Disaster Related Appropriations Supplemental Program

Tropical Cyclone Operations and Research Forum

NATIONAL WEATHER SERVICE

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Two current NOAA Disaster Supplemental Programs

- FY18: Improving Forecasting and Assimilation (IFAA)
  - Projects include hurricanes, data assimilation, floods, physics and infrastructure
  - 12 hurricane projects, about $16M
  - Year 2 - results are coming in

- FY19: Improving Forecasting of Hurricanes, Floods and Wildfires (IFHFW)
  - 4 hurricane projects, about $9M
  - Year 1 - some early results

Program Development by Supplemental

	Challenges/Con's	Benefits/Pro's
Resource	Delta infusion of funds	Can be substantial
Attention	Closely scrutinized	Visibility at high level
Scope	Focused	Impactful

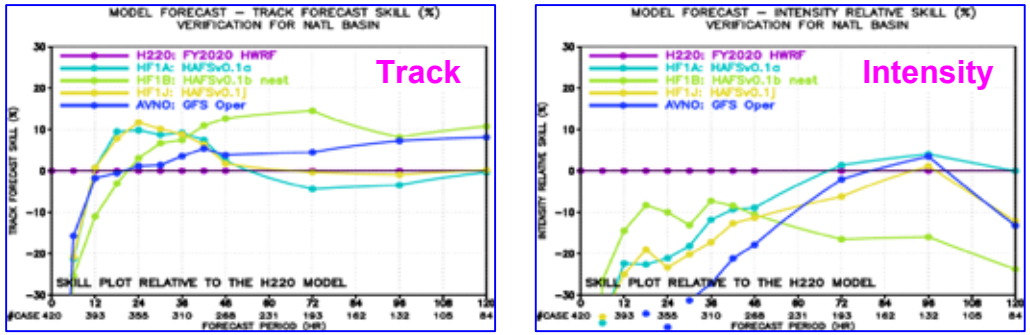
PO Team	Executive	Program manager	Contract support
NWS	Stephan Smith	Dorothy Koch (& Jung)	Linden Wolf (& Upadhayay)
OAR	Russ Schneider	Mark Vincent	Ben Woods, Chris Spells
NESDIS	Maureen Madden	Kevin Garrett	

Hurricane activities
Current status

- Modeling
- Data collection
- Data application
- Forecast communication

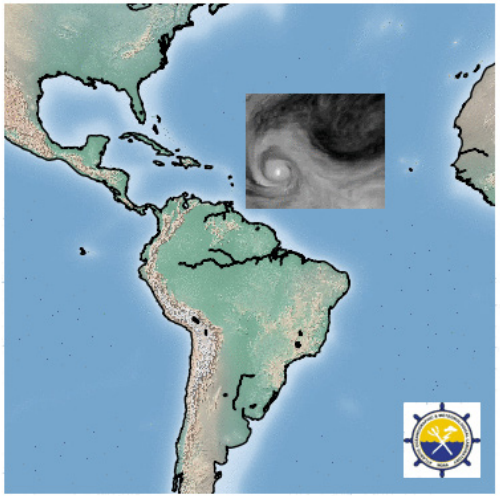
Modeling Projects: Hurricane Models

- Accelerate HFIP (FY18, Marks)
  - HAFS physics evaluation - e.g. EDMF, cloud microphysics; AOML Hurricane model viewer and share on AWIPS, evaluate ocean-related diagnostic variables
- HAFS engineering (FY18, Tallapragada/Mehra)
  - 4 HAFS configurations run real-time in 2020
- Multiple moving nests for HAFS (FY18, Gopal, Mehra)
  - Moving nest code running in the FV3 dycore



HAFS V0.1 skill relative to HWRF for 2020 season (NATL)

