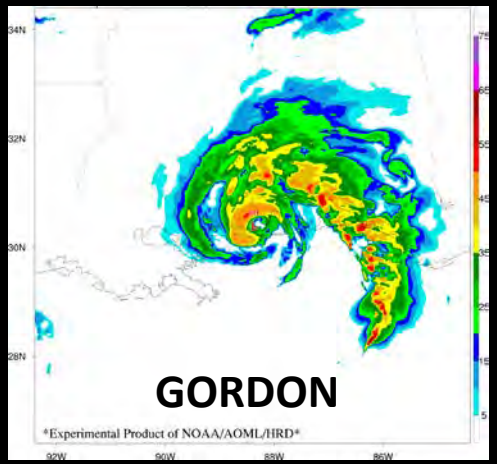
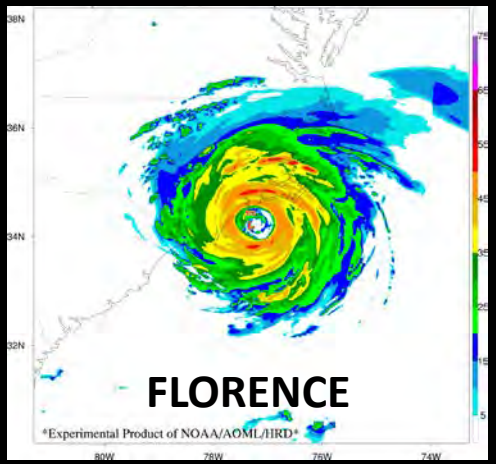
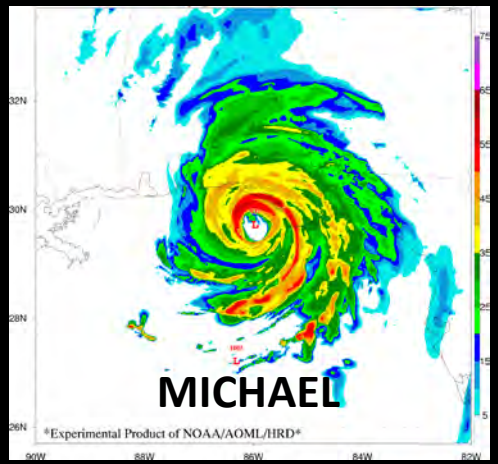
BASIN-SCALE HWRF:
Evaluation of 2018 Real-Time Forecasts







Presented by
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[2]*NOAA/AOML/Hurricane Research Division*

Basin-Scale HWRF is a Team Effort!

HRD Team:

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Collaborators:

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Evan Kalina, James Frimel, Evelyn Grell, Laurie Carson (DTC)

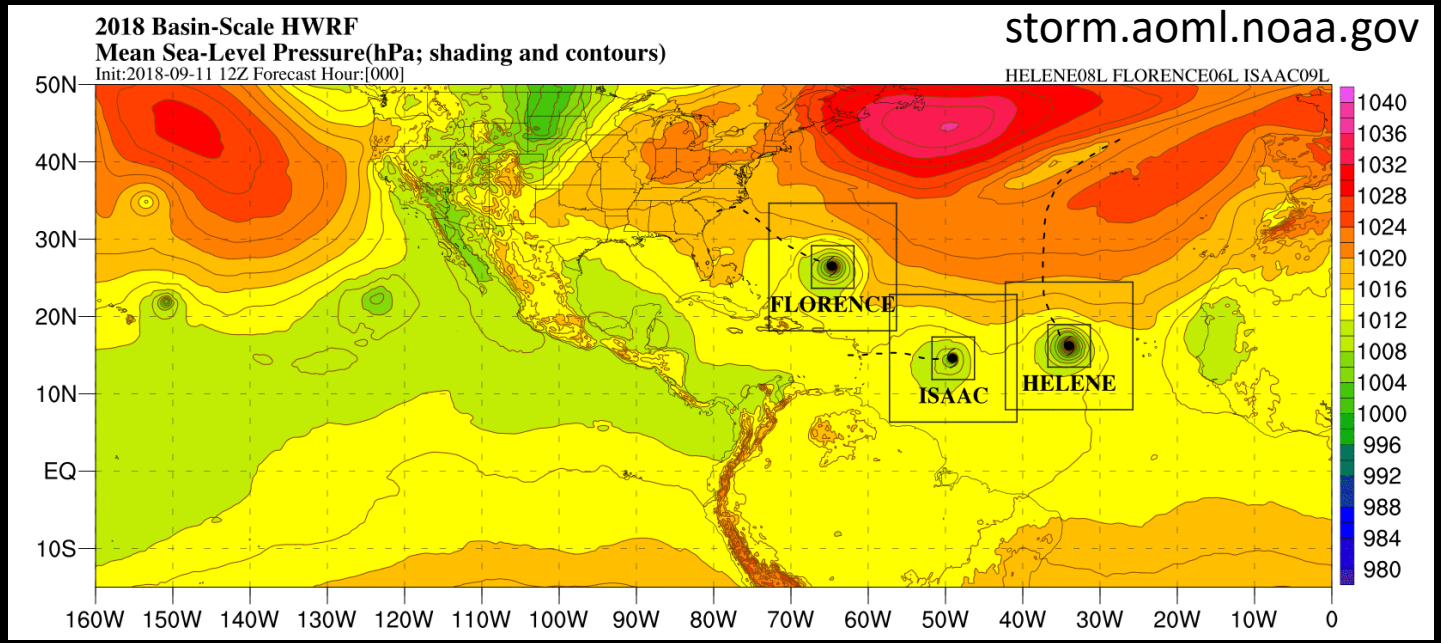
Andrew Penny (NHC)

