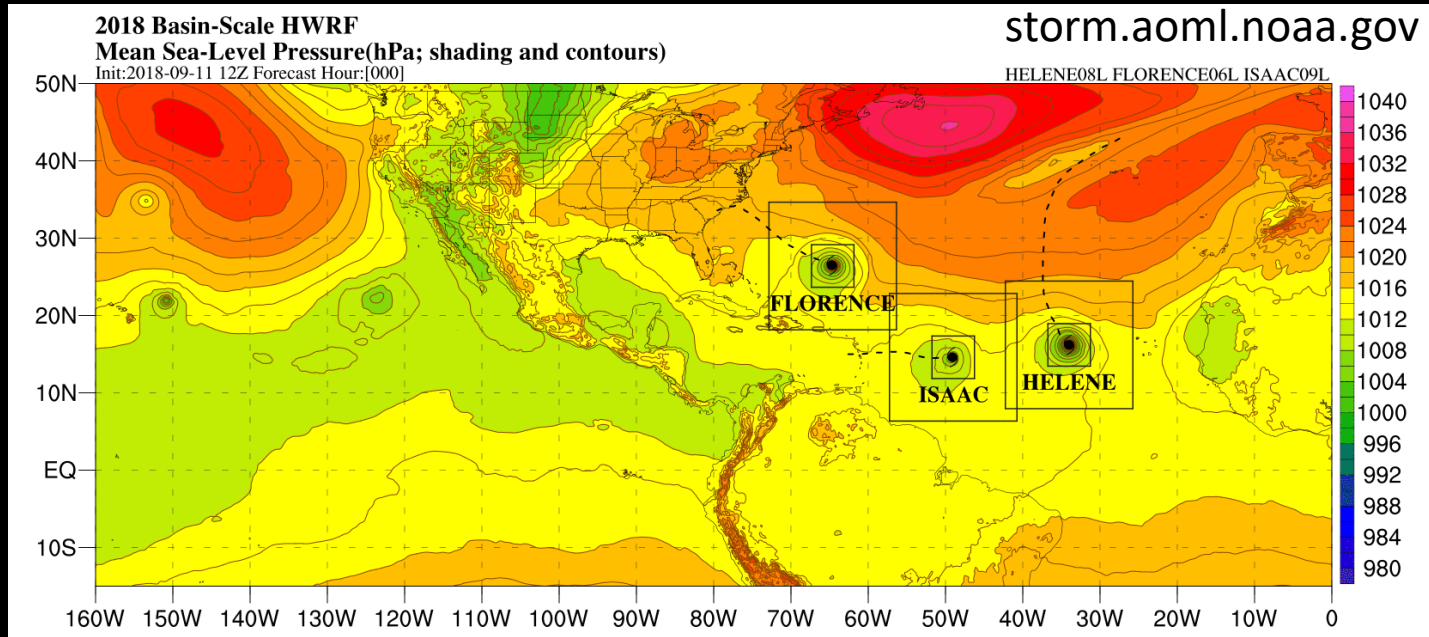
Avichal Mehra, Bin Liu, Zhan Zhang, Henry Winterbottom, Qingfu Liu (NCEP/EMC)
Evan Kalina, James Frimel, Evelyn Grell, Laurie Carson (DTC)
Andrew Penny (NHC)

The advancement & success of the Basin-Scale HWRF project is a reflection of excellent collaborations within NOAA that aim to reach a common goal.

THANK YOU VERY MUCH!

What is Basin-Scale HWRF?

An HFIP Real-Time Demonstration since 2013!



X. Zhang et al. (WAF, 2016)
Alaka et al. (WAF, 2017)

Key differences: Multiple high-resolution moving nests; Large outermost domain
New in 2018: Ocean coupling (POM); Satellite data assimilation system

Basin-Scale HWRF in 2018

Two Basin-Scale HWRF projects supported for 2018 HFIP Real-Time Demos:

- “Traditional” Basin-Scale HWRF (HWRF-B; HB18)
 - Upgraded in lockstep with operational HWRF
 - Multi-storm paradigm
- Basin-Scale HWRF DA and Ensemble Prediction System (HWRF-C; HC18)
 - Satellite data assimilation on the outer domain
 - Probabilistic 7-day forecasts

Major Findings & Milestones

Scientific Findings

- **HB18** had better intensity forecasts than **H218** at longer lead times (> 72h)
- **HB18** track errors consistent with **H218**
- **HB18** performed well because most forecasts had multiple storms
- **HB18** had lower forecast errors than **H218** for Florence/Helene/Isaac forecasts
- **HC18** performed satellite DA for 6+ weeks & had no apparent model drift

Project-Oriented Milestones

- Ran **HB18/HC18** 4x daily in real-time for the HFIP demo on Jet
- Implemented POM coupling for **HB18** (thx Biju)
- Relocation bug for storms near the edge of D01 in **HB18** (thx EMC & DTC)
- Developed a Python/Rocoto workflow for **HC18** (thx Jon P., Henry, & DTC)
- Developed single-nest capacity for **HC18** → delivered to HWRF trunk
- Configured the GFDL Genesis tracker for **HC18**
- Delivered products to our web site in real-time for our collaborators (HFP, Map Discussion)