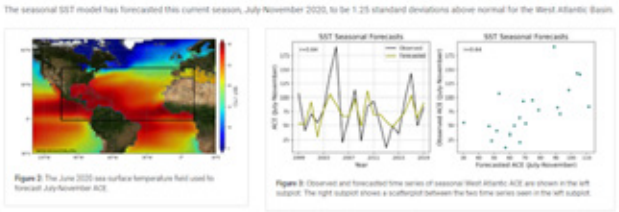
FV3 Moving Nest WV at Timestep 000

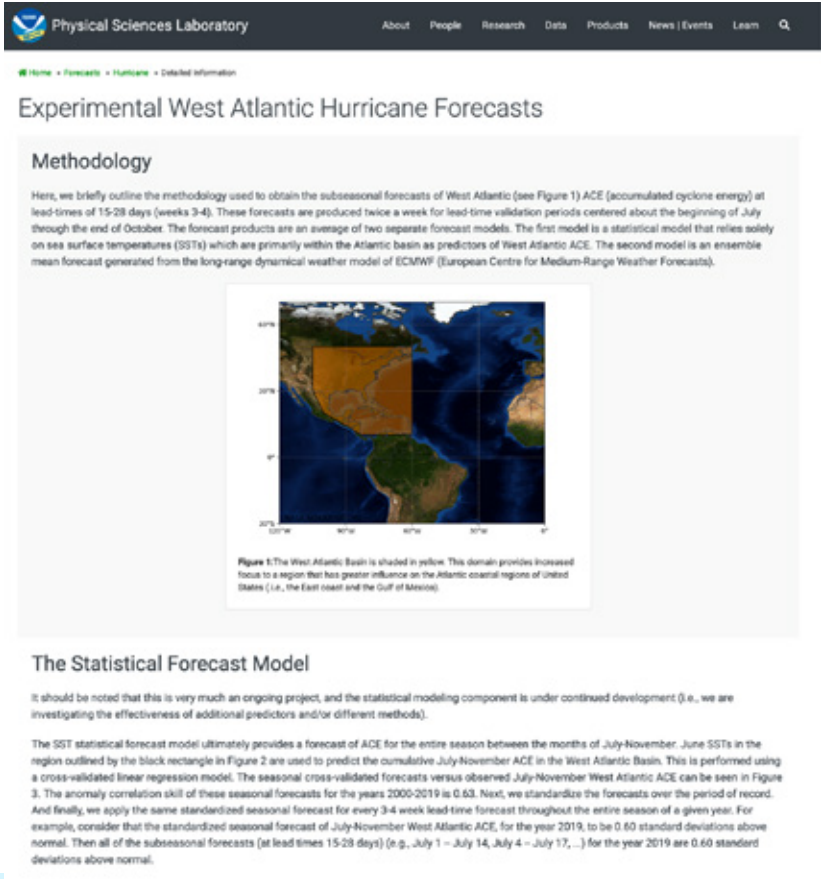


First ever moving nest implementation in HAFS

Modeling Projects: Extended Range

- Improve Sub-seasonal Hurricane forecasts (FY18, Webb)
  - Web page for quasi-real time graphics based on ECMWF reforecasts
  - GEFS v12 under development https://www.psl.noaa.gov/forecasts/s2s_hurricane/