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 a. (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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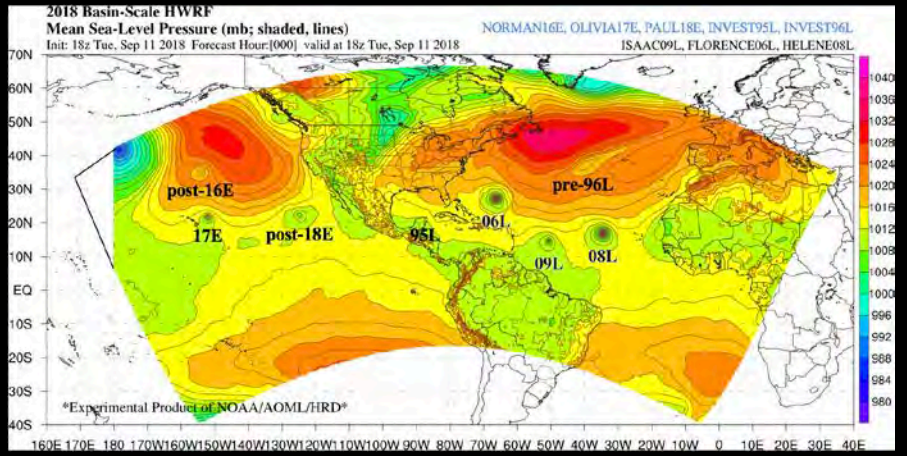
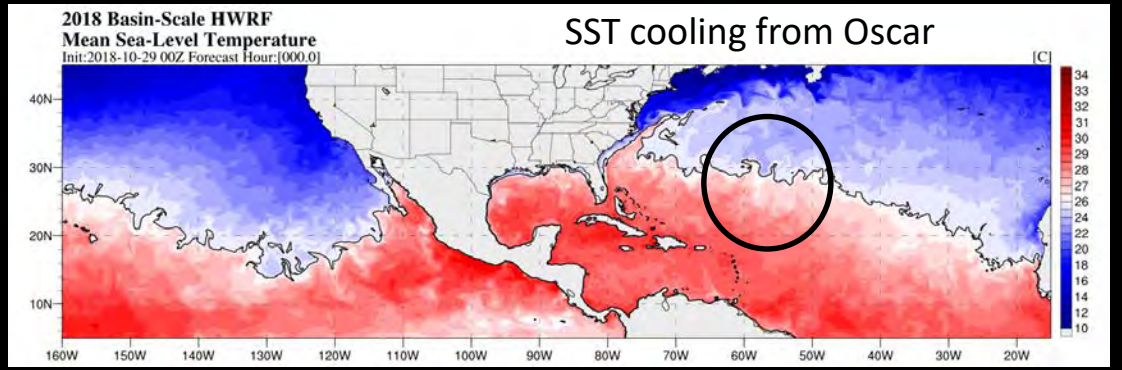
    RTOFS vs. NSST