Project #1: HB18

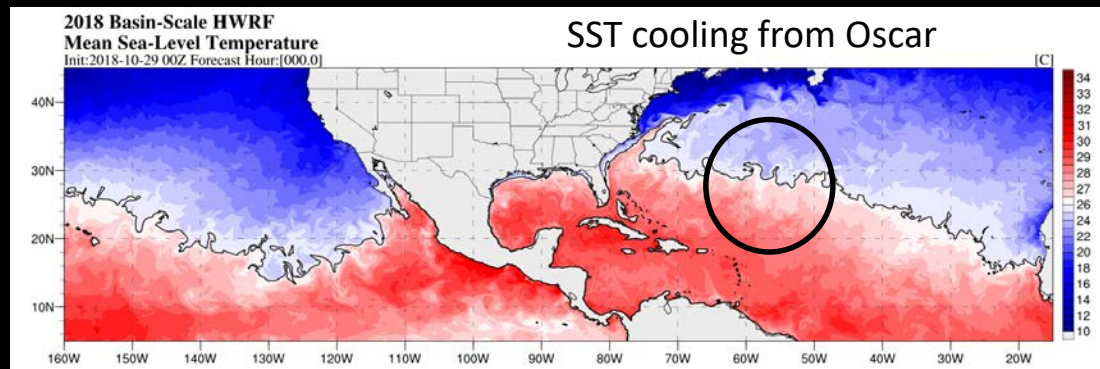
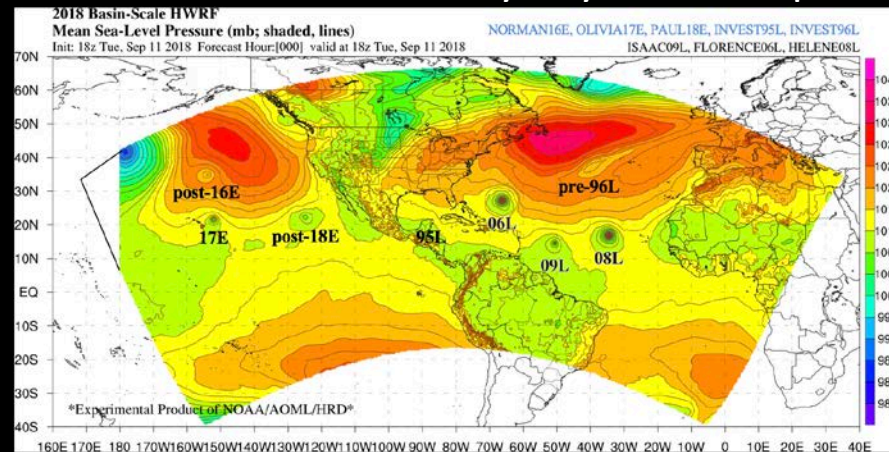
- Dynamical core is identical to the 2018 operational HWRF (**H218**)
- Most configuration options were identical
 - All physics, vertical resolution, 13.5/4.5/1.5 km horizontal resolution
- Key configuration differences
 - **Outermost domain size***
Covers NHC Area Of Responsibility
 - **Multiple high-resolution nests***
Up to 3 this year
 - Data assimilation
No TDR DA ensemble
 - Ocean initialization
RTOFS vs. NSST

Configuration Options	HB18	H218
Domain	13.5 km: 194.0° x 84.2° 4.5 km: 16.5° x 16.5° 1.5 km: 5.5° x 5.5°	13.5 km: 77.2° x 77.2° 4.5 km: 17.7° x 17.7° 1.5 km: 5.9° x 5.9°
Model Top	10 hPa	10 hPa
Vertical Levels	75	75
Vortex Init.	At 4.5/1.5 km	At 4.5/1.5 km
Data Assimilation	Hybrid DA	Hybrid DA & TDR Ensemble
Ocean Coupling	13.5 km: YES (POM) 4.5/1.5 km: Downscaled	13.5/4.5 km: YES (POM) 1.5 km: Downscaled
Multi-Storm	YES (up to 3)	NO
PHYSICS SCHEMES		
Microphysics	Ferrier-Aligo	Ferrier-Aligo
Radiation (LW,SW)	RRTMG	RRTMG
Surface Layer	HWRF (GFDL-based)	HWRF (GFDL-based)
PBL	GFS Hybrid-EDMF	GFS Hybrid-EDMF
Convection	Scale-Aware SAS	Scale-Aware SAS
Land Surface	Noah LSM	Noah LSM

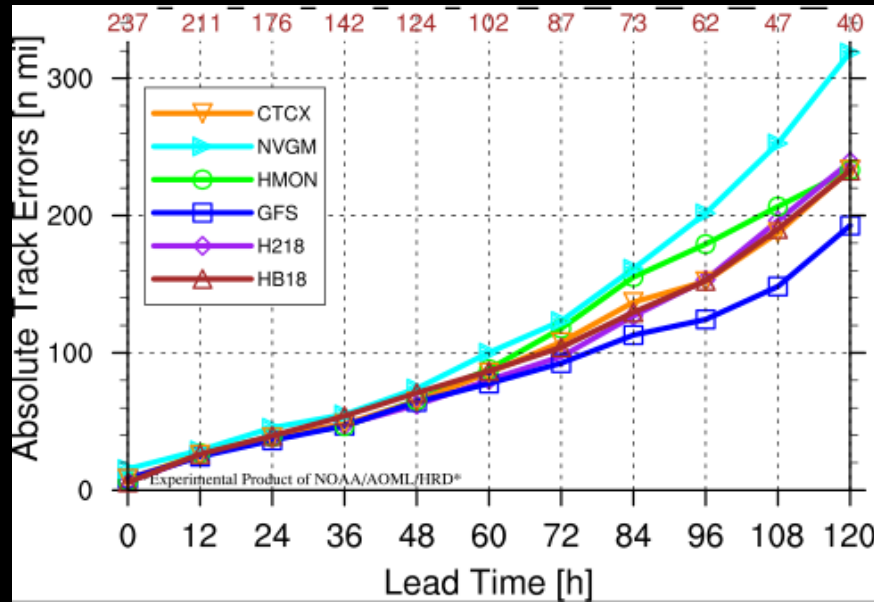
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RTOFS vs. NSST

A busy day in the tropics...

