

Research to Improve NOAA's Hurricane Forecasts

Hurricane
Irma

Hurricane
Jose

#NOAAHurricaneAware



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19 June 2018

2017 Hurricanes: Impacts

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Rockport, TX after Harvey 2017



Marathon, FL after Irma 2017



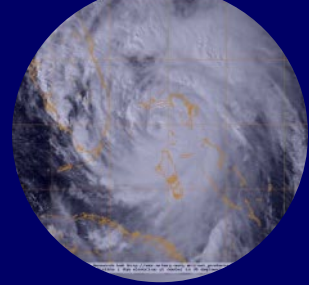
Houston, TX during Harvey 2017



San Juan, PR after Maria 2017



Tropical Cyclone Intensity



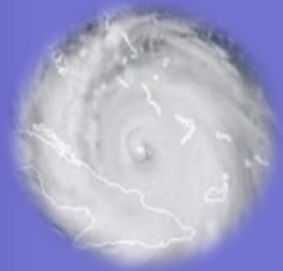
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- HWRF skill has improved over the past few seasons, but rapid change cases are still a problem
 - Statistical models have difficulty forecasting rapid change
 - Dynamical models can forecast rapid change, but not reliably (e.g., Harvey, Irma, Maria)
- Consensus approach still shows best hope for modest improvements in forecast accuracy, but dramatic improvements still likely years away
- Large improvements requires increases in inner-core observations, higher resolution computer models, and better ways to get observations into models

So how do we get there?

Keys to Success

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• Science

- Improve operational high-resolution coupled models (HWRF) – **particularly intensity changes**
- Improve understanding from combination of observations & high-resolution models

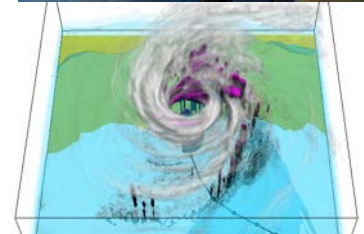
• Information Technology

- Develop research computing capacity to **accelerate** transition of research to operations