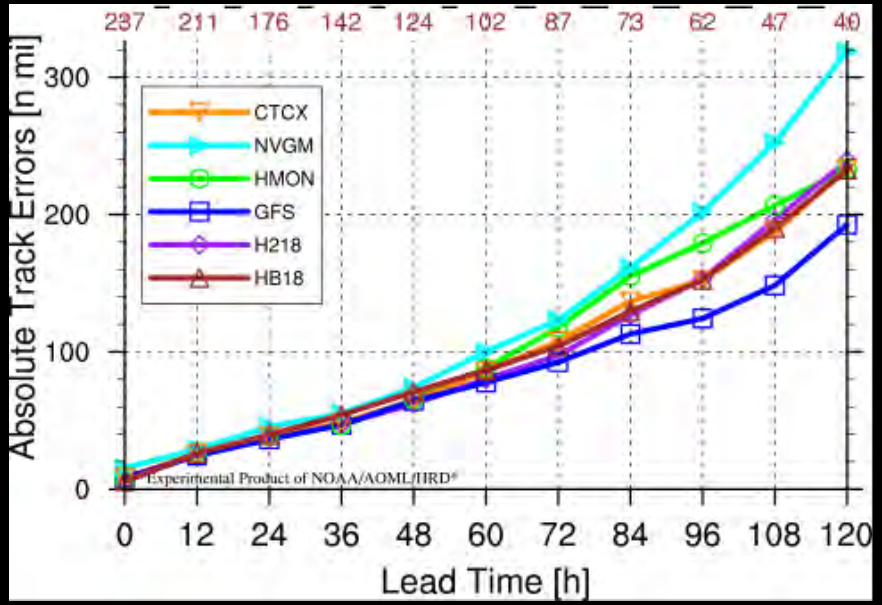
A busy day in the tropics…



SST cooling from Oscar

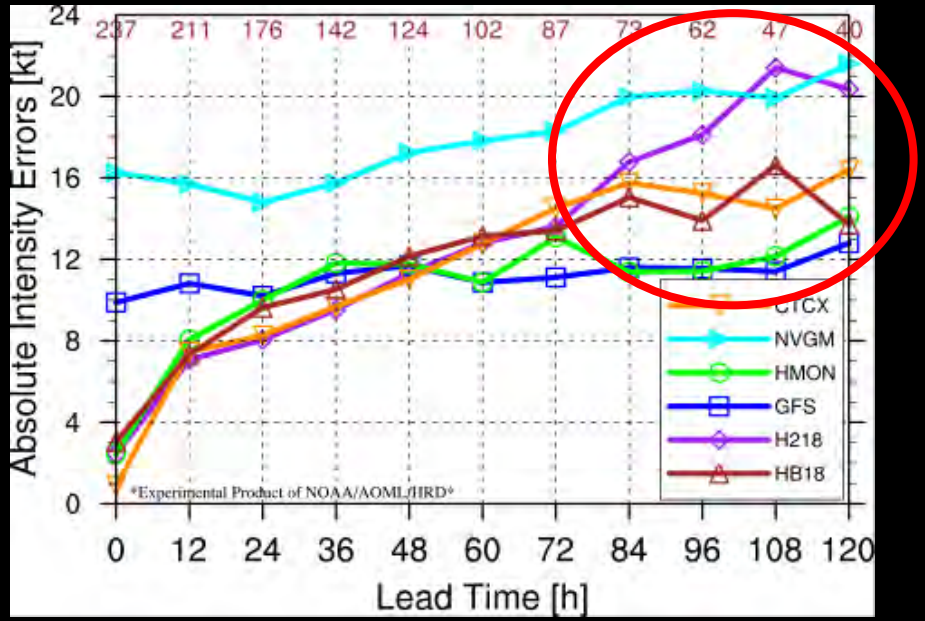


HB18 Verification: North Atlantic



H218 & **HB18** were consistent

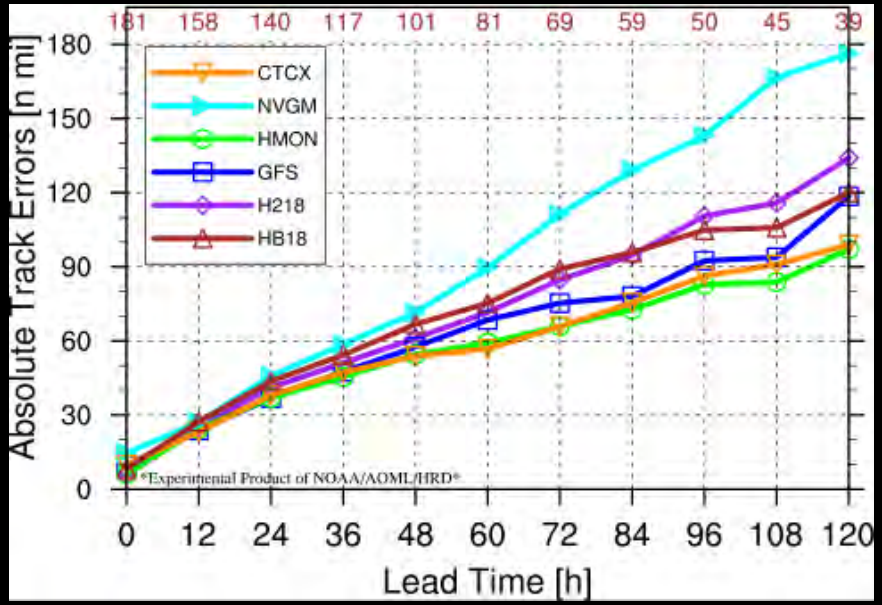
HB18 had better tracks than **H218**
52% of the time