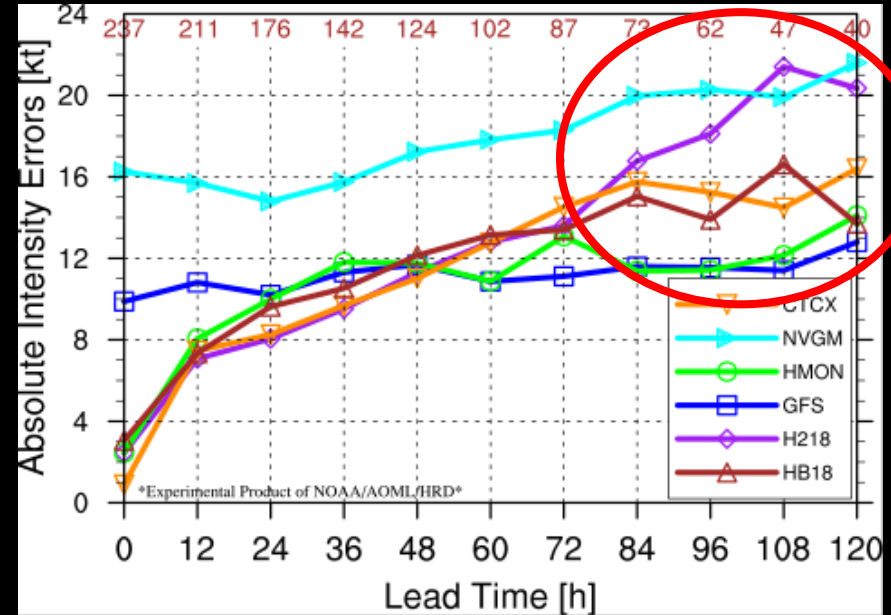


HB18 Verification: North Atlantic



H218 & **HB18** were consistent

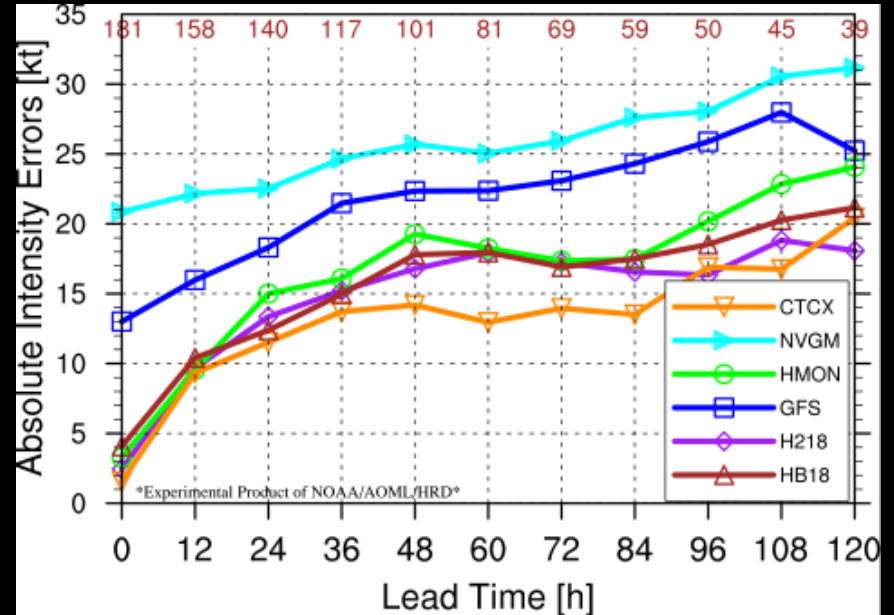
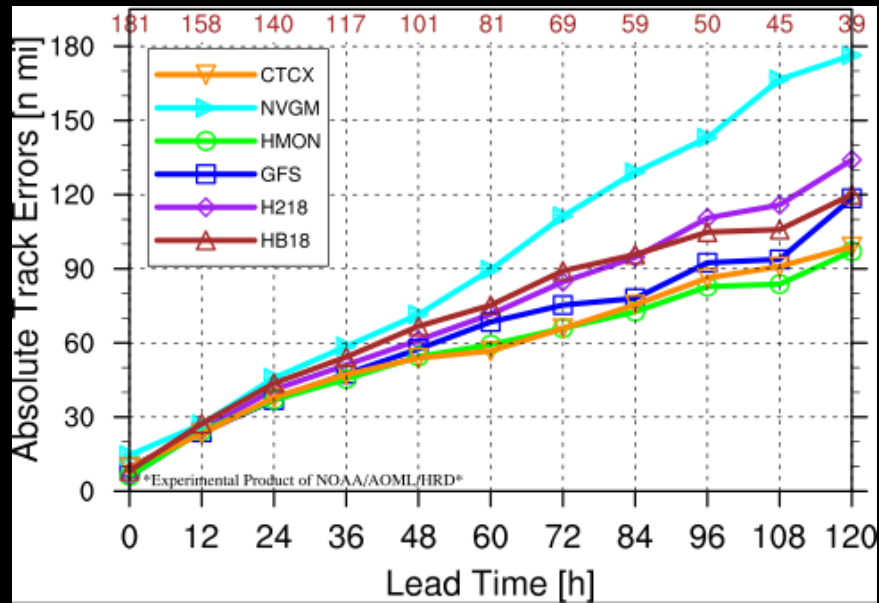
HB18 had better tracks than **H218**
52% of the time



