# Accelerate development of Hurricane Analysis and Forecasting System (HAFS)



## FY19 Hurricane Supplemental Project HU-2



Contributing projects: HU-4, HFIP NOFO, IFAA 3A.1, 3A.2, & 3B, UFS R2O

**HAFS DA workflow in HAFS v0.2A with generalized task names**

**Current Status**
- Cold-start, warm-start capabilities
- DA/GSI-based Vortex Relocation
- 3DVar & hybrid 3DEnVar with GDAS ensembles
- FGAT capability (OU)
- 3DEnVar with dual-resolution self-cycled EnKF system (EMC/OU)

**On-going Development**
- Assimilate all observations ingested in HWRF & GDAS/GFS, enhanced GOES-16 storm floater AMVs, cloud radiances, etc.
- Hurricane DA specific observation preprocessing, domain merging, & increment processing techniques;
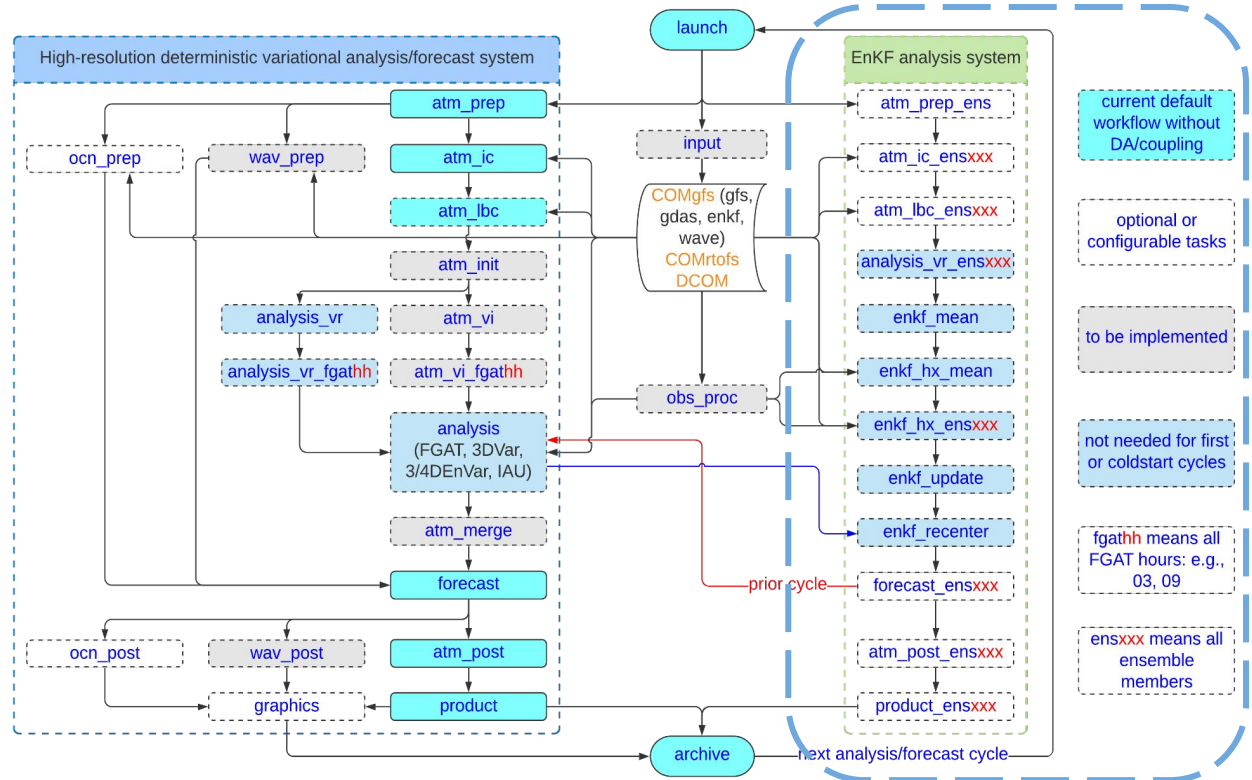- HAFS satellite radiance DA & online bias correction (OU, UMD). See next slide
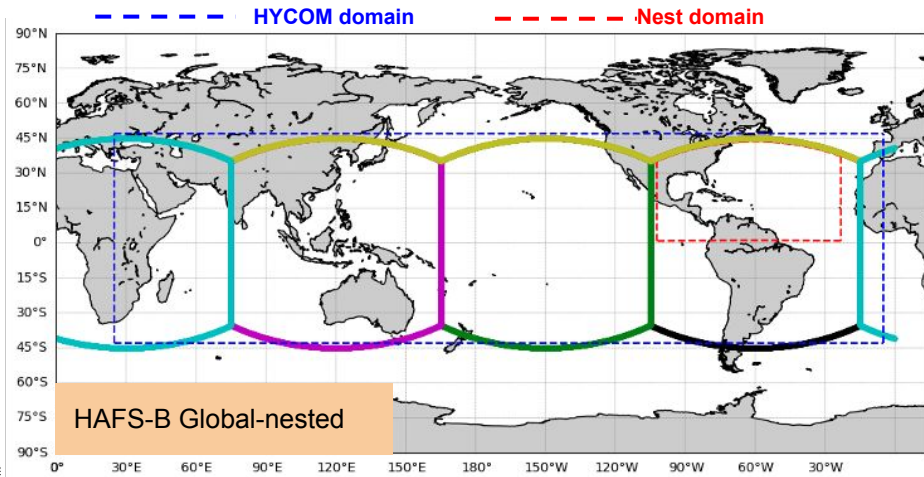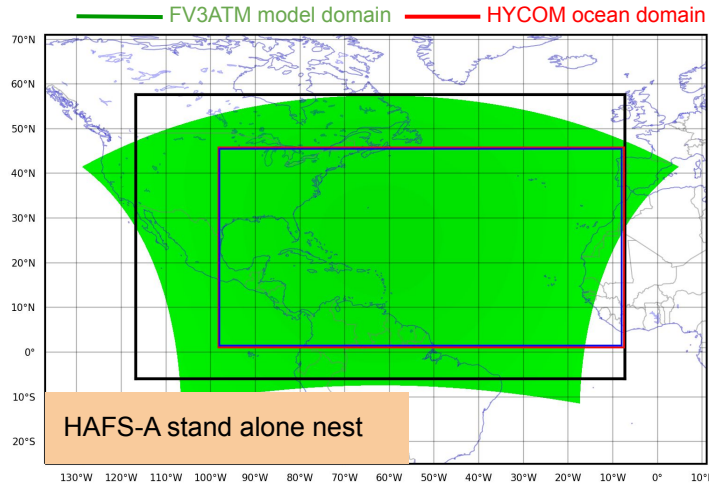