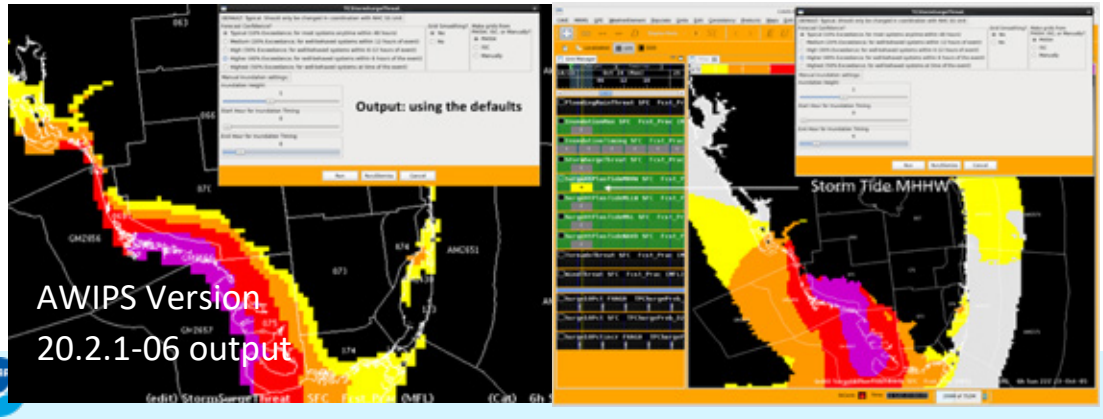


Modeling Projects: Surge and Flooding

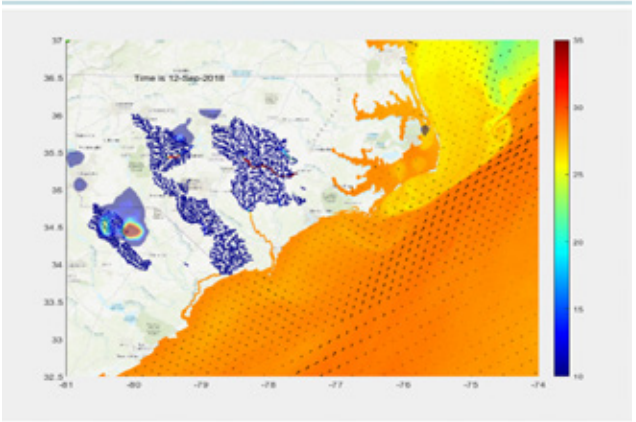
- IOOS (NOS obs) support to integrated water level modeling (FY18, Snowden)
  - WRF/ROMS coupling tested on WCOSS and AWS, developed prototype coupled ocean-atmosphere-river model
- Storm surge modeling (FY18, Kurkowski)
  - coupling HSOFS and WW III (ongoing)
  - P-ETSS implementation Feb 25, 2021;
  - Hazard-specific threat (wind, flooding, tornado) forecast algorithms, available in AWIPS

Run time comparison

System	24 Processors	144 Processors
AWS	135 minutes	48 minutes
WCOSS	180 minutes	60 minutes



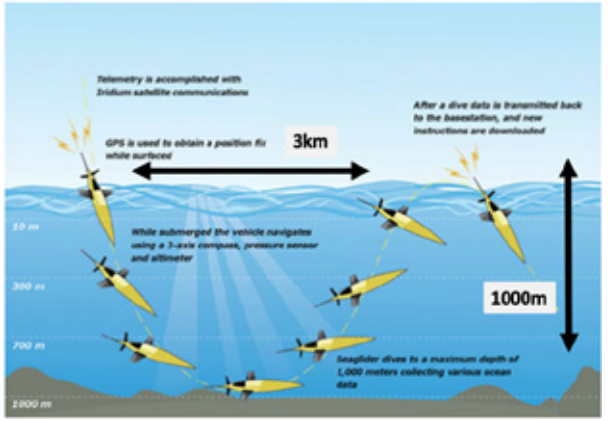
Model coupling of ocean-atmosphere-river