HB18 better than **H218** at longer lead times

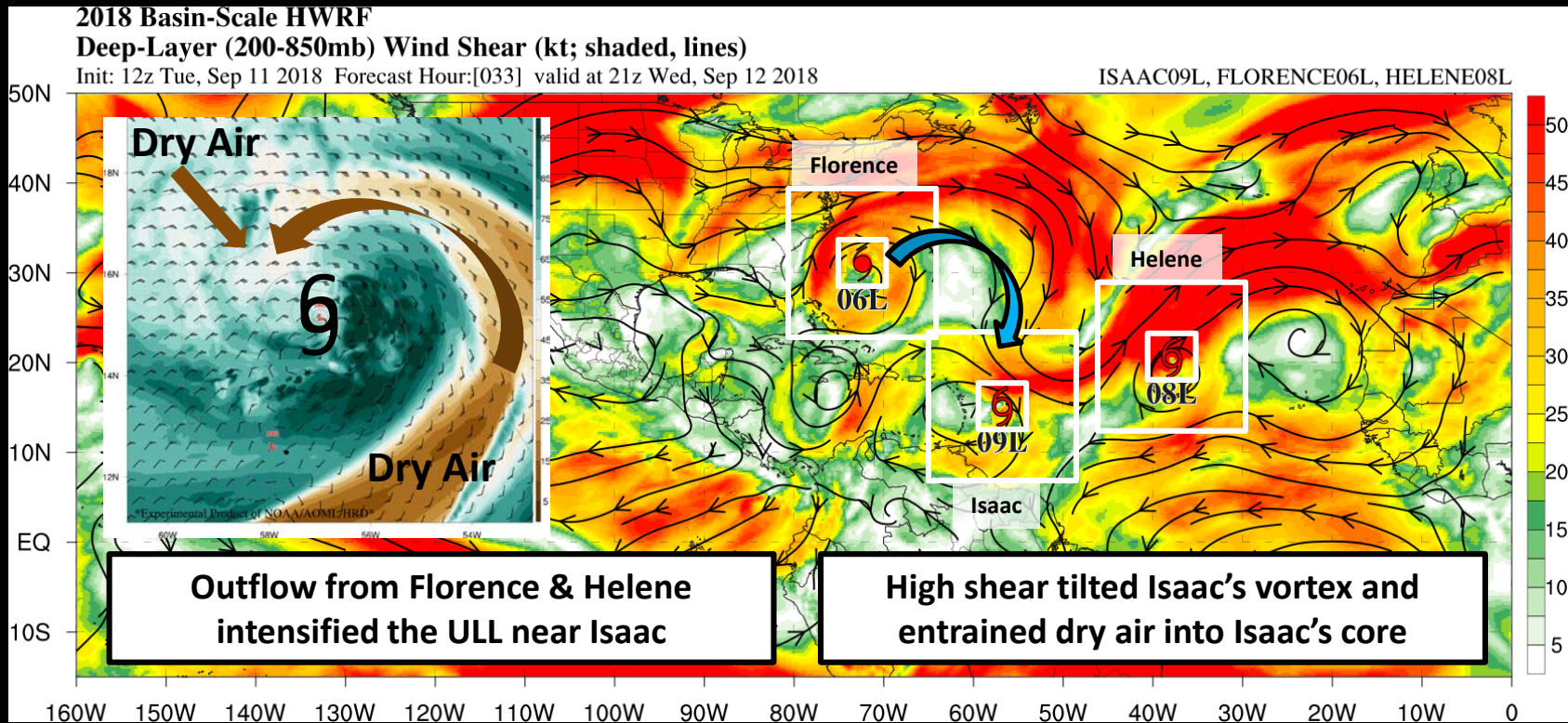
HB18 had better intensities than **H218**
69% of the time

HB18 Verification: Northeast Pacific



HB18 & **H218** were consistent for both track and intensity forecasts

HB18 Research: Multi-Storm Interactions



Project #2: HC18

- Same physics & outermost domain as **HB18**
- Data Assimilation System
 - 60 member EnKF
 - Satellite radiances
- Ensemble Prediction System
 - Up to 20 members for 7 days
 - Use DA analyses as initial conditions
 - Capacity for high-resolution nests
- ~2 million obs. processed per cycle
 - ~10% assimilated

