Hurricane Forecast Improvement Project (HFIP): Programmatic Overview

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Outline

- OSTI - Modeling Program context
- HFIP Goals
- 2019 Highlights
- Accomplishments and progress
- Outreach and community
- Priorities
- Unified Forecast System (UFS) and hurricane modeling
OSTI-Modeling context

- OSTI-Modeling includes NGGPS, HFIP, Weeks 3-4, Air Quality & COASTAL Act
- FY19 total budget: $29.5M, over half to NGGPS program, over ⅓ to EMC
- HFIP support has been $3.5 - 4M in recent years, and is distributed among EMC, NHC, DTC (GSD, UCAR) & Universities
- Hurricane Supplemental in FY18 has been leveraged to support hurricane model developments; Disaster Supplemental FY19 projects will also benefit hurricane forecasting
- Changes in OSTI-Modeling staff:
  - Ed Mifflin retired
  - Yan Xue is new Program Manager, focus is on S2S, weeks 3-4, coupled system
  - Search is ongoing for 2 more federal PM’s, including hurricane program PM
OSTI-Modeling context

- OSTI-Modeling is increasingly oriented towards support of the Unified Forecast System (UFS)
- The UFS will streamline codes and facilitate R2O2R
- UFS will be supported by a proposal, based on the updated UFS-Strategic Implementation Plan (SIP). Joint support expected by OSTI-Modeling and OWAQ-EPIC/JTTI. Project support for 2 years.
- Notice of Funding Opportunity (NOFO) will also support UFS (and hurricane modeling)
- UFS (SIP) process may also be used (eventually) by other Offices in NOAA (e.g. NOS, CPO, NESDIS), possibly to other agencies (e.g. NASA, NSF)
- EPIC is anticipated to improve infrastructure, software, cloud-compute-readiness and community support for UFS. The EPIC-contract Statement of Objectives will be released soon. See DaNa Carlis for details
Revised HFIP Goals aligned with the Weather Act

- Reduce numerical forecast guidance errors, including during rapid intensification, by 50% from 2017
- Produce 7-day forecast guidance that is similar to 2017 5-day forecast guidance
- Improve guidance on pre-formation disturbances, including genesis timing, and track and intensity forecasts, by 20% from 2017
- 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
Hurricane Forecast Improvement Project (HFIP) Highlights for 2019

- Under Section 104 of the Weather Act, 2018 HFIP Strategic plan has been completed and approved.
- FV3 based Hurricane Analysis and Forecast System (HAFS) version 0.A (SAR) and 0.B (moving nest) is running in real-time for 2019 hurricane season.
- Time of Arrival of Tropical Storm graphics were operationally implemented in 2018, and GIS files were made available to media and emergency management partners for the first time.
- 2019 upgrades to HWRF and HMON model cancelled due to moratorium. (The upgrades are expected to occur in Q3FY20)
Hurricane and Coastal
6 NWS FY20 AOP milestones

• Implement HWRF v13.0 and HMON v3.0 into operations on WCOSS (EMC - Q3)

• Statistical post-processing hurricane intensity forecast model extended from 5 to 7 days (HSUP-NHC- Q3)

• Implement Near Shore Wave Prediction System NWPS v1.3 into operations on WCOSS (EMC - Q2)

• Storm surge enhancements, including new hazard risk maps for Guam and American Samoa, and optimizing wave component of the SLOSH model (HFIP-NHC - Q4)

• Probability Thresholds for Tropical Cyclone W/W Wind Hazard Grid Guidance CFP Prototype (NHC - HFIP/HSUP - Q4)

• NEMS infrastructure development to two-way couple ADCIRC and NWM for the East and Gulf coasts completed ( COASTAL - OWP - Q4)
Accomplishments and Progress

- HAFS models (HAFS 0.A and 0.B) generally have the better performance in track forecast for 2019 Atlantic Basin.
- HWRF intensity performance is much better than HAFS models.
- Storm surge: upgrade of SLOSH parametric wind model to utilize real-time RMW information and provided MOMS/MEOWs for Southern California.

