

NSAR



HAFS Data Assimilation Progress Update from EMC Hurricane Modeling Team

HAFS Coordination Meeting (07/21/2021)





HAFS DA Development and Progress



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).



Assimilation of meso-sector GOES-R AMVs

n: 15620

std: 2.52 mean: -0.264

max: 6.852 min: -7.246

> 7.5 10.0

26 Aug 2019 12z

n: 25989

std: 3.215

mean: -0.465 max: 9.837 min: -10.558

10





NESDIS AMV

NESDIS AMV

+ CIMSS AMV



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

MODEL FORECAST - INTENSITY VMAX ERRORS (KT)





MODEL FORECAST - TRACK ERRORS (NM)



MODEL FORECAST - MINIMUM CENTER PRESSURE ERRORS (hPa) VERIFICATION FOR NATL BASIN 2019



MODEL FORECAST - BIAS ERRORS (KT) VERIFICATION FOR NATL BASIN 2019



MODEL FORECAST – TRACK FORECAST SKILL (%) STATISTICS VERIFICATION FOR NATL BASIN 2019



MODEL FORECAST - INTENSITY RELATIVE SKILL (%) STATISTICS VERIFICATION FOR NATL BASIN 2019





Storm Size Verification Comparison (HAFS vs HAMV) Hurricane Dorian, 2019



MODEL FORECAST - AVERAGE 50KT RADIUS BIAS (NM) VERIFICATION FOR NATL BASIN 2019



MODEL FORECAST – AVERAGE 34KT RADIUS BIAS (NM) VERIFICATION FOR NATL BASIN 2019



Improved storm size when meso-sector AMV data is assimilated in HAFS













- 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)

FV3ATM ESG grids FV3ATM product domain HYCOM ocean domain



Track

Vmax



Hurricane Claudette, 03L

HAFS-A





24

48 72 96 Forecast lead time (hr) 120

144



Slightly left bias

HAFD forecast: CLAUDETTE (al032021) Maximum 10-m wind time series



Better intensity forecasts

AND ATMOSPHE

NOAA



Track

Vmax



140

120-

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80

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HAFS-A





HAFS-D



HAFD forecast: ELSA (al052021)

Maximum 10-m wind time series

72 96 1 Forecast lead time (hr

3 20210704

6 20210705 7 20210705

.12.20210706

20 202107

Slightly right track bias, compared to HAFS-A

Better intensity forecasts

AND ATMOSPHI

NOAA



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



300 HWRF: Operational HWRF HAFA: HAFS 0.2A baseline AFD: HAFS 0.2D DA 240 ERRORS_(NM) 08-08-**Track-error** 3120 M 60 96 108 12 26 24 22 36 60 72 13 120 #CASE 30 21 19 15 11 9 7 Forecast lead time (hr) Hurricane project - NOAA/NCEP/EMC

MODEL FORECAST - TRACK ERRORS (NM) VERIFICATION FOR NATL BASIN 2021

MODEL FORECAST - MINIMUM CENTER PRESSURE ERRORS (hPa) VERIFICATION FOR NATL BASIN 2021









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 11





Thanks!