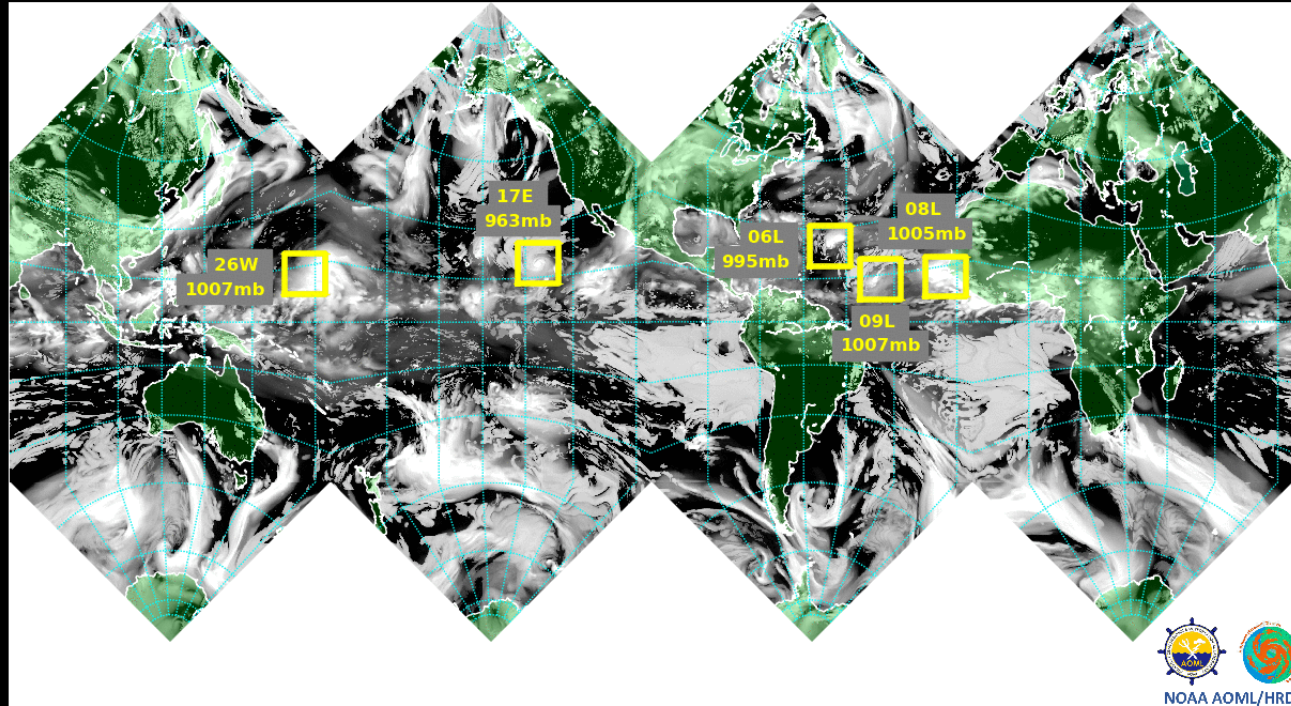
No model drift
3D hurricane analysis
Physics evaluation



Basin-Scale HWRF Transition

Multiple moving nest paradigm is being transitioned into FV3

See X. Zhang's presentation
from Day 1



The Milestones Sum It Up...

Scientific Findings

1. **HB18** had better intensity forecasts than **H218** at longer lead times (> 72h)
2. **HB18** track errors consistent with **H218**
3. **HB18** performed well in part because most forecasts had multiple storms
4. **HB18** had good Florence/Helene/Isaac forecasts
5. **HC18** had no apparent model drift in 6+ weeks of cycling

Project-Oriented Milestones

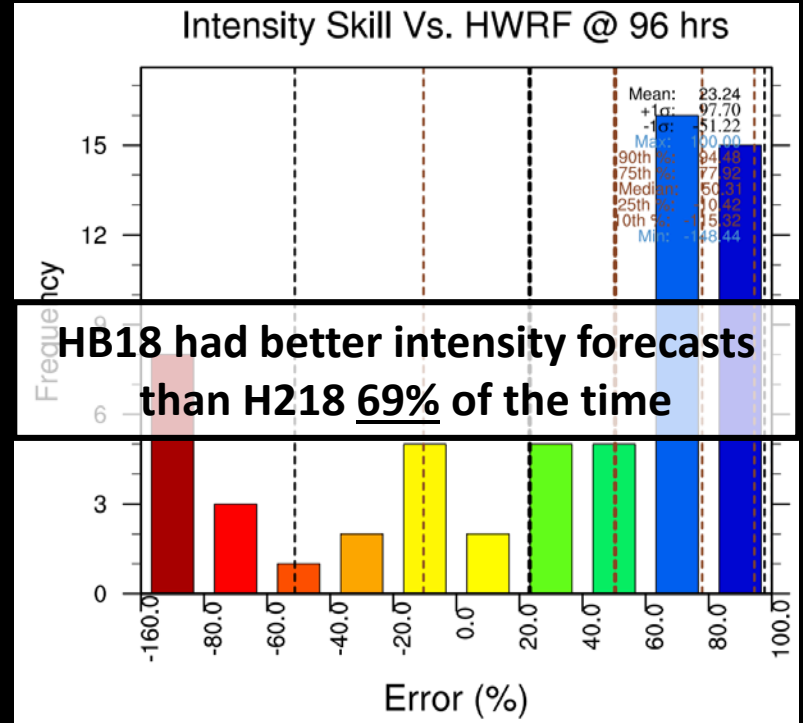
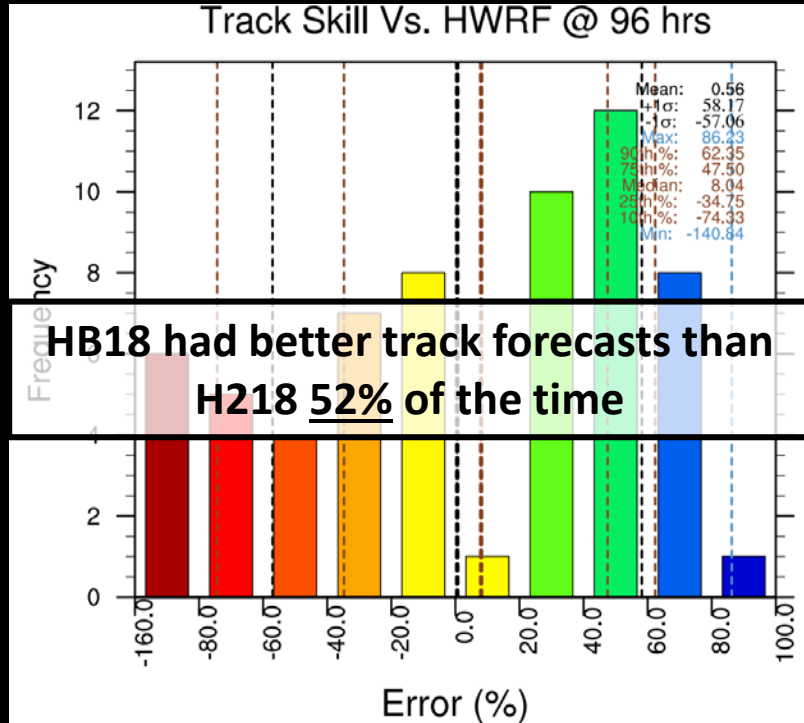
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Extra Material