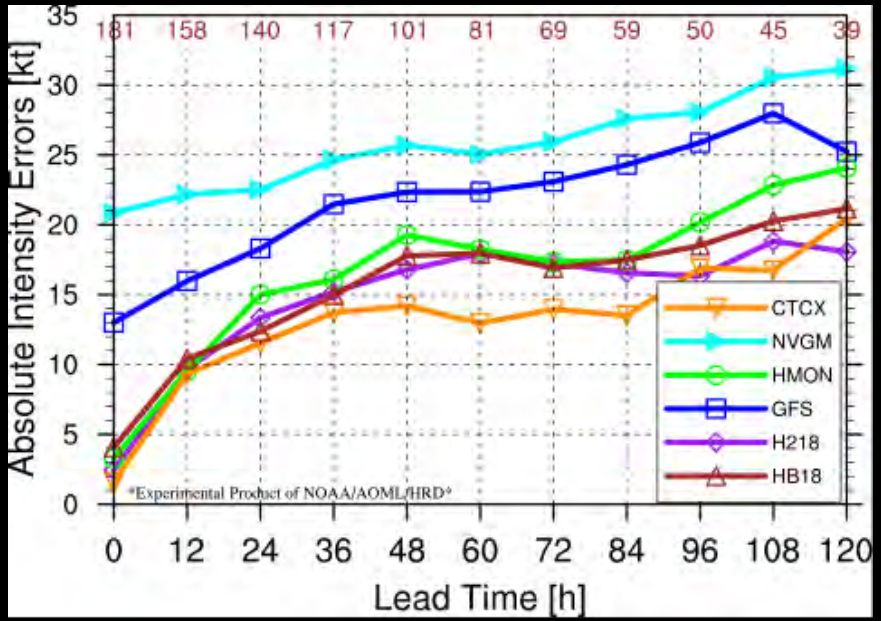


HB18 better than **H218** at longer lead times

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

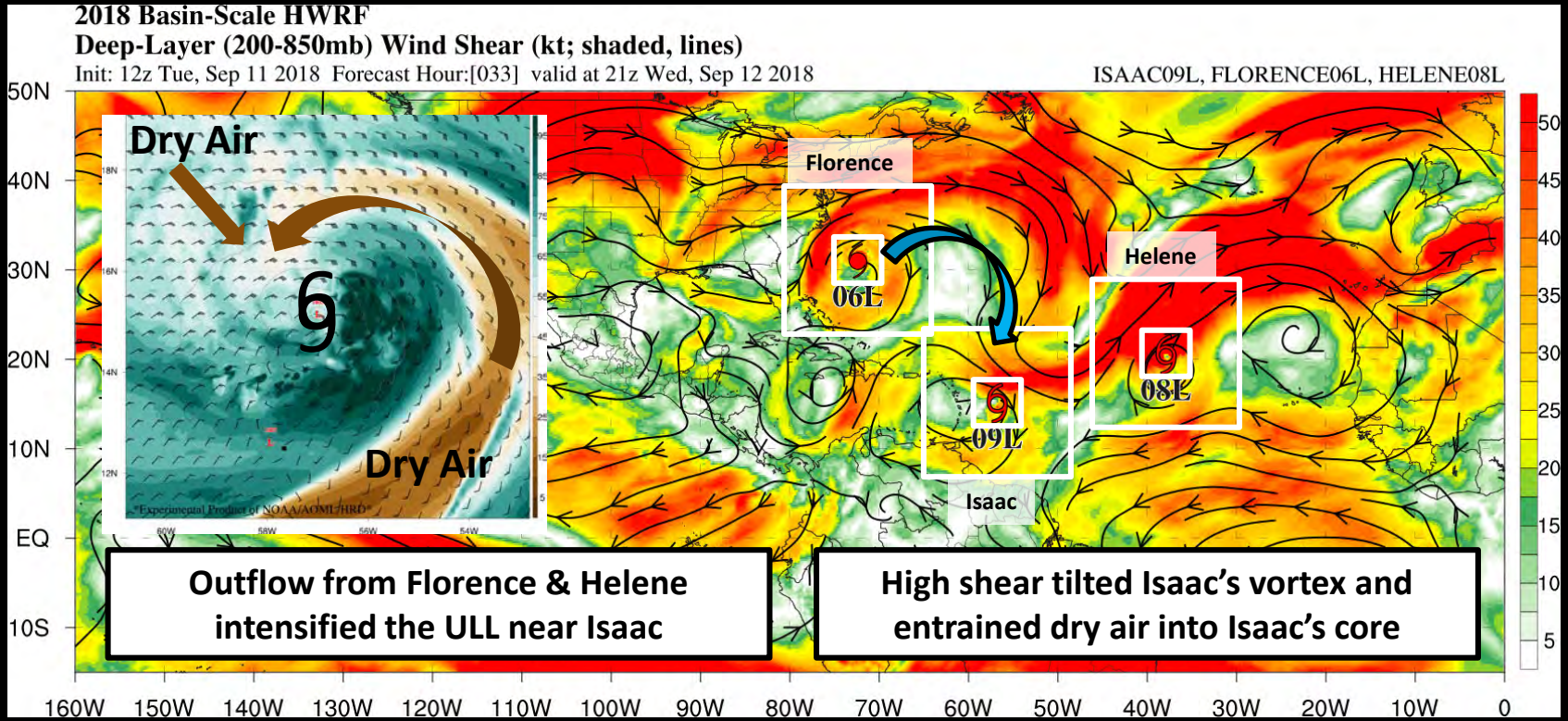
HB18 Verification: Northeast Pacific





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