2
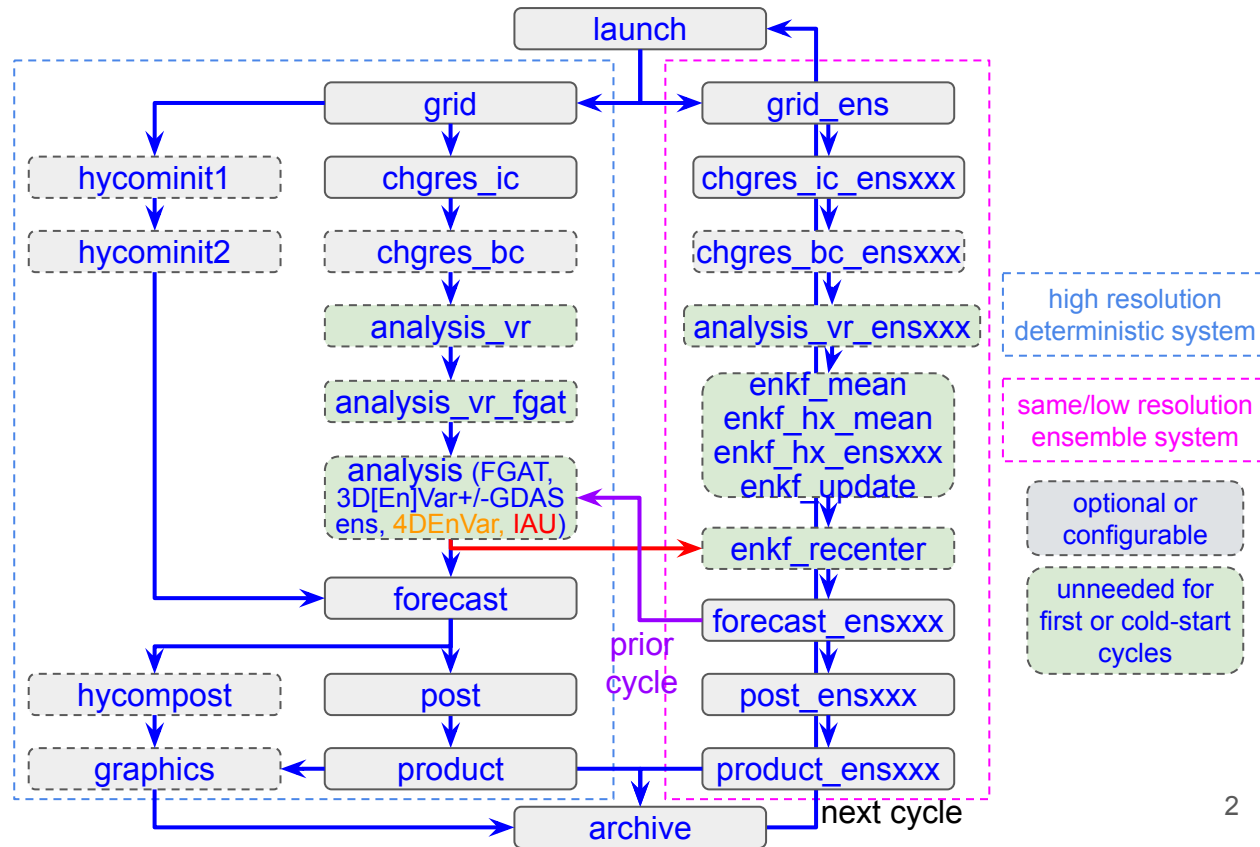
# Accomplishment Details

**HAFS workflow (including DA & Coupling) in HAFS v0.2D with generalized task names (ongoing)**

## Current Status

- Cold start from GFS analysis (without DA)
- GSI-based TC relocation capability (configurable, on/off, under development)
- 6-h hybrid 3DEnVar using GDAS ensemble or HAFS ensemble (dual-resolution)
- 3-h (configurable) FGAT capability
- 3DEnVar DA to assimilate observational datasets used by operational HWRF plus:
  - Metar data
  - Meso-sector GOES-R AMVs



3

# HAFS Physics Testing & Evaluation


FV3ATM model domain — HYCOM ocean domain

HAFS-A stand alone nest


HYCOM domain — Nest domain

HAFS-B Global-nested

- **Ocean Coupling**
  - CMEPS based coupling
  - From ATM to OCN: air-sea momentum flux, sensible/latent heat flux, net short-wave/long-wave radiation fluxes, precipitation, surface pressure
  - From OCN to ATM: sea surface temperature
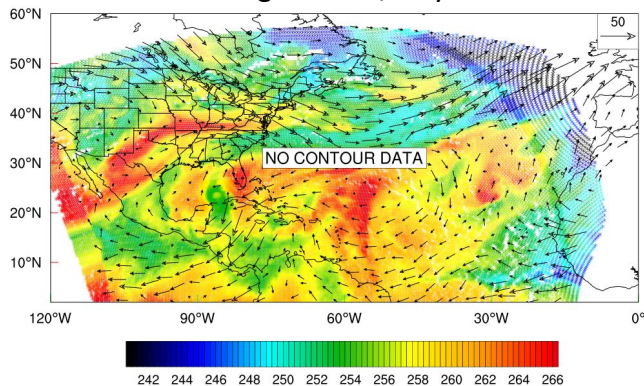  - Added ocean-coupling diagnostics


