HAFS Data Assimilation Progress Update from EMC Hurricane Modeling Team

HAFS Coordination Meeting (07/21/2021)
New DA capabilities (since last update)

- Assimilate drifting corrected tempdrop data using a new obs_proc task in the workflow.
- Assimilate METAR data
- Assimilate Enhanced GOES-R AMVs
- The TC vitals is now being assimilated in HAFS; missed in the previous configuration (reported by OU group)
- Updated crtm library from version 2.2.6 to crtm-2.3.0 in GSI

Workflow/source code bug fixes --- collaborated with community developers

- Ensure the TDR/NEXRAD radial winds are assimilated in the EnKF analysis. (OU)
- Change in exhafs_enkf.sh script to use the ensemble mean instead of mem001 from enkf_mean in the enkf_update step. (Reported by OU and UMD)
- Bug fix for enkf analysis steps when using t(tv) as a control vector variable for regional FV3 DA (UMD/OU/EMC)
- Bug fix when dual-res EnKF is invoked, in progress (OU).
HAFS Workflow (including DA & Coupling)
Assimilation of meso-sector GOES-R AMVs

Test experiment for Hurricane Dorian, 2019, total cycles of 25;

Plan to include real-time CIMSS AMV assimilation in HAFS-D experiment
Track/Intensity Verification Comparison (HAFS vs HAMV)  
Hurricane Dorian, 2019

~15% improvement

Improved before day-3

Improved Vmax bias
Storm Size Verification Comparison (HAFS vs HAMV)

Hurricane Dorian, 2019

Improved storm size when meso-sector AMV data is assimilated in HAFS
HAFSv0.2D Real-Time Experiment

- Forecast model: same as 2021 HAFS-A configuration
- Data Assimilation Options:
  - 6-hourly hybrid 3DEnVar by using GDAS 6-h ensemble forecasts
  - 3-hourly FGAT
- Data Assimilated:
  - All observations included in HWRF (TDR, NEXRAD, Drifting corrected tempdrop)
  - Metar observations
  - Enhanced GOES-16 Atmospheric Motion Vector (AMV)

*TDR and GOES-R AMV have not been included in the system yet.*
Composite track/Vmax Comparisons between HAFS-A and HAFS-D Configuration
Hurricane Claudette, 03L

HAFS-A

Track

HAFS-D

Slightly left bias

Vmax

Better intensity forecasts
Composite track/Vmax Comparisons between HAFS-A and HAFS-D Configuration
Hurricane ELSA, 05L

HAFS-A

Slightly right track bias, compared to HAFS-A

HAFS-D

Better intensity forecasts
HAFSV0.2D Real-time Experiment results

- **Improved initial Vmax, as well as almost of other forecast hours**
- **Vmax error reduction is mainly due to improvement Vmax bias**
Ongoing and near future developments

Data Assimilation and TC Initialization

○ Work on assimilation of mesonet/metar, enhanced AMVs from GOES-R
○ Analyze/verify results from various DA options, e.g. HAFS ens. vs GDAS ens.
○ Optimize DA options, e.g. localization scale settings used HAFS 3DEnVar and EnKF
○ Configurable and more frequent (3-hrly or hourly) DA/analysis cycling
○ Explore TC relocation, initialization (VR/VM) capability for nests
○ HAFS inner-core DA with high-resolution storm-following moving nests
○ Hurricane specific obsproc, domain merging, and increment processing techniques
○ Blending GFS above HAFS model top for radiance DA bias correction
Thanks!