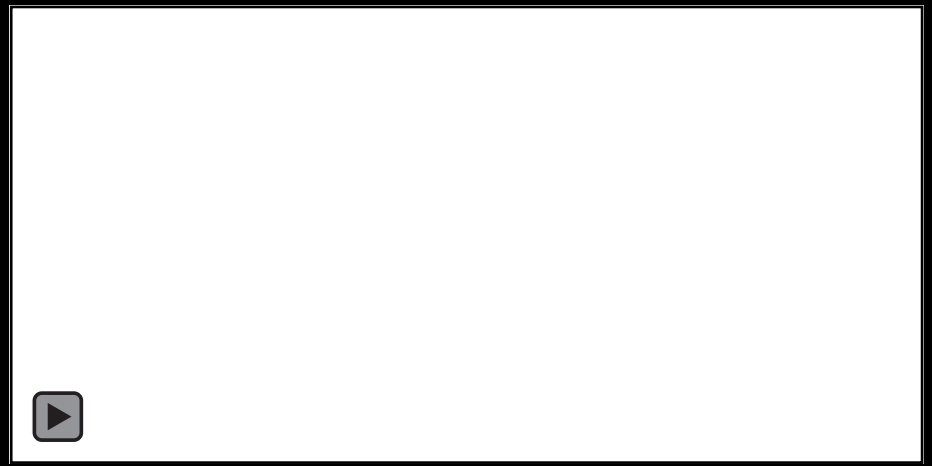
HB18 Research: Multi-Storm Interactions



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

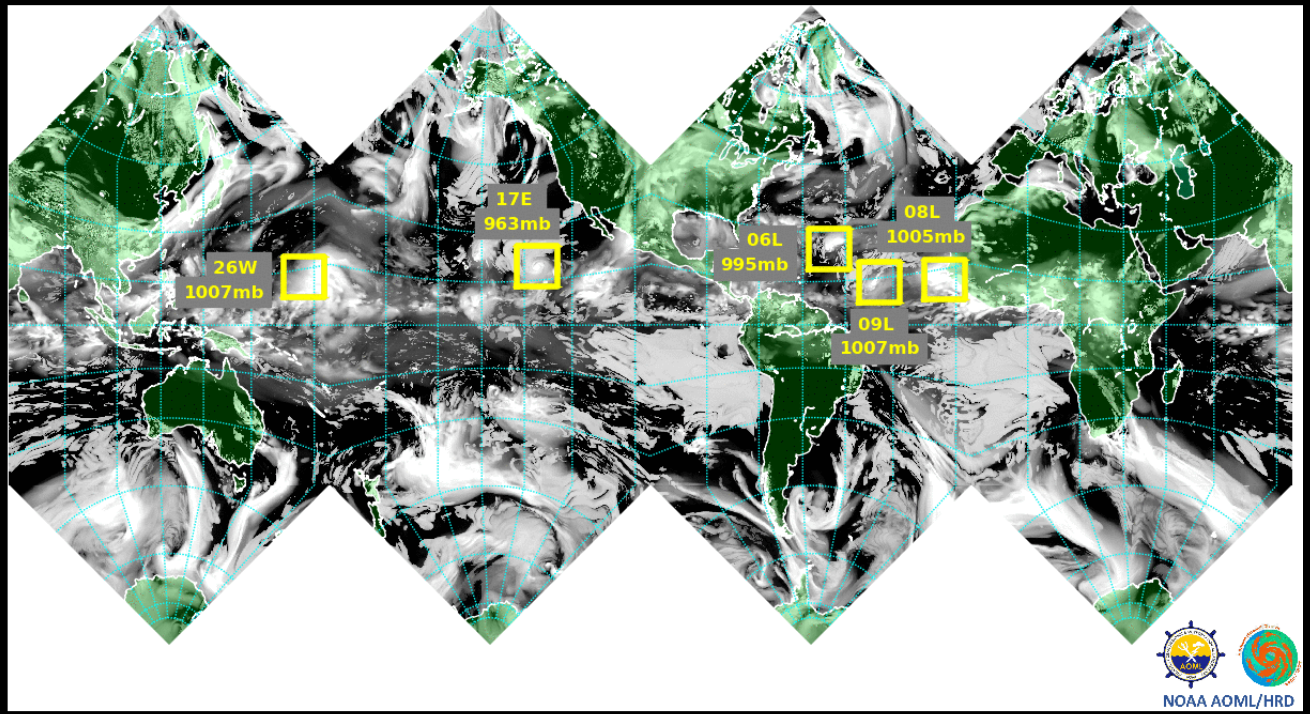
No model drift
3D hurricane analysis
Physics evaluation



