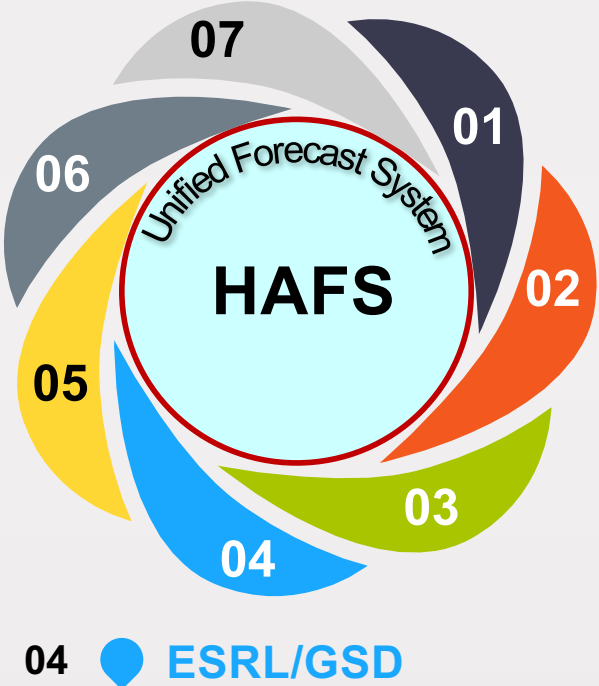# Hurricane Analysis and Forecast System (HAFS): A collaborative Project in UFS Framework



07 NCAR/DTC

06 OFCM/AOC

05 ESRL/NESII

04 ESRL/GSD

NCEP/EMC 01

AOML/HRD 02

GFDL 03

Unified Forecast System

HAFS

# HAFS: Hurricane Analysis and Forecast System

## Goals:

- Develop FV3 based multi-scale model and data assimilation package capable of providing analyses and forecasts of the inner core structure key to improving size and intensity predictions, as well as the large-scale environment that is known to influence the TC's motion.

- Provide an advanced Hurricane Analysis and Forecast System for cutting-edge research within the outlined Next Generation Global Prediction System (FV3) plans for the Unified Forecast System.

# Ongoing Efforts at EMC Towards Simplified Production Suite

| Modeling System | Current Status | Proposed Plans in the UFS Context |
|---|---|---|
| Global Deterministic | FY19: Transition FV3GFS into operations | Advancement of NGGPS/FV3GFS (biennial upgrades) |
| Global DA | 4D-Hybrid En-Var using GSI | Migrate to JEDI |
| Global Ensembles (Sub-seasonal) | FV3/NEMS based reanalysis/ reforecasts | FY20: Implement FV3 GEFS for sub-seasonal weather forecasts (35 days) |
| Global Seasonal Climate | Develop coupled UFS and coupled DA | Implement FV3 SFS for seasonal climate forecasts (MOM6, CICE5, Noah-MP, WWIII, GOCART, JEDI) |
| Global Aerosols | NGAC V2 (NEMS/GSM + GOCART) | FY20: Merge with FV3 GEFS |
| Hurricanes | HWRF & HNMMB | FV3 GFS with multiple moving nests (HAFS) |
| Waves | Waves Multi2 merged with HWRF | FY20: Merge wave ensembles models with FV3GEFS FY21: Merge deterministic Waves with GFSv16 |
| Ocean | RTOFS/HYCOM | MOM6 + NCODA + Marine JEDI |
| Meso-Scale | NAM V4 & NMMB frozen | Transition to FV3 CAM, NAM/RAP Parent domains subsumed by FV3GFS? |
| Short-range ens. | SREF V7.1 frozen | FY20: Replace SREF with FV3GEFS??? |
| HREF | V2: HiRes Window + NAM Nests (SSEO) | FV3 SAR to replace poor performing HREF members |
| RAP/HRRR | V2/V3 | FY20: V3/V4 UFS CAM (RRFS) |
| Products, V&V | UPP, VSDB/MET, MEG, NAWIPS | UPP+, MET+, MEG+ |
| Collaborative Infrastructure | Various | NEMS/ESMF/NUOPC+; EE2+; CROW; Shared infrastructure and distributed development |

# Revised HFIP Goals aligned with the Weather Act

1. Reduce forecast guidance errors, including during RI, by 50% from 2017

2. Produce 7-day forecast guidance as good as the 2017 5-day forecast guidance

3. Improve guidance on pre-formation disturbances, including genesis timing, and track and intensity forecasts, by 20% from 2017

4. Improve hazard guidance and risk communication, based on social and behavioral science, to modernize the TC product suite (products, information, and services) for actionable lead-times for storm surge and all other threats

