Hurricane Research at NOAA







NOAA's Atlantic Oceanographic and Meteorological Laboratory U.S. Department of Commerce

Vision

Advance understanding & prediction of tropical cyclone (TC) track, intensity, & structure change & their impacts utilizing observations, numerical models, & theory

NOAA's hurricane research focus for >65 years





Current State of the Art

Operational Forecast Performance





Courtesy John Cangialosi & James Franklin (NWS/NHC)



Hurricane Forecast Improvement Program

- Unified approach to guide & accelerate forecast improvements since 2008
 - improve prediction of rapid intensification & track
 - improve forecasts & communication of storm hazards
 - incorporate risk communication research to create more effective products





HAFS Prototype

Hurricane Analysis and Forecast System (HAFS)

HAFS is the next-generation hurricane model which uses multiscale multiple storm-following moving-model domain nests, coupled with ocean/wave models. HAFS is being developed to provide an operational analysis and forecast system out to 7-day lead times for hurricane forecasters giving them reliable, robust and skillful guidance on tropical cyclone (TC) track, intensity, storm size, genesis, storm surge, rainfall, and tornadoes associated with TCs. Learn more



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Challenge: Intensity & Structure Forecasting

Multiscale nature of processes are major reason for this difficulty



- Characterizing & understanding these processes & their interactions are key steps in forecast improvement
- Airborne observations provide a unique opportunity to study these processes across scales

Courtesy Robert Rogers (AOML/HRD)

NOAA Advancing Hurricane Prediction Experiment

- Collect observations over tropical cyclone's life cycle
- Develop measurement technologies to provide improved situation awareness
- Improve understanding of processes important in intensity change

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On this page you can find detailed descriptions of the research field activities planned for the current hurricane season. The 2022 Hurricane Field Program supports NOAA's Advancing the Prediction of Hurricanes Experiment (APHEX). This page is organized by projects that support research of the lifecycle stages of storms, from genesis to end stage, as well as ocean observations and satellite validation.

About APHEX: Developed in partnership with NOAA's Environmental Modeling Center, National Hurricane Center, Aircraft Operations Center, and AOML's Physical Oceanography Division, APHEX is intended to improve our understanding and prediction of hurricane track, intensity, structure, and associated hazards by collecting observations that will aid in the improvement of current operational hurricane models, such as the Hurricane Weather Research and Forecasting model, and the development of the next-generation operational hurricane models.

https://www.aoml.noaa.gov/2022-hurricane-field-program/

NOAA Hurricane Hunters

https://www.omao.noaa.gov/learn/aircraft-operations

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Advance Hurricane Forecast Guidance: HWRF -> HAFS

Hurricane Ida (09L) 00 UTC 27 August 2021

HAFS: Moving Nests in Global FV3

Courtesy Bill Ramstrom (AOML/HRD)

Improve understanding of intensity change

- Characterizing Inner-core Structure & Intensity Change
- Intensity Change in Vertical Wind Shear
- Boundary Layer Processes & Air-sea Interactions
- Secondary Eyewall Formation & Replacement Cycles
- Genesis & Development of weak systems
 - Most recent research focused on structures associated with intensity change processes
 - Research used tail Doppler radar & GPS dropsonde data
 - Both composite (multi-case) & case study frameworks
 - Composites provide robustness
 - Case studies can provide temporal evolution

Characterize, Understand, & Predict Processes Important to TC Landfall Impacts

Hurricane Ida 29 August 2021

Courtesy Forrest Masters (UF), Mike Biggerstaff (OU) & Digital Hurricane Consortium

Emerging Research Theme

Coordination of observing systems to improve hurricane preparedness Drones Saildrones Dropsondes Drifters Floats Gliders Captured by SD 1045's onboard camera during SALDRONE Category 4 Hurricane Sam, Sept. 30 2021 NORA

2/27/2023 - Marks

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Emerging Research Theme Improve representation of TC structure in AWIPS

TDR tilt analysis using streamlines in AWIPS-II during Hurricane Lisa 1 November 2022

Wave height data in AWIPS-II during Hurricane Lisa 1 November 2022

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Emerging Research Theme

Address Hurricane Forecast Guidance Uncertainty: Ensembles

Emerging Research Theme

Improve forecast communication of hazards: Link SBES & Physical Science

Forecasting A Continuum of Environmental Threats (FACETs)

https://wpo.noaa.gov/Programs/FACETs

https://sites.google.com/a/noaa.gov/tropical-roadmap/home?authuser=0

Courtesy Jessica Schauer (NWS)

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Questions?

frank.marks@noaa.gov http://www.hfip.org https://noaahrd.wordpress.com/ https://www.aoml.noaa.gov/hurricane-research-division/ REDDIT AMA Hurricanes FAQ Data a