• Observing Strategy

- Improve use of existing and planned systems

• Improve Forecaster Products

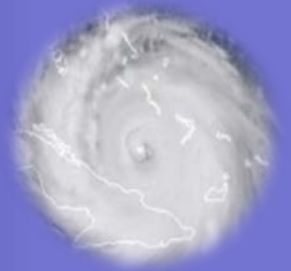


NOAA Hurricane Forecast Improvement Project

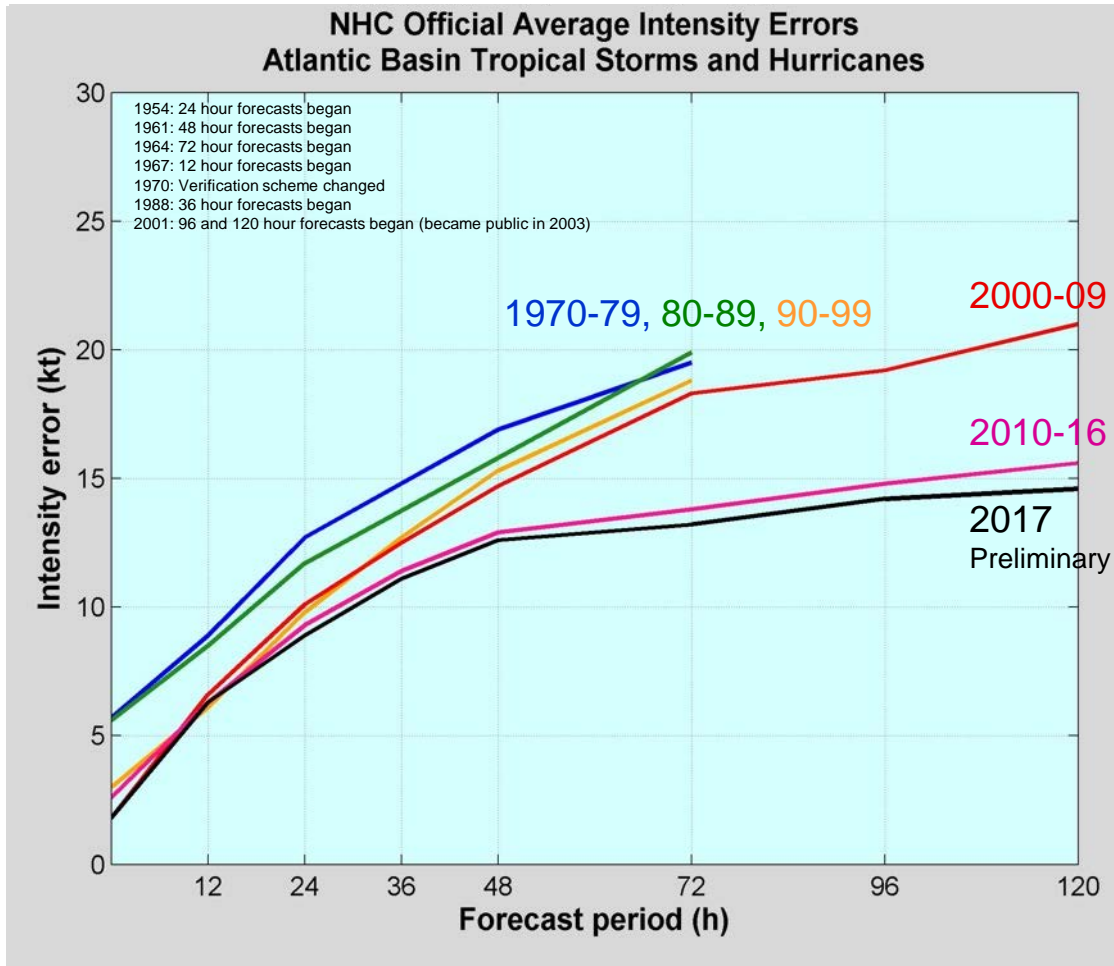