Figure Courtesy: Morris Bender
Outreach and Community Participation


- Next round Announcement of Opportunity published 4 Nov 2019
  - Letters of Intent due 6 December 2019
  - Application deadline is 7 February 2020
  - Expected award date for selected proposals 1 Sep 2020;

- 34th Conference on Hurricanes and Tropical Meteorology, 10-15 May 2020, New Orleans, LA
  - Request award recipients to register under HFIP and HAFS session
    - **Session Topic ID:** 53022
    - **Session Topic Title:** Hurricane Forecast Improvement Program (HFIP) and Hurricane Analysis and Forecast System (HAFS)
FY20 NOFO hurricane topics

1. Advances in verification and validation:
   a. Improve post-processing, including bias correction, calibration, and statistically post-processed output
   b. Increase hurricane forecaster utility of tropical cyclone forecast guidance.
   c. Artificial intelligence techniques for genesis, track, intensity, surface wind structure and estimating forecast uncertainty

2. Computational efficiency and accuracy of the HAFS for cloud computing platforms

3. Coupled model development and DA advances targeted for the HAFS aligned with JEDI

4. Hurricane and tropical cyclone prediction subsystem advances:
   a. High resolution vortex initialization techniques
   b. Downstream applications for landfalling storms for improved size, structure, rainfall, surge and inundation forecasts
# Current HFIP Awards (2018-2020)

## HFIP Collaborative Awards Round V (2018-2020)

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<td>Agnes Lim</td>
<td>University of Wisconsin (UWI)</td>
<td>Advanced DA Techniques for Satellite-Derived Atmospheric Motion Vectors from GOES 16/17 in the HWRF</td>
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<tr>
<td>Andrea Schumacher</td>
<td>Colorado State University (CSU)</td>
<td>Using Dynamically-Based Probabilistic Forecast Systems to Improve the NHC Wind Speed Products</td>
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<td>Kerry Emanuel</td>
<td>Massachusetts Institute of Technology (MIT)</td>
<td>New Frameworks for Predicting Extreme Rapid Intensification</td>
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<td>Ping Zhu</td>
<td>Florida International University (FIU)</td>
<td>Rapid Intensification Changes: Improving Sub-Grid Scale Model Parameterization and Microphysical-Dynamical Interaction</td>
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<td>Ryan Torn</td>
<td>SUNY Albany</td>
<td>Evaluating Initial Condition Perturbation Methods in the HWRF Ensemble Prediction System</td>
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<tr>
<td>Ting-Chi Wu</td>
<td>Colorado State University (CSU)</td>
<td>Enabling Cloud Condensate Cycling for All-Sky Radiance Assimilation in HWRF</td>
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Priorities for 2020

- Continue development upgrades of operational HWRF and HMON until the transition of HAFS
- Continue improvement of storm surge models, including OCONUS
- Alignment of hurricane models with UFS
- Hurricane model physics consistent - toward unification - with UFS - use the Common Community Physics Package (CCPP)
- Improve extreme precipitation forecast
Unified Forecast System (UFS)

- The UFS is reorganizing and “projectizing”:
  - Two Application Teams (AT’s) are established and have written plans for forecast and modeling goals
    - Medium-Extended Range forecast (to S2S)
    - Convective Allowing Modeling (CAM), formerly a Working Group (WG)
  - The WG activities should support the AT goals
  - The ATs and WGs are writing “3-pagers”, (i.e. LOI’s). On the basis of these 3-pagers, we will invite a proposal
- Hurricane modeling may want to form another (informal) UFS AT and provide development and forecast goals to the UFS
  - Hurricane community should consider how best to join the UFS, by aligning and contributing hurricane physics (into CCPP), workflow, V&V, etc.
  - 3-pagers on either a Hurricane AT or other developments could be submitted - should include a path to unification, convergence with UFS
Conclusions and future directions

● Alignment of hurricane models with UFS:
  ○ High-resolution grid nested in global model, coupled to (high-resolution nested?) ocean, with moving nests?
  ○ Cheaper regional versions? How important are moving nests?
● Hurricane community has end-to-end nature, modeling, forecasters, observationalists, University & NOAA communities working closely. (Some other “applications” do as well)
● **Coastal systems**, storm surge - potential for improved collaboration and unification among (NOAA) groups, including tropical and extra-tropical
● Need to better integrate hurricane prediction requirements into GEFS implementation testing process. Start with UFS V&V?
● Prepare for post-Supplemental funding reality