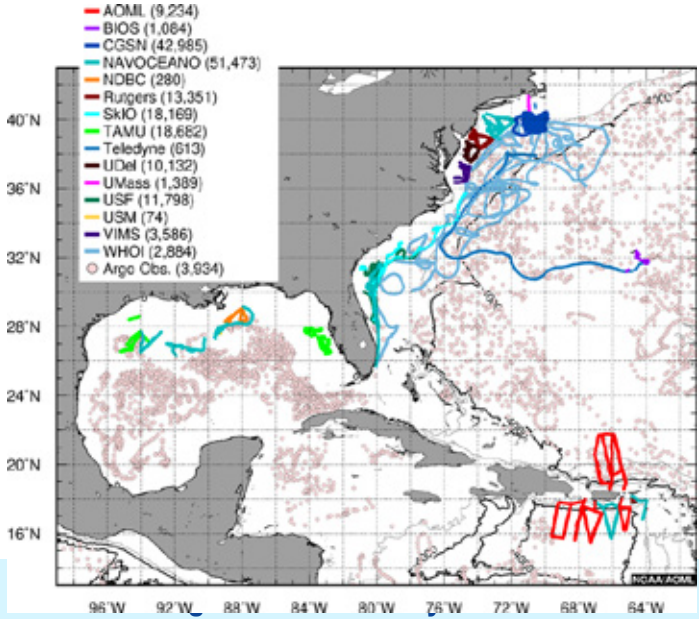


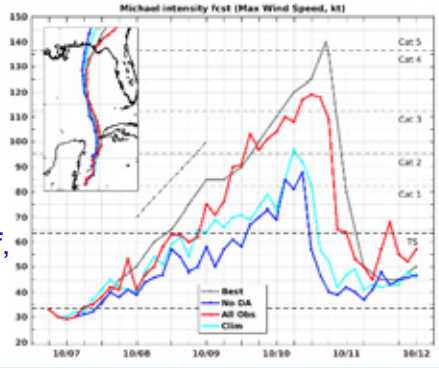
collaboration with John Warner (USGS) and George Xue (LSU)

Data Collection Projects

- Glider deployment, data assessment (FY18, Goni)
  - 36 gliders deployed (4500+ glider days), over 222k T and S profiles
  - DA experiments with the coupled model
- Autonomous ocean observations (FY19, Lacour)
  - gliders and drifters
- Test next generation in-situ systems (FY18, Sloan)
  - Air Launched UAS (ALTIUS) deployment: week of 11JAN2021







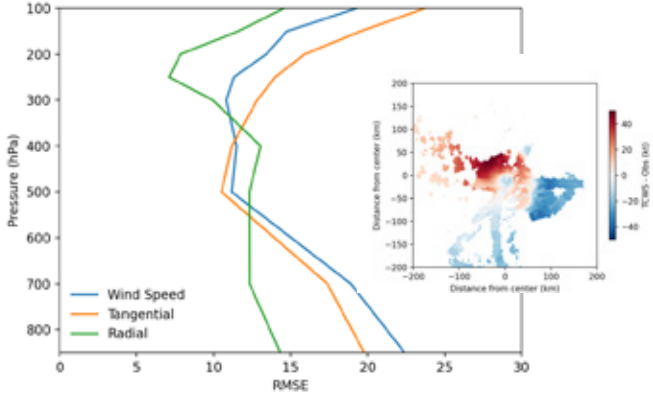
Intensity of Hurricane Michael: All Obs experiments improves intensity prediction. (Le Henaff, et al 2021)

Data Application Projects

- Observing System Experiments (FY18, Cucurull)
  - Data denial experiments for dropsondes - Dropsondes <250 km add value to forecasts, particularly to intensity forecasts
- Increasing satellite data use for hurricane modeling, using AI (FY19, Garrett)
  - ML models for Intelligent data selection and QC
  - Algorithm for Simultaneous Wind-Rain
  - AI based tropical cyclone 3D winds
    - Algorithm validation with TDR and AMV

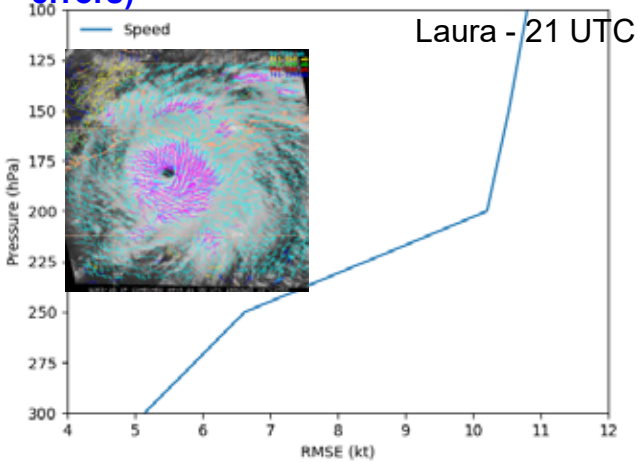
3D Wind Validation with TDR (wind errors)

Laura - 12 UTC 25 Aug



3D Wind Validation with AMV (wind speed errors)