FV3ATM → CMEPS → HYCOM
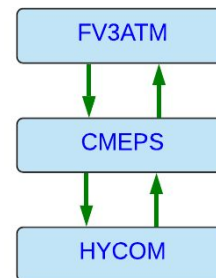

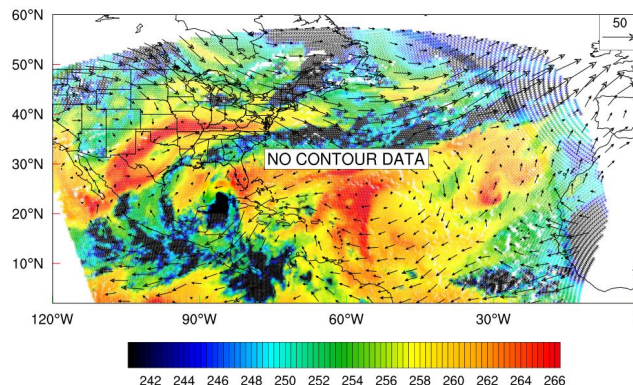SST coupled-uncoupled (°C), 10-m wind (kt)
Laura (2020)
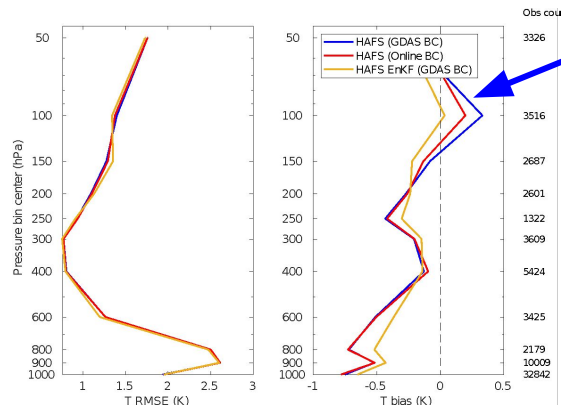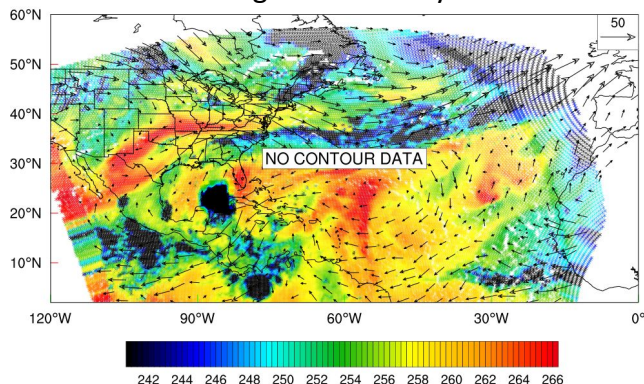
4
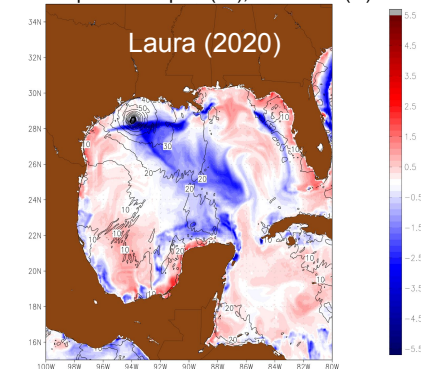
# Accomplishment Details