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

6. Ran **HB18**/**HC18** 4x daily in real-time for the HFIP demo on Jet
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11. Configured the GFDL Genesis tracker for **HC18**
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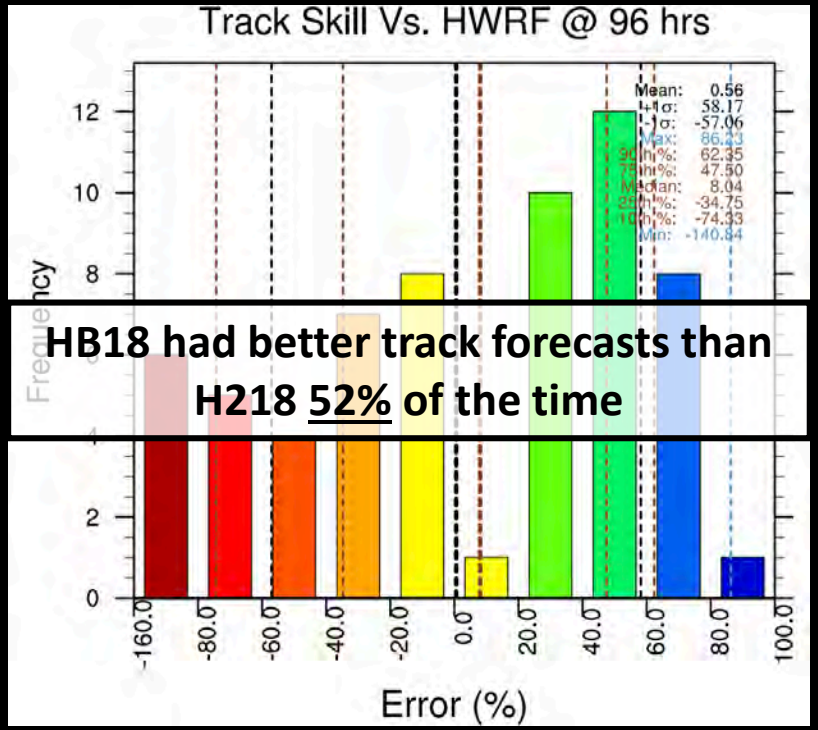
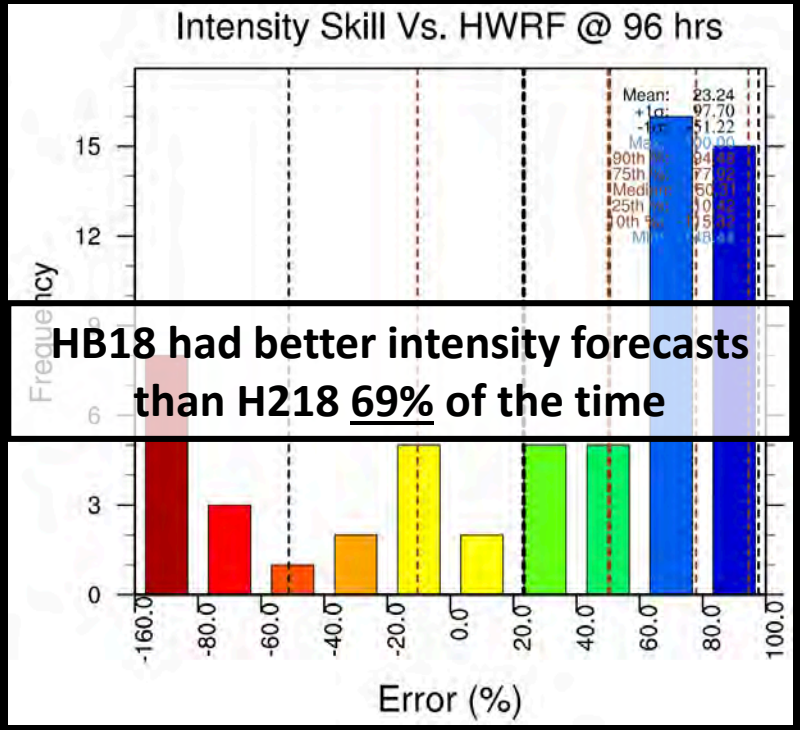
Extra Material

HB18 Verification

How did HB18 track errors compare with HWRF?



HB18 had better track forecasts than H218 52% of the time



HB18 had better intensity forecasts than H218 69% of the time

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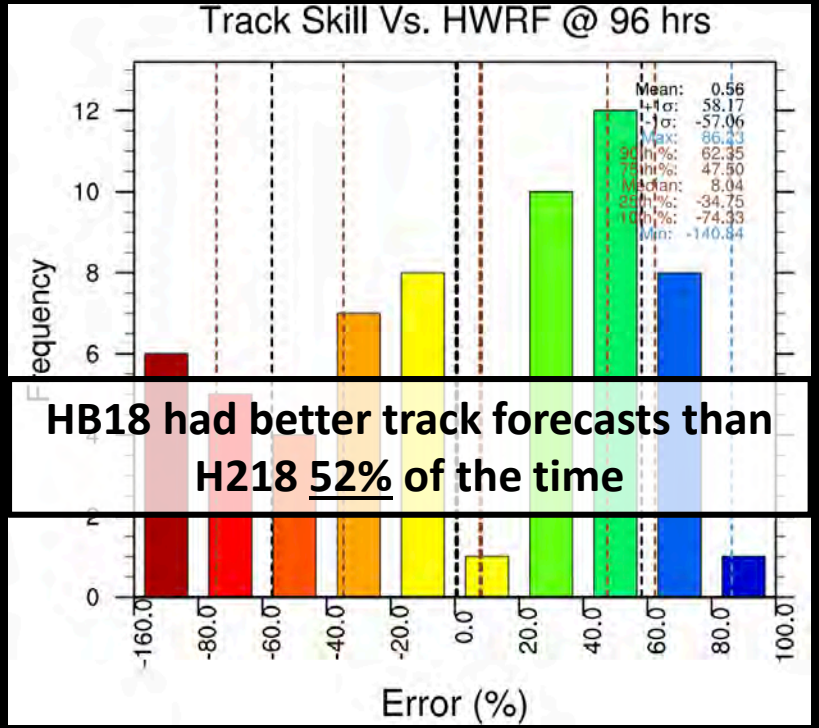