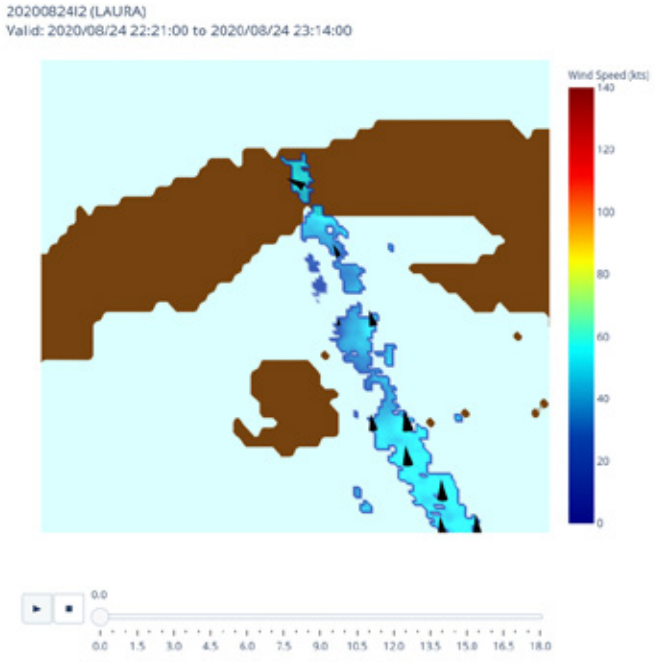
Laura - 21 UTC 26 Aug



Forecast & Communications

- Improve Effectiveness of communication (FY18, Sprague, Eosco)
  - Conducted surveys/interviews during 2020 hurricane season, final analysis and Emergency Manager/Broadcast survey testing for 2021 season underway
  - Tropical Socio-Econ Meeting (December 2020)
- Improve NHC Forecast Techniques (FY18, DeMaria/Zachry)
  - Web utility to generate real-time 3-D plots of P-3 TDR (Doppler Radar)

Real-time P-3 TDR Diagnosis
Example: Tilt of Tropical Storm Laura



Articulating Major Outcomes

1. Hurricane Analysis and Forecast System (HAFS)
   a. Deterministic and ensemble predictions to 7 days
   b. Major advances in Data Assimilation
   c. Improved forecast skill - yet TBD
2. New data
   a. New gliders, drifters, dropwindsondes
   b. New satellite products, using AI to optimize information
   c. Data denial will quantify impact on forecast skill
3. Communication
   a. Hurricane forecast social science is a pilot for improving forecast communications - **what are key lessons?**
   b. New forecast products - **how are these applied?**

Next steps?

Large coordinated project(s) focused on impactful outcomes!

Gaps?

- Next priority improvements for models:
  - Probabilistic information - working with ensembles
  - Multiple high-resolution moving nests
  - Surge developments?
  - Ocean stratification?
  - More/better data assimilation?
  - Community engagement: port to cloud, model release
  - Other?
- Which data are most impactful, what are gaps?
- What are the next steps for meeting the information needs of forecasters, stakeholders, public?

Thanks!

FY18: Improving Forecasting and Assimilation (IFAA)