Meeting the Nation's Needs

Current State of the Art

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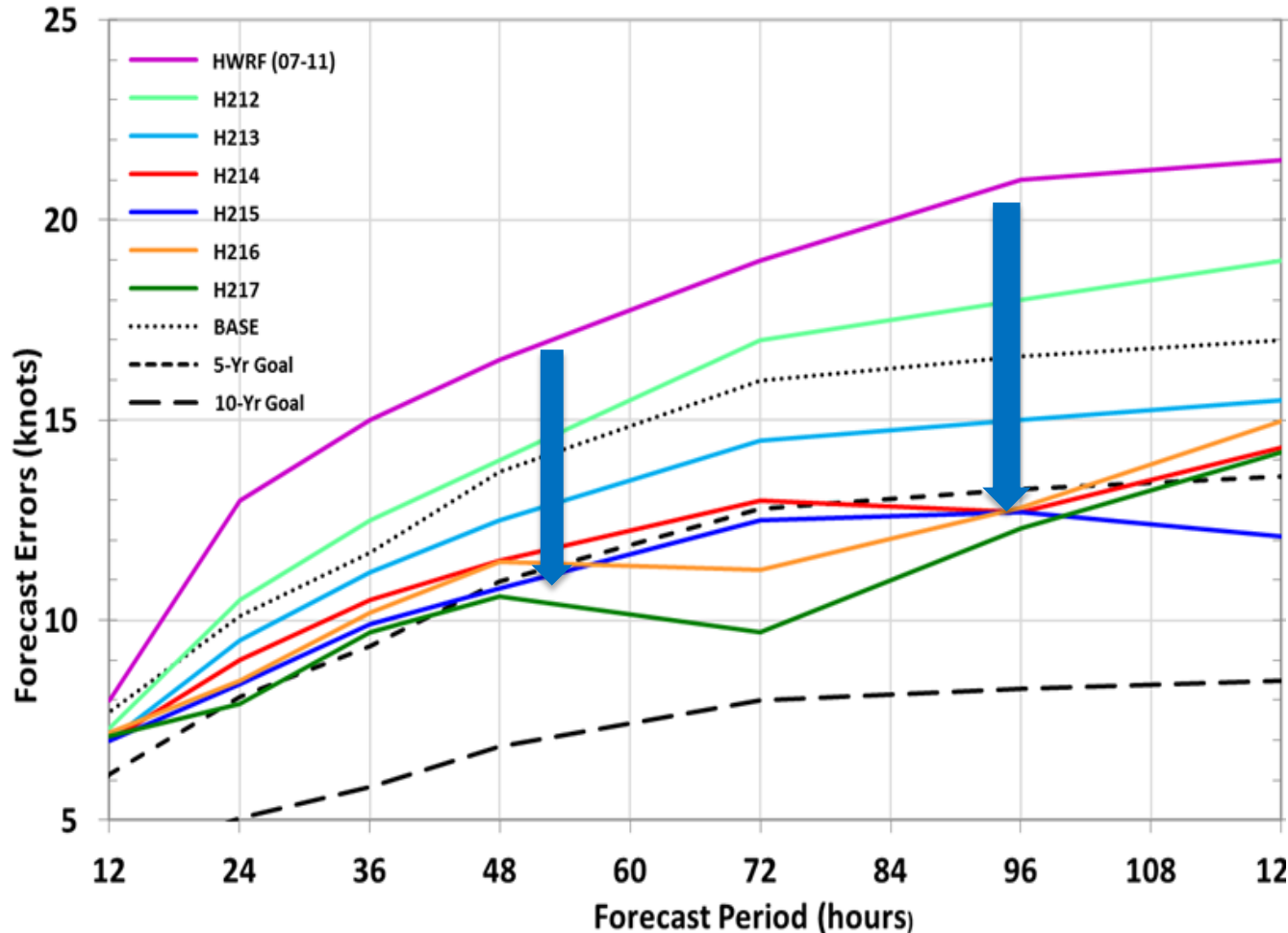
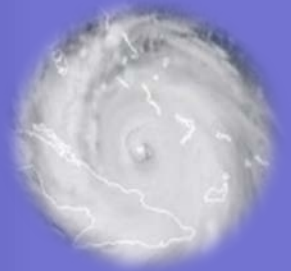
Operational Forecast Performance