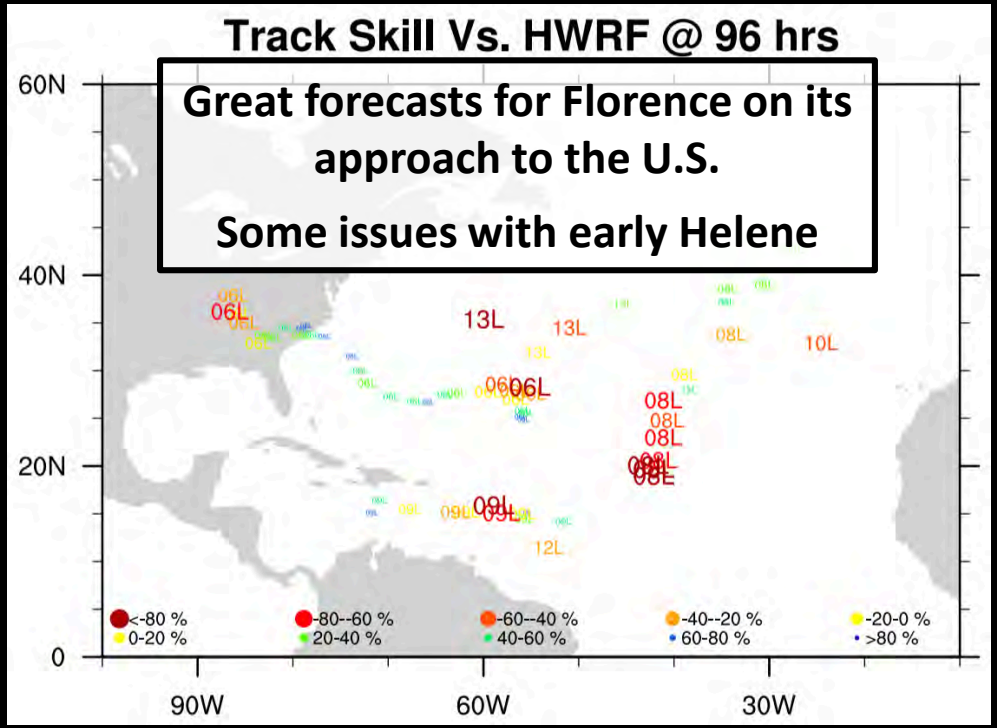

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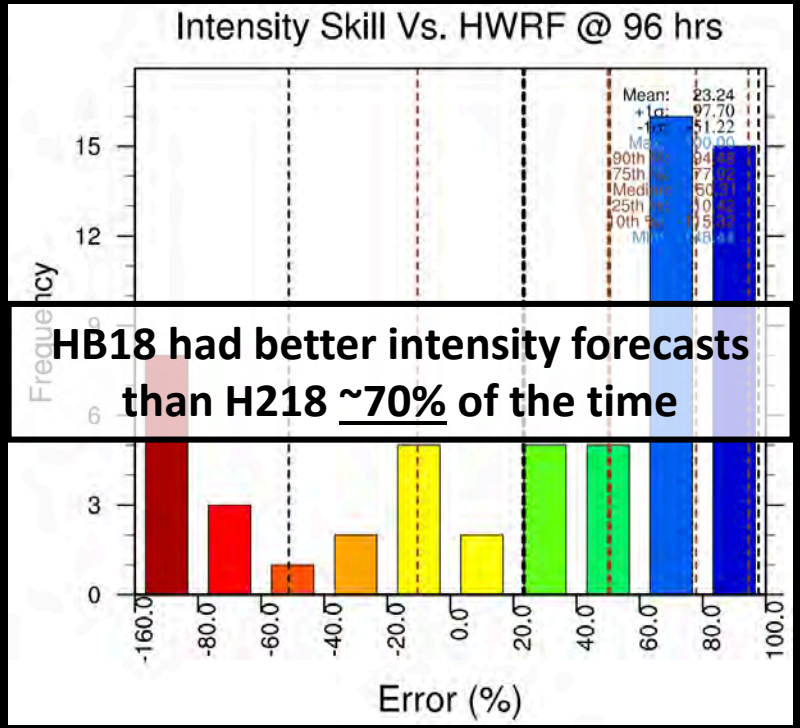
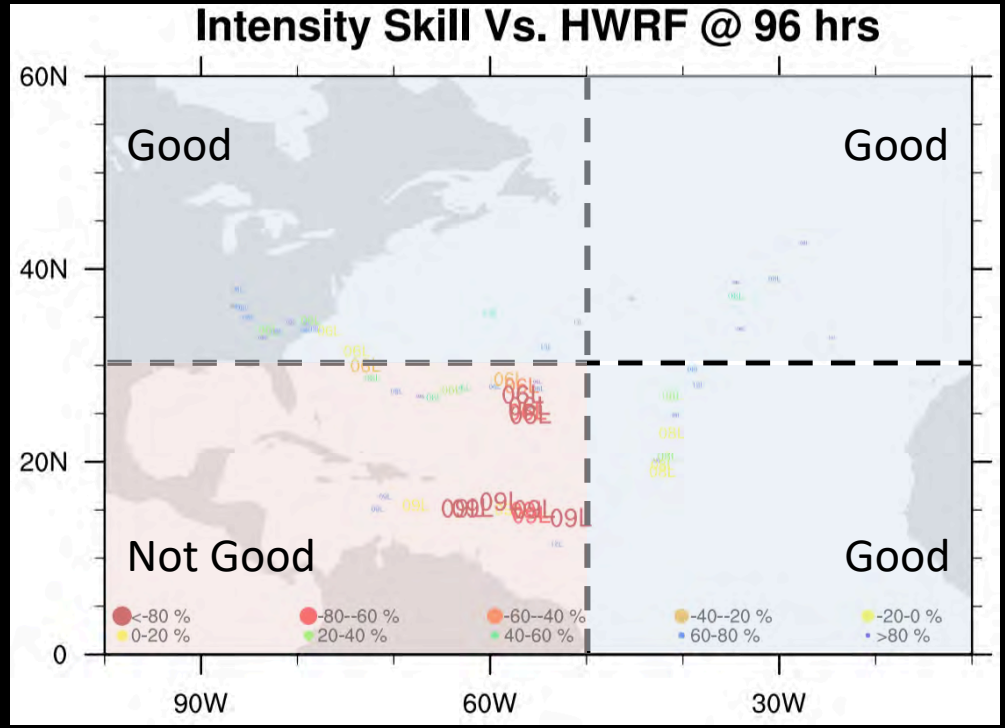
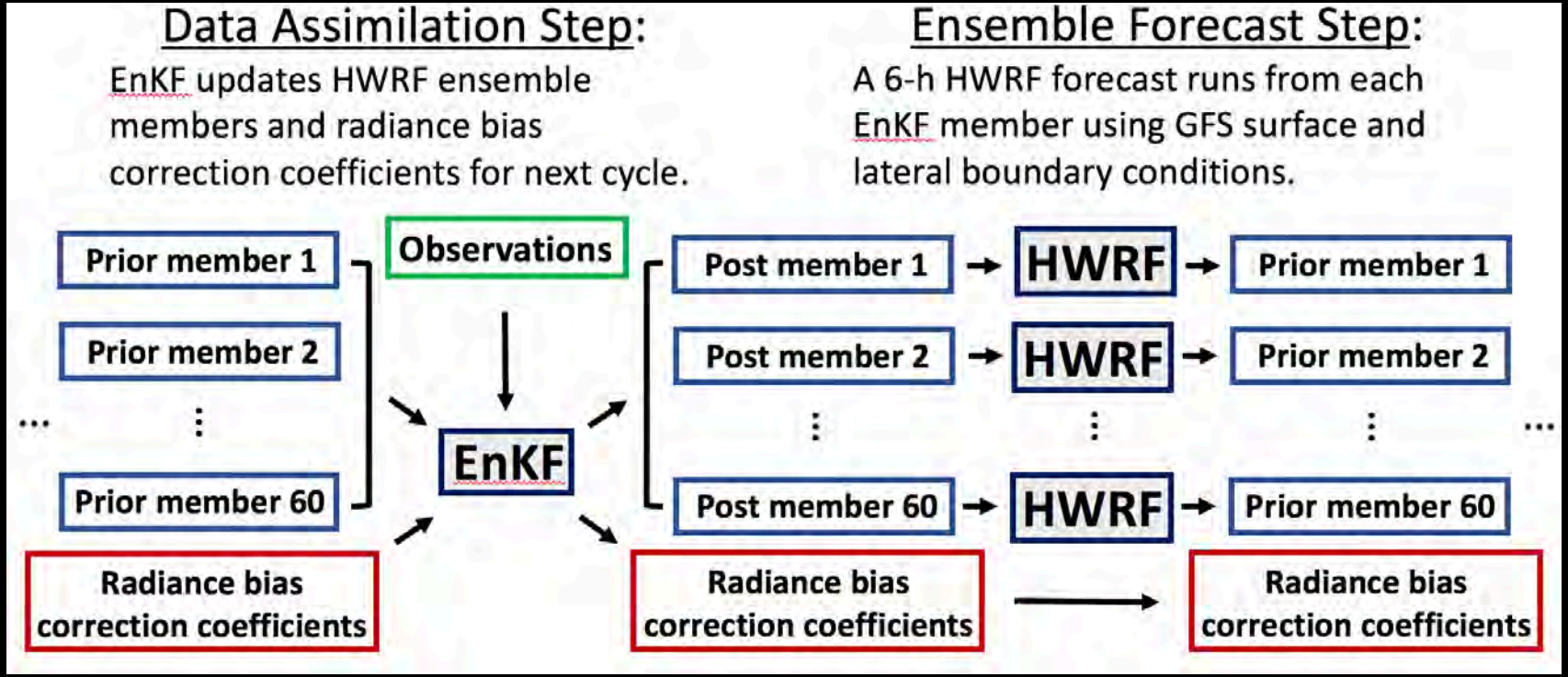