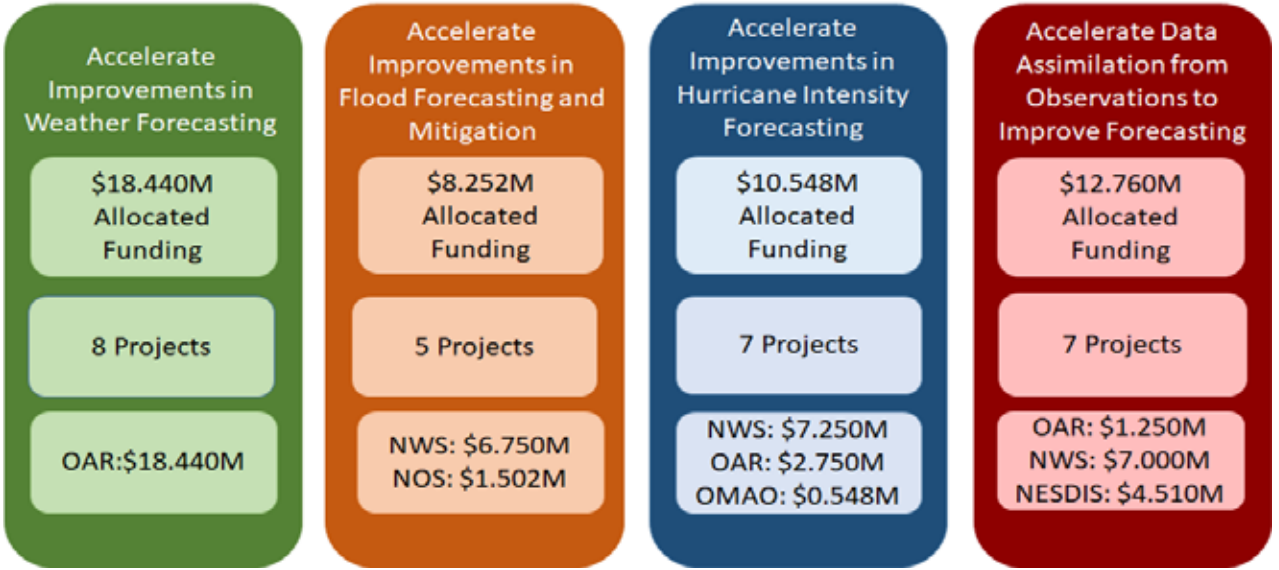
- **Bipartisan Budget Act signed February 9, 2018, including $50M to improve weather forecasting, hurricane intensity forecasting and flood forecasting and mitigation capabilities**
- **Funding allocations started in summer 2019, projects complete within 2 years.**

$50M also for computing:

- MSU-Orion (72,000 Skylake processors)
- Theia-replacement (52,000 Skylake processors)

There are 27 major projects across 4 primary focus areas.

$15.85M for hurricane work (31%)



FY19: Improving Forecasting of Hurricanes, Floods and Wildfires (IFHFW)

- **Supplemental bill passed April 9, 2019, $17.2billion to several agencies for expenses related to wildfires, hurricanes, volcanos, earthquakes, typhoons and other natural disasters.**