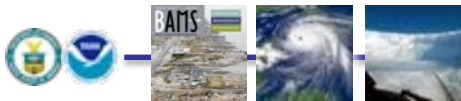
- Since HFIP began in 2008, forecast error has decreased by 20-25% for 1-5 day forecasts.
- NOAA upgraded HWRF model resolution; now 1.5 km
- Remarkable improvements in HWRF since HFIP

HWRF Improvements

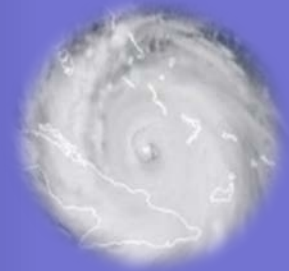
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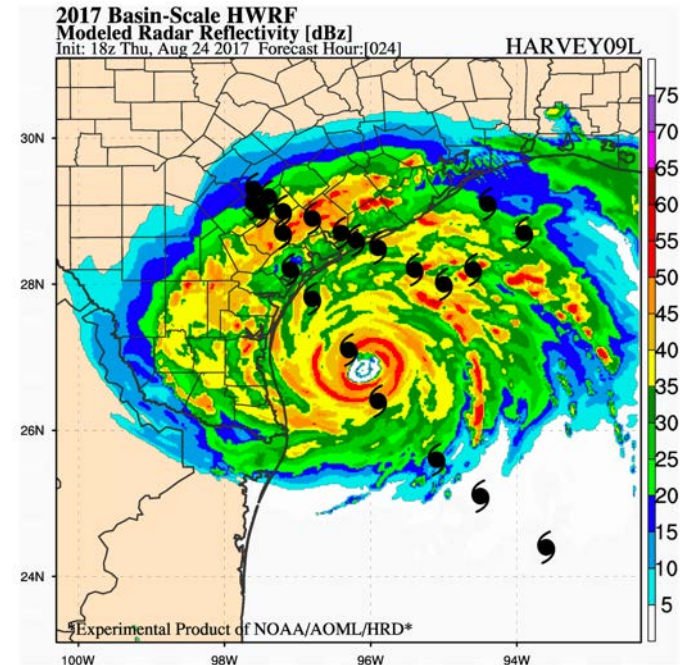
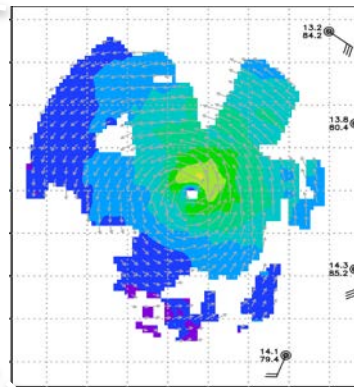
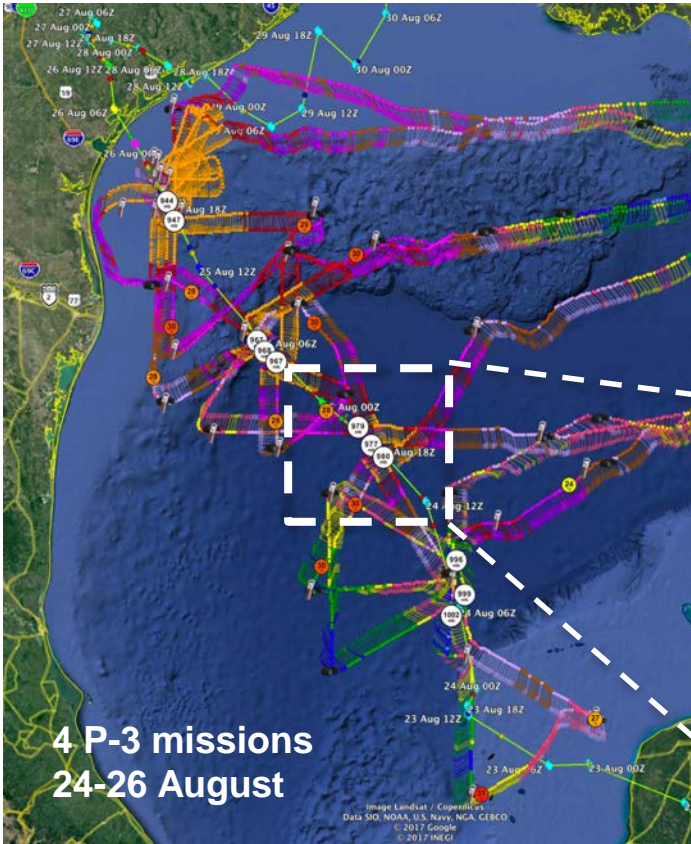
- Under HFIP, the HWRF model demonstrated a **15-20% improvement** in hurricane intensity forecast accuracy each year since 2011