HB18 had better intensity forecasts than H218 ~70% of the time

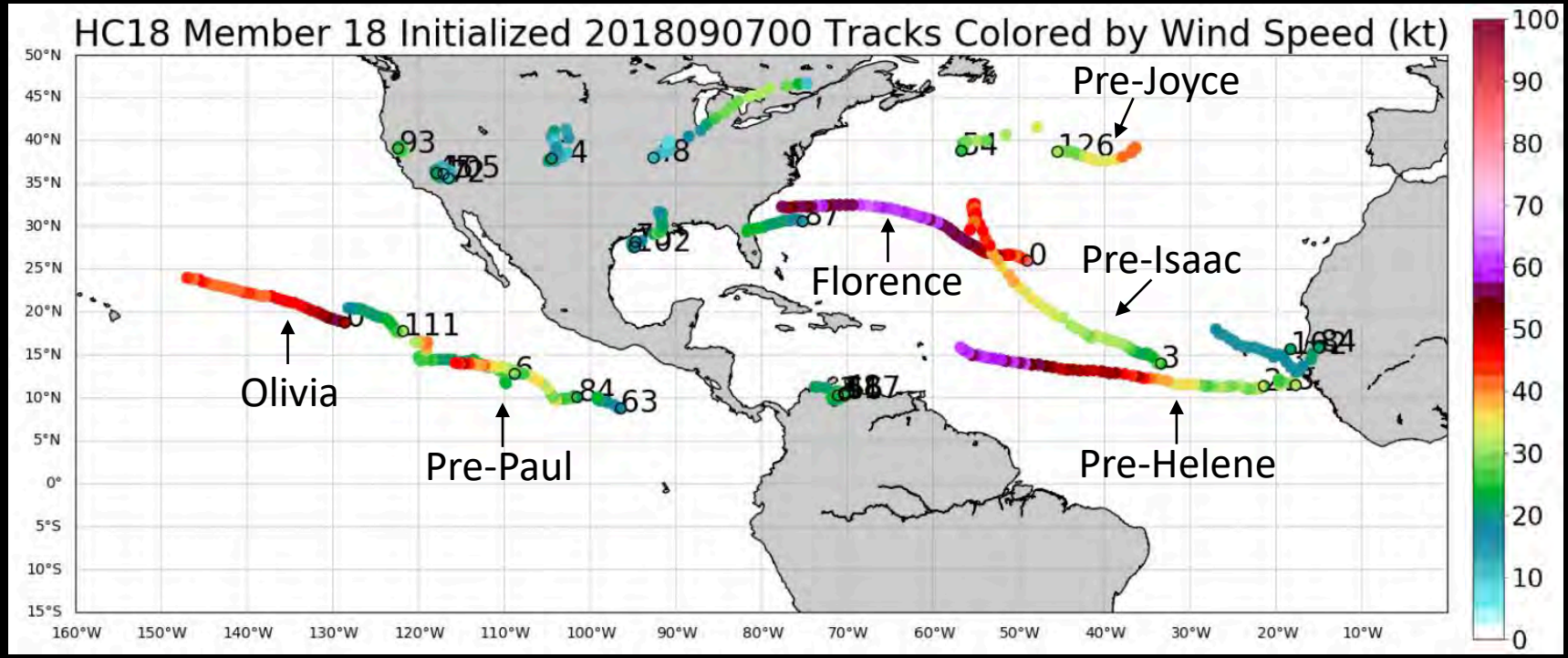


HC18 Configuration



Genesis Tracker Output from HC18

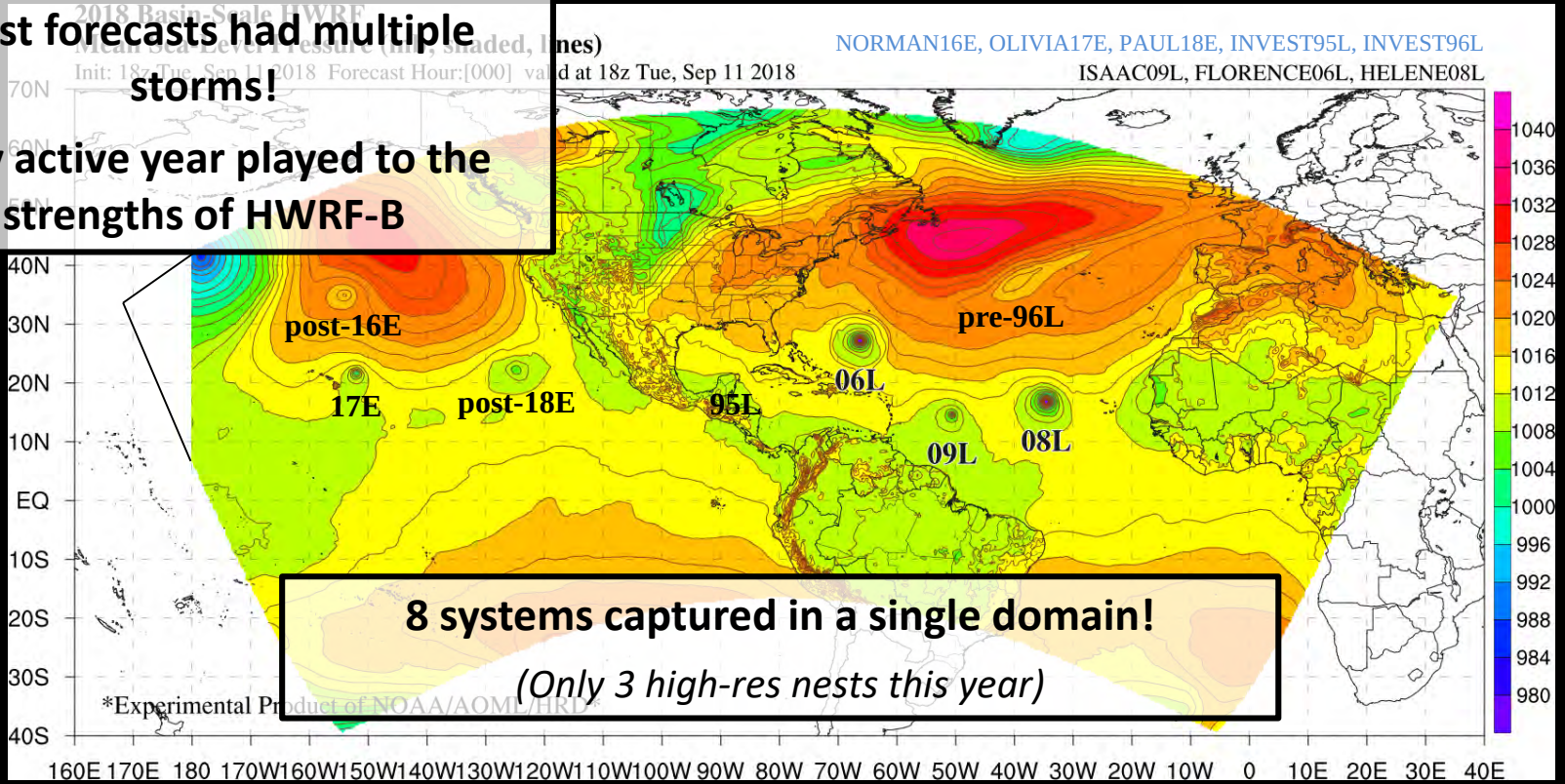
Configured within the HC18 workflow to capture real & potential storms



A busy day in the tropics…

Most forecasts had multiple storms!

Very active year played to the strengths of HWRF-B



8 systems captured in a single domain!

(Only 3 high-res nests this year)