# HAFS Strategies

## 1. Advance operational hurricane analysis and forecast system (HAFS)

- R&D for HAFS to advance deterministic and ensemble prediction capabilities
- R&D for fusion of modeling, data assimilation and observations to produce an analysis of record
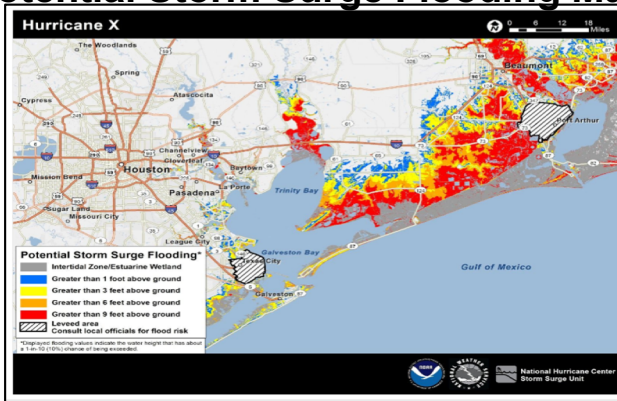- R&D for ensemble post-processing to extract guidance and uncertainty information
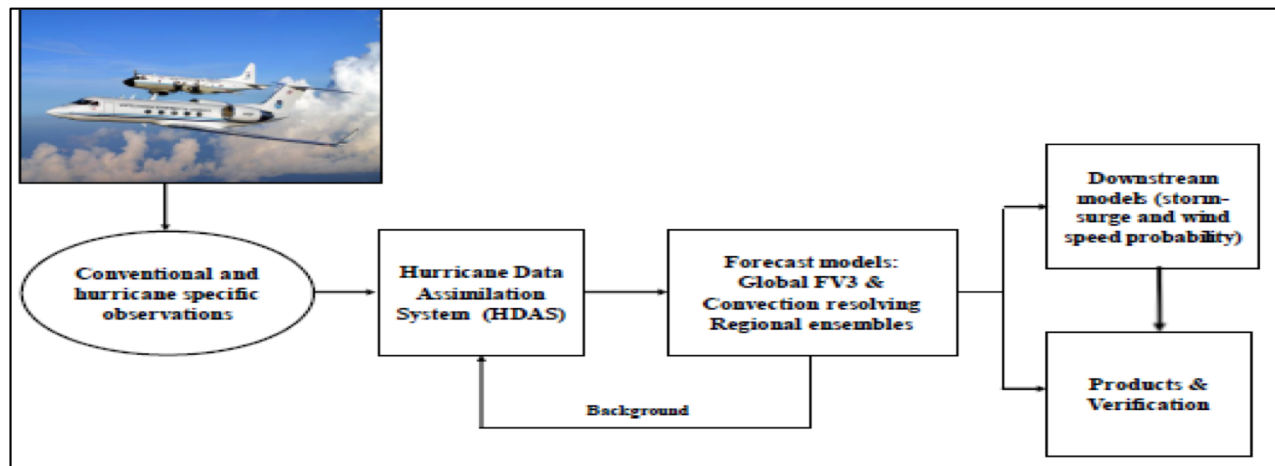
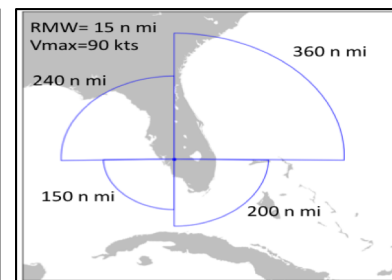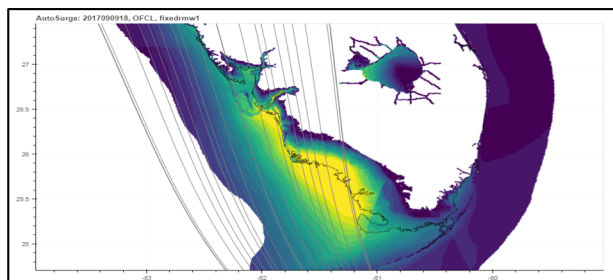# HAFS: Guidance & Products

## 2. Improve probabilistic guidance

- Calibrate guidance with HAFS
- Incorporate dynamically-based uncertainty into hazard models and products
- R&D for hazard-specific products from HAFS

**Potential Storm Surge Flooding Map**



**Planned improvements to P-Surge to Improve the Potential Storm Surge Flooding Map**



## 3. Enhance communication of risk and uncertainty

- Evaluate TC products for the effective communication of risk
- Modernize TC products as informed by social and behavioral science

# HAFS Sub-Projects

- Reproduce HWRF functionality and skill with FV3 based HAFS

- Accelerate moving nest implementation in FV3

- FV3 nests coupling to ocean and waves using NEMS NUOPC

- Implement vortex initialization for FV3

- Implement inner-core Hybrid En-VAR DA

- Implement HWRF Physics using CCPP

- Coupling advanced LSM, hydrology, inundation and surge models