HWRF Improvements: Assimilation of Aircraft Recon

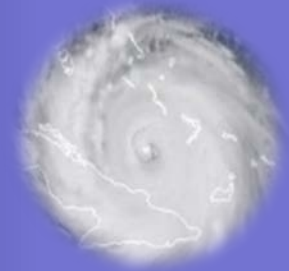


- #NOAAHurricaneAware • NOAA P-3 transmitted Tail Doppler radar data in real-time for assimilation into HWRF



Hurricane Harvey (2017)

HWRF Improvements: New Observations - 2018



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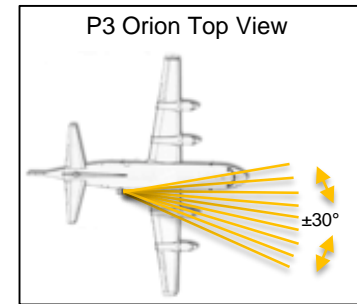
Doppler Wind Lidar

- Compliments P-3 & G-IV Tail Doppler radar



P3 Orion Side View

30° off nadir



P3 Orion Top View

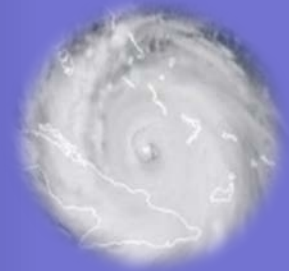
±30°

Coyote

- Targets data gaps in hurricane boundary layer thermodynamics
- 1-2 Coyote in 2018
- Data sent to NHC