HB18 Verification

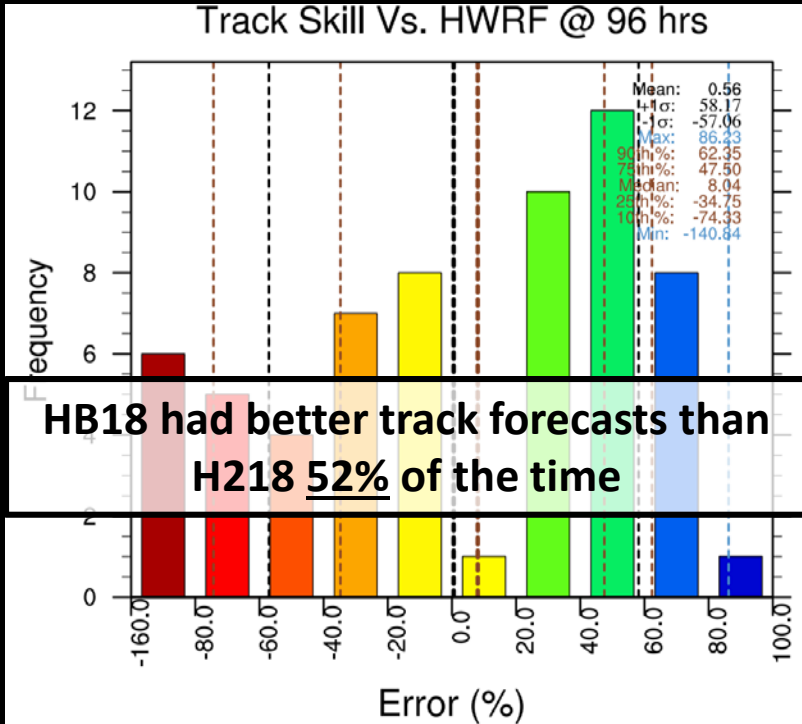
How did HB18 track errors compare with HWRF?



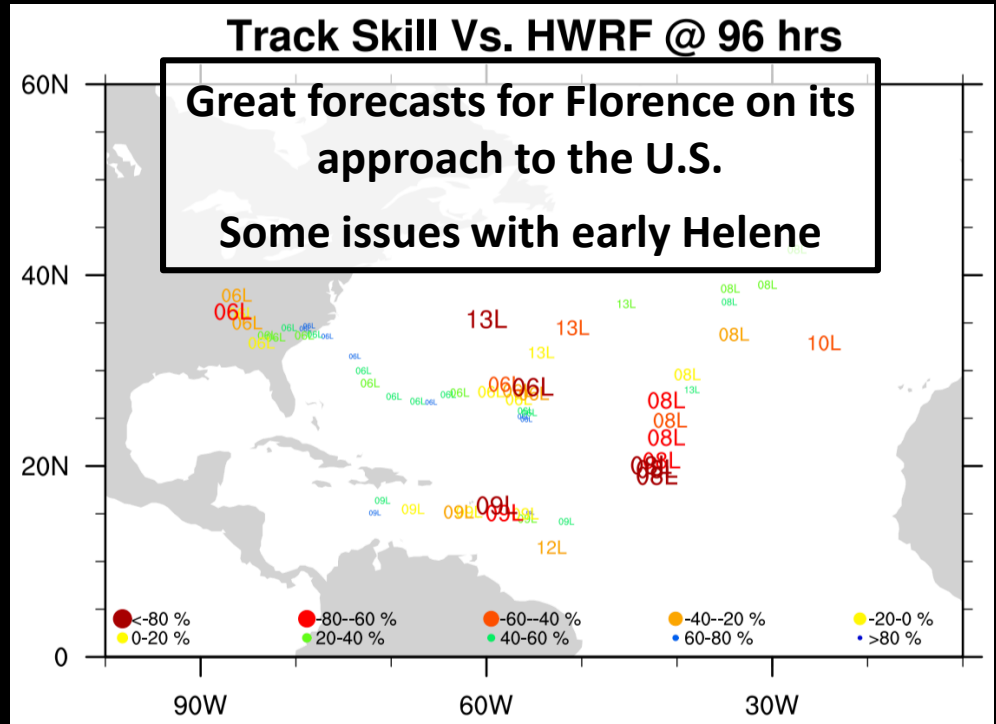
HB18 Verification

How did HB18 track errors compare with HWRF?