Background w/o hydro



Observations



Background with hydro





**Satellite DA**

- Development & testing of ABI all sky radiance data assimilation capabilities (OU)
- Online satellite bias correction (BC) capabilities added & tested in HAFS (UMD)
- BC significantly reduces upper-air temperature & water vapor errors in HAFS—over GDAS-specified bias model
- Research provides necessary infrastructure to introduce all-sky radiance DA capabilities in HAFS.
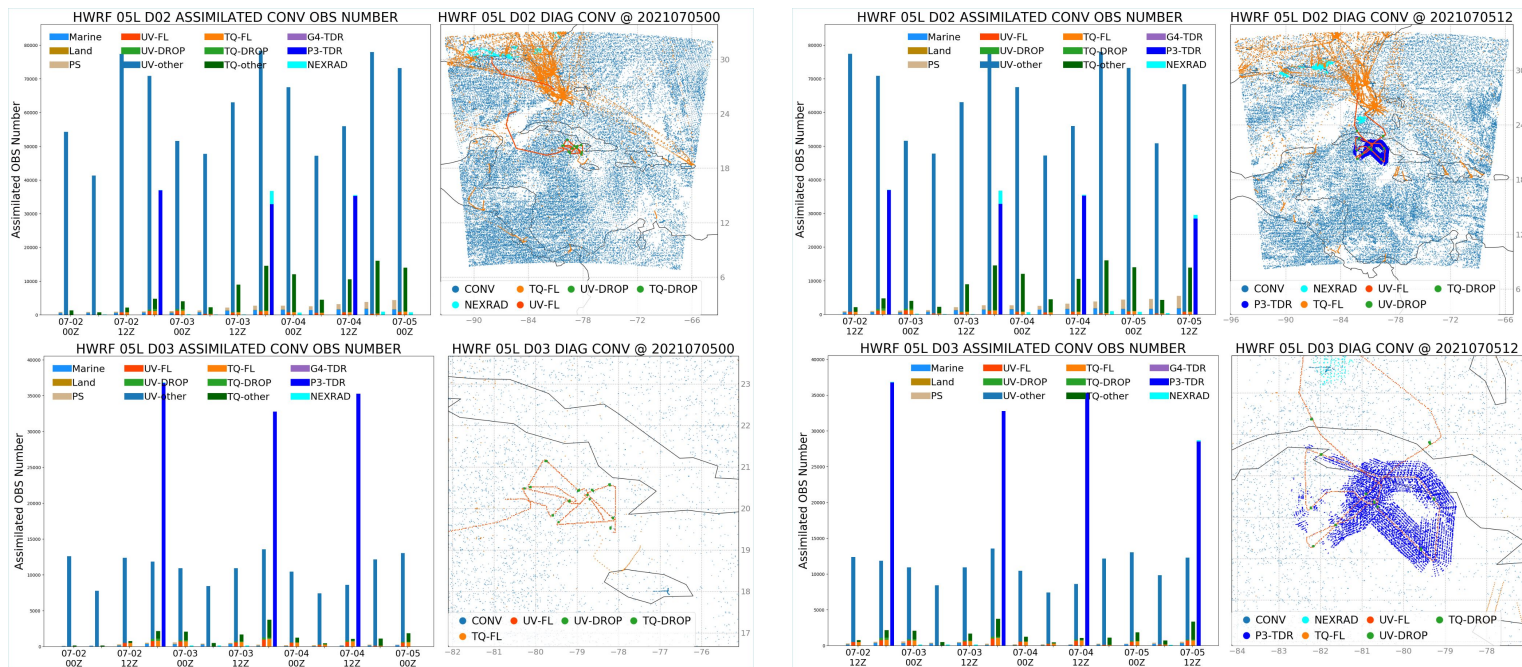
5

# Accomplishment Details

**Collect high-resolution observations to test HAFS DA (ongoing)**

- Collaborating with EMC, UMD, and OU to work on initial capability within HAFS DA (Miami)
- Developed new situation awareness product for NHC to display distribution of observations (type & number) that go into each data assimilation cycle. Demonstrated in Hurricane Elsa (Miami & EMC)



Hurricane Elsa

https://www.emc.ncep.noaa.gov/gc_wmb/vxt/HATCF/