Next steps — Basin-HWRF & fvGFS

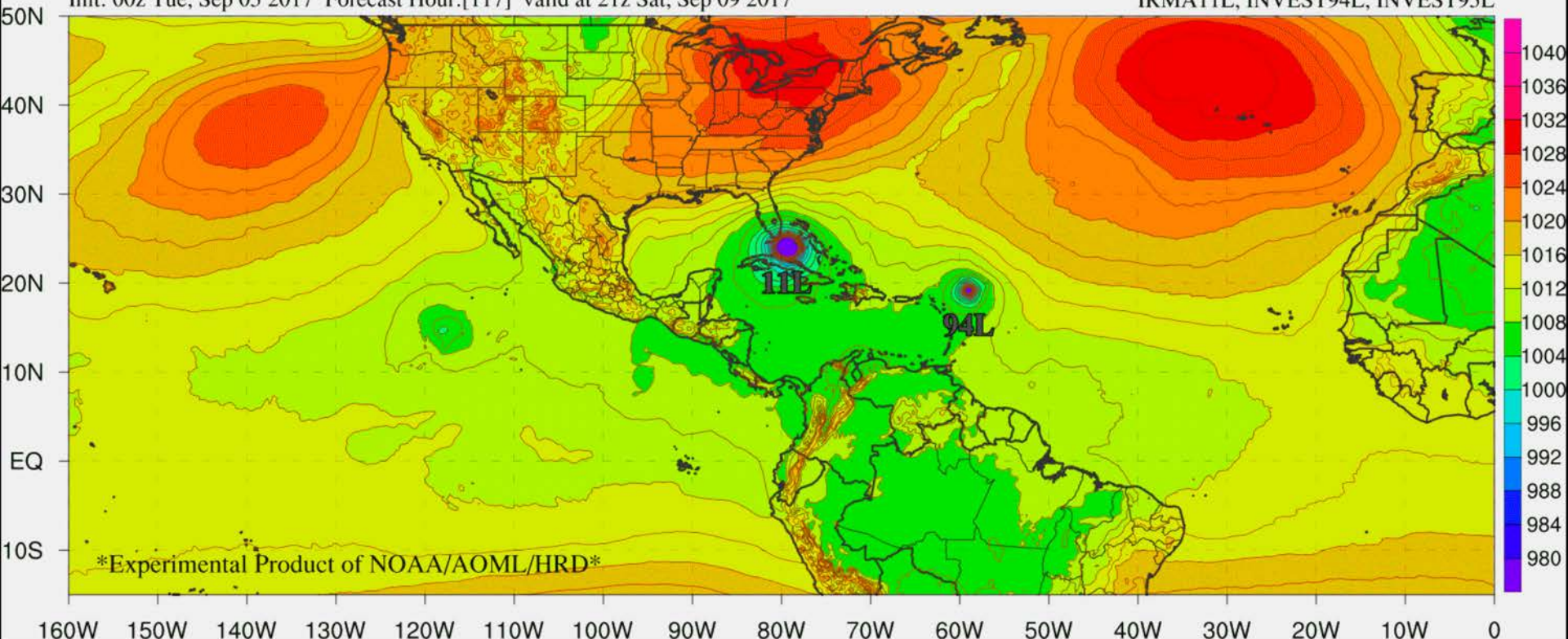


2017 Basin-Scale HWRF

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

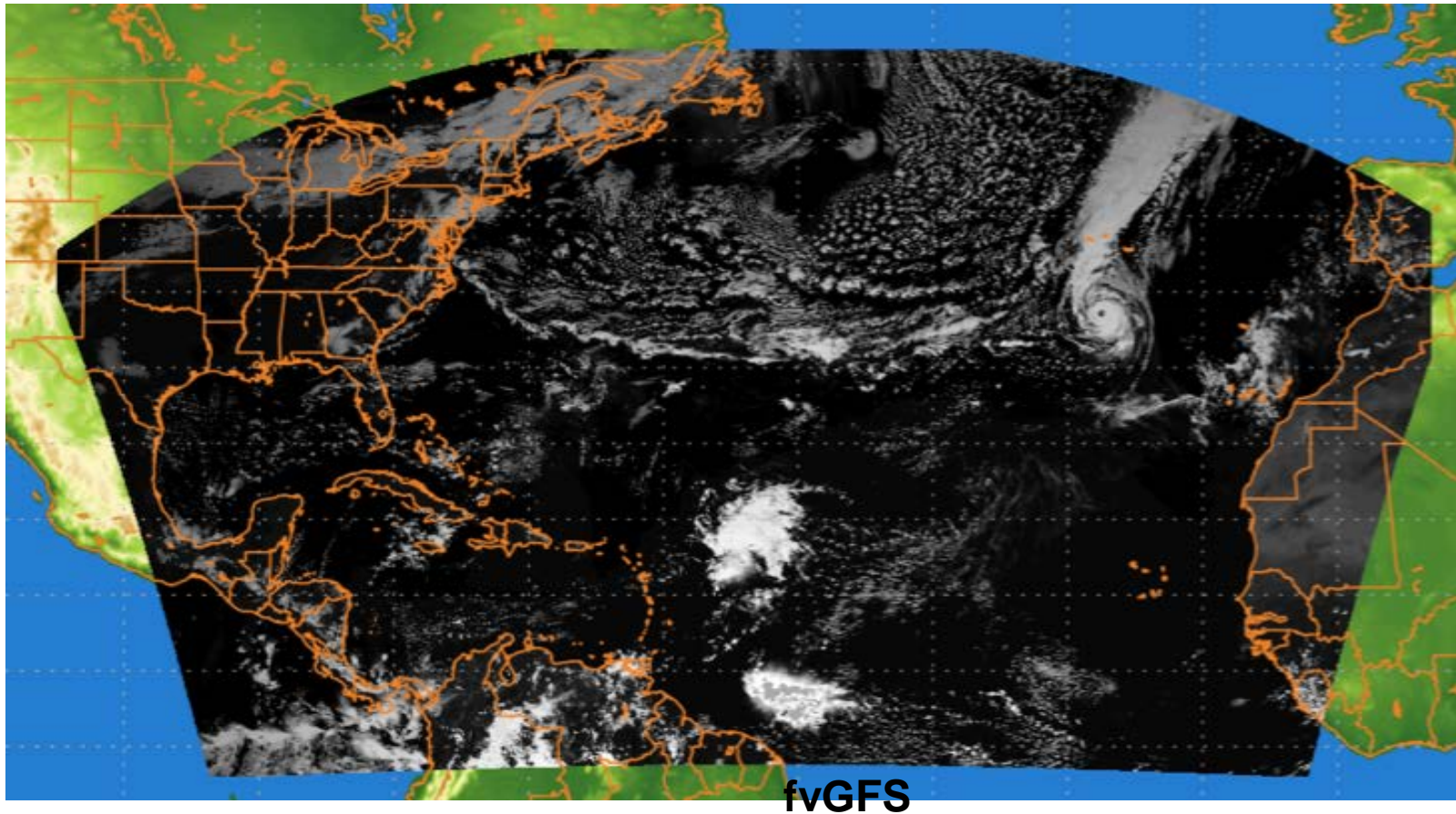
Init: 00z Tue, Sep 05 2017 Forecast Hour:[117] valid at 21z Sat, Sep 09 2017