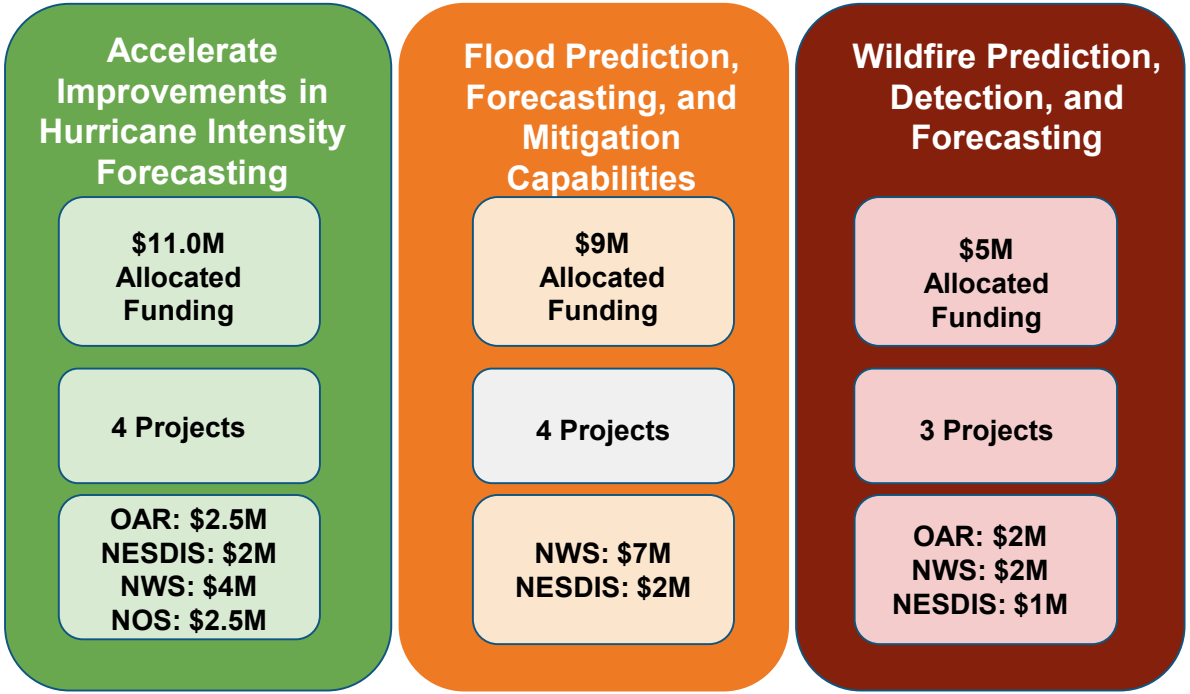
$25M to NOAA to improve

(a) hurricane intensity forecasting, including deployment of unmanned ocean observing platforms and enhanced data assimilation;

(b) **flood prediction**, forecasting and mitigation capabilities and

(c) **wildfire prediction**, detection, and forecasting

- Funding allocation is underway, project duration of 2 years
- There are 11 projects across 3 primary focus areas
- **8.8M for hurricane modeling (35%)**



FY18 IFAA Hurricane and Surge Project List

1	**Weather Forecasting**	**2,800,000**
Mehra/Gopol	Accelerate NGGPS elements related to severe weather prediction, especially landfalling tropical storms and hurricanes	1,300,000
Sprague	Accelerate Effective Communication of weather forecasts and warnings to decision makers	1,500,000
2	**Flood Forecasting & Mitigation**	**1,252,000**
Snowden	NOS/IOOS - Regional Obs - IOOS support to integrated water level Modeling	1,252,000
3	**Hurricane Intensity Forecasting**	**10,548,000**
Marks	Accelerate Hurricane Forecast Improvement Plan	2,000,000
Tallapragada/ Mehra	Accelerate re-Engineering of Hurricane Analysis and Forecasting System (HAFS)	2,150,000
Kurkowski	Improve Storm Surge Modeling	1,650,000
DeMaria	Accelerate Improvements in NHC Forecast Techniques	750,000
Webb	Improve Seasonal Hurricane Forecasts	700,000
Goni	OAR-OWAQ Sustained Ocean Observations	2,750,000
Sloan	OMAO - Test and Evaluation of next-generation in-situ measurement systems	548,000
4	Data Assimilation	1,250,000
Cucurull	Optimize current observing system to improve prediction of extreme weather	750,000
Cucurull	Observing System Simulation Experiments (OSSEs)	500,000
	Total FY18 Hurricane projects	**15,850,000**

Budget - FY19 IFHFW Hurricane Project List

1	**Accelerate improvements in Hurricane Intensity Forecasting, including through deployment of unmanned ocean observing platforms and enhanced data assimilation**	**6,200,000**
Chawla	Prototype UFS based RRFS (Rapid Refresh Forecast System) on the Cloud	3,500,000
Cortinas	Accelerate the development of the Hurricane Analysis and Forecasting System (HAFS)	2,200,000
Garrett	Increasing satellite data use and impacts in hurricane analysis and prediction leveraging artificial intelligence applications	1,800,000
Gouldman	Autonomous Observation in Support of Hurricane Intensity Forecasts	2,200,000
2	**Accelerate Flood Prediction, Forecasting, and Mitigation Capabilities**	**2,600,000**
Mehra	Advance ocean data assimilation and coupling of air-sea models in the NOAA Unified Forecast System (UFS) in support of improved flood and inundation forecasting through coordination with NWS and NOS.	2,600,000
	Total FY19 Hurricane projects	8,800,000

UFS Short-Range Application (RRFS)

FY23: RRFSv1
FY24: RRFSv2

Rapid Refresh Forecast System (Ensembles) for Severe Weather Prediction

Combines NAM Nests, HiResWindow, HREF, and HRRR

Convective scale Ensemble DA