Track Skill Vs. HWRF @ 96 hrs

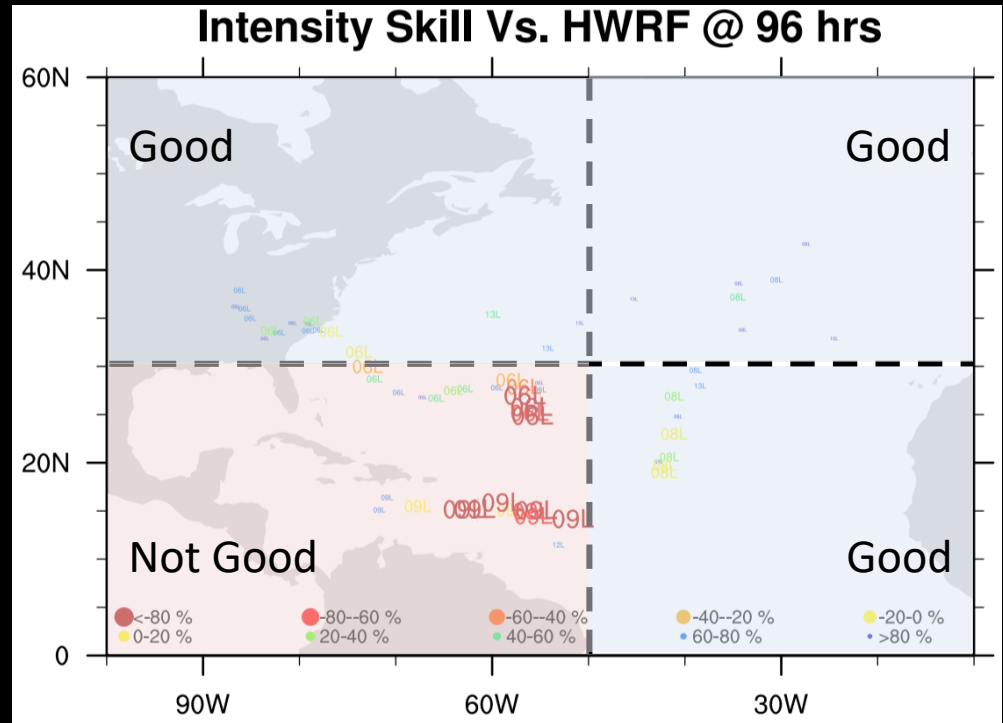
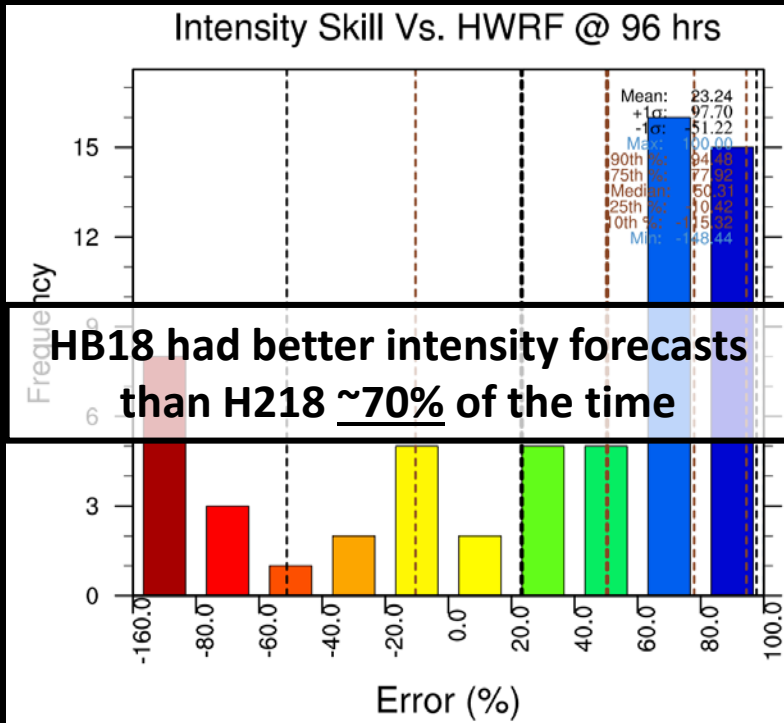