IRMA11L, INVEST94L, INVEST95L

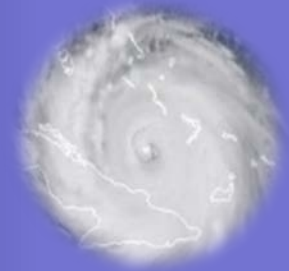


Next steps — Basin-HWRF & fvGFS

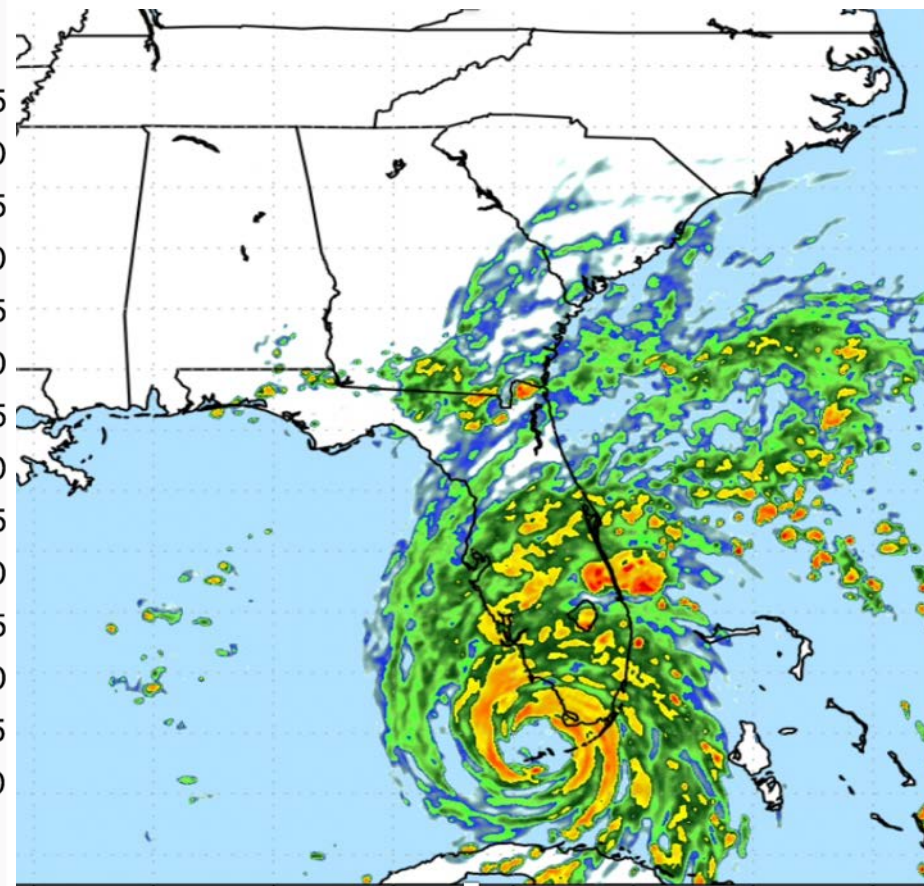
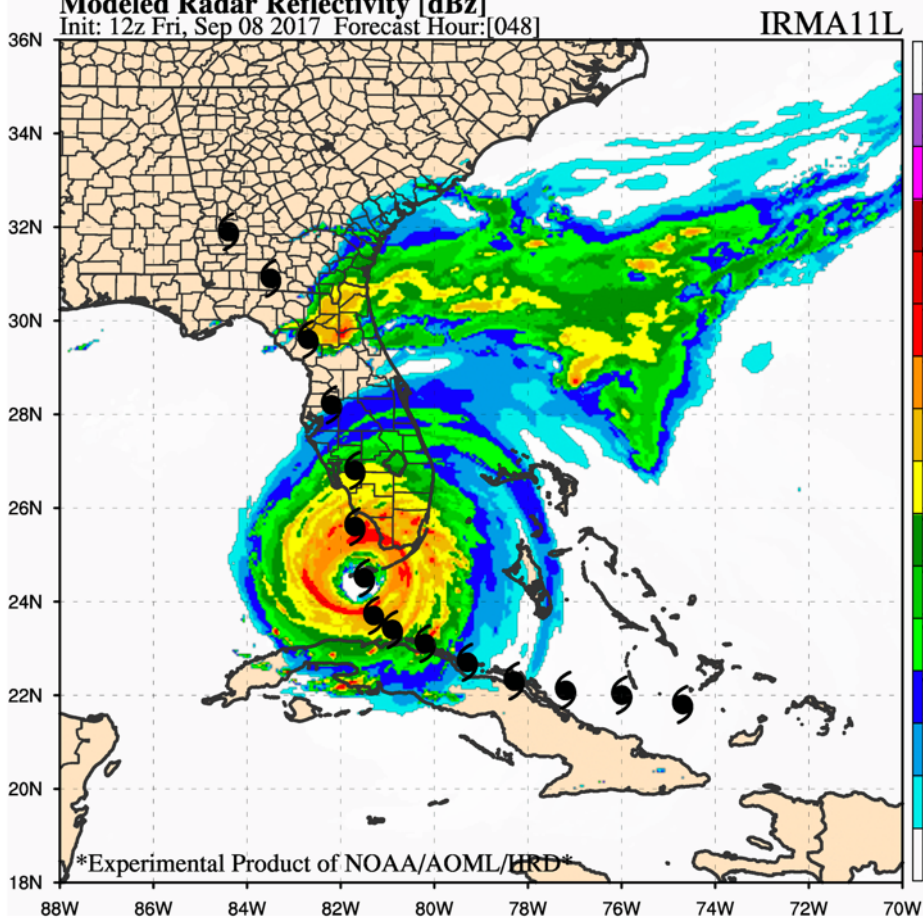
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Next steps — Basin-HWRF & fvGFS



2017 Basin-Scale HWRP
Modeled Radar Reflectivity [dBz]
Init: 12z Fri, Sep 08 2017 Forecast Hour:[048]



Research Challenges -

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Priorities for HFIP to address Weather Act:

- Improve forecast confidence to enhance public response
 - Reduce largest track and intensity errors
 - Improve **vortex/shear** interactions
 - Improve initialization & physics impacting **RI**
- Maintain focus on forecast accuracy (track and intensity) to improve overall forecast performance
- Reduce uncertainty
 - Improve ensemble prediction products
- Improved forecasts for landfalling storms and increased emphasis on **storm surge**
- Incorporate **risk communication** into product suite

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