Track Skill Vs. HWRF @ 96 hrs



HB18 Verification

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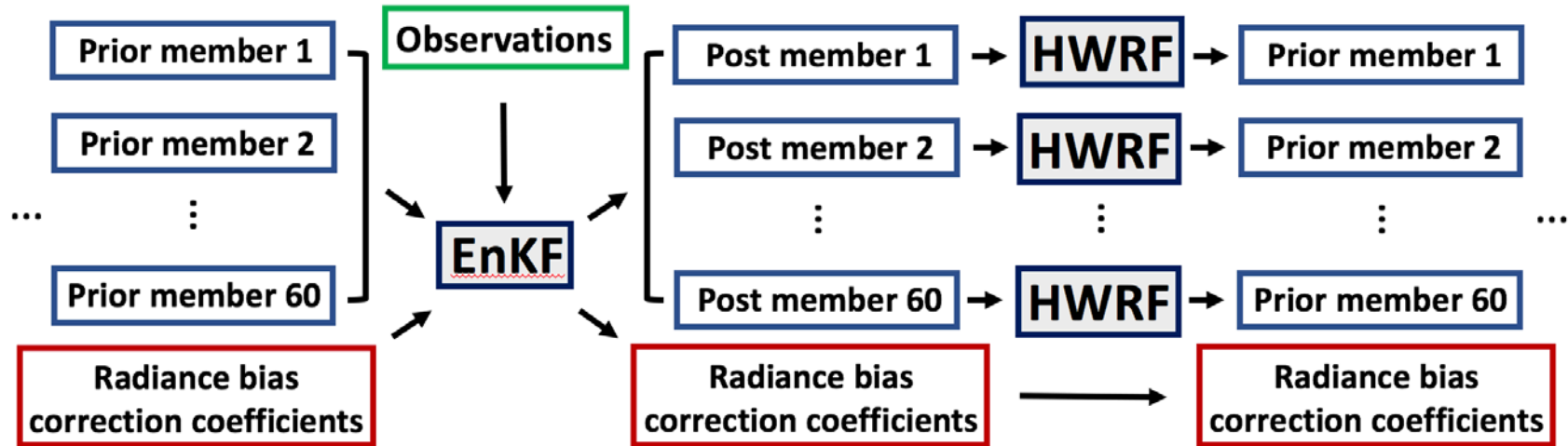
HC18 Configuration

Data Assimilation Step:

EnKF updates HWRf ensemble members and radiance bias correction coefficients for next cycle.

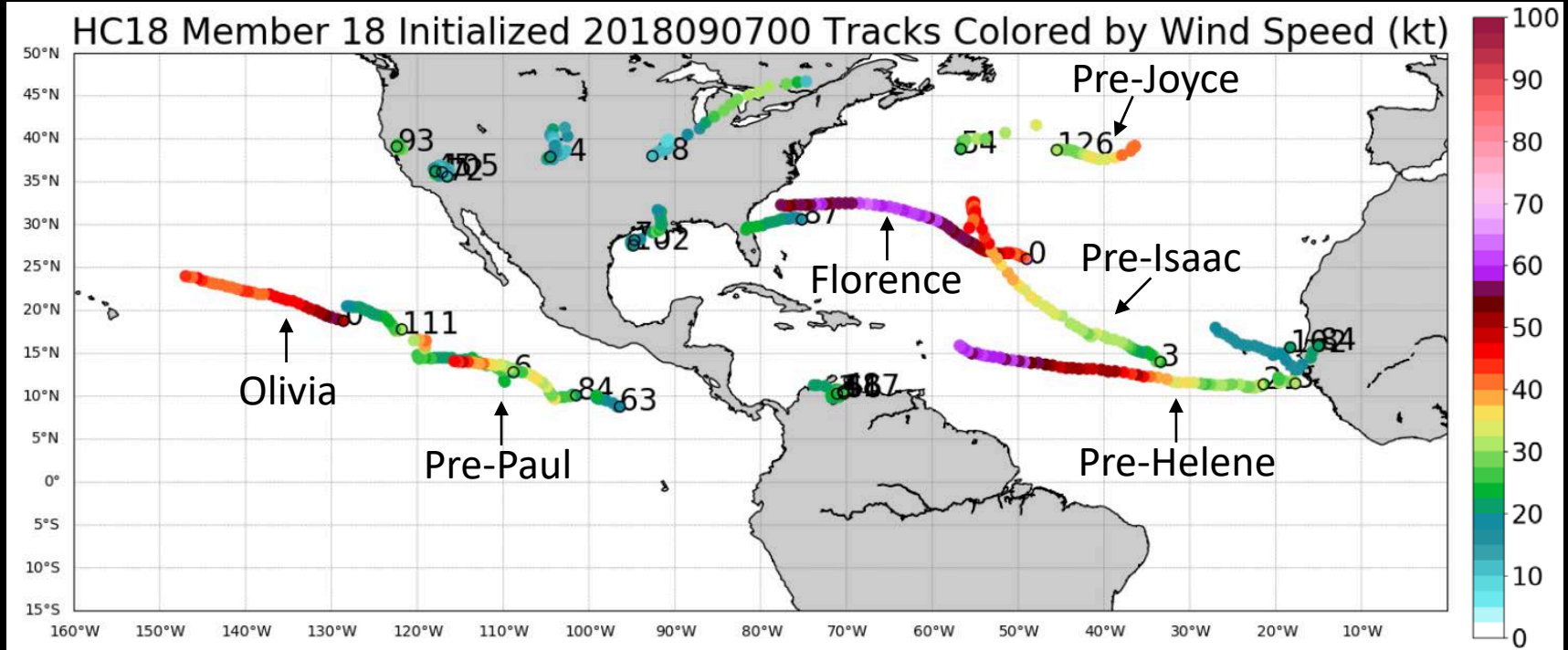
Ensemble Forecast Step:

A 6-h HWRf forecast runs from each EnKF member using GFS surface and lateral boundary conditions.



Genesis Tracker Output from HC18

Configured within the HC18 workflow to capture real & potential storms



A busy day in the tropics...

Most forecasts had multiple storms!

Very active year played to the strengths of HWRF-B

