

The Hurricane Forecast Improvement Program NOAA's Atlantic Oceanographic and Meteorological Laboratory

Hurricanes are the Most Deadly Billion-Dollar Climate Disaster in the U.S.

US states and territories impacted by hurricanes represent half the U.S. population¹. Expected annual economic losses from damage caused by hurricanes affect each part of our society—\$34 billion in losses to households, \$9 billion to commercial businesses, and \$12 billion to the public sector with more fatalities than any other single category of billion-dollar weather and climate disaster². Scientists have detected a statistically significant trend of more severe hurricanes and have observed an accelerating rate of sea level rise, which is the baseline for destructive storm surge³.

¹ Estimated July 1, 2019 population totals from <https://www.census.gov/quickfacts/fact/map/US/PST045219>. Hurricane impacted states and territories here include: PR, TX, LA, MS, AL, FL, GA, SC, NC, VA, MD, DE, PA, NJ, NY, CT, RI, MA, VT, NH, ME, HI.

² Hall, K. (2019). Expected Costs of Damage from Hurricane Winds and Storm-Related Flooding. Congressional Budget Office: Washington, DC, USA, 1-48.

³ Kopp, R. E. (2020). Sea Level Rise, 1970–2070: A View from the Future. Earth 2020: An Insider's Guide to a Rapidly Changing Planet.

Sweet, W. V., R. Horton, R.E. Kopp, A.N. LeGrande, and A. Romanou (2017). Sea level rise. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I. Ed. by D. J. Wuebbles, D.

The Hurricane Forecast Improvement Program (HFIP) began in 2009 and was updated in 2019 in response to The Weather Research and Forecasting Innovation Act of 2017. It aims to improve hurricane forecast accuracy, lead time, and risk communication. Forecasting has already advanced under HFIP, with 25% improvements for track, intensity, and rapid intensification relative to the original HFIP baselines.

Intense Tropical Cyclones are Dangerous, Expensive, and Increasing



6,500 DEATHS
Hurricane-related
fatalities since 1980.



\$54 BILLION
Expected annual
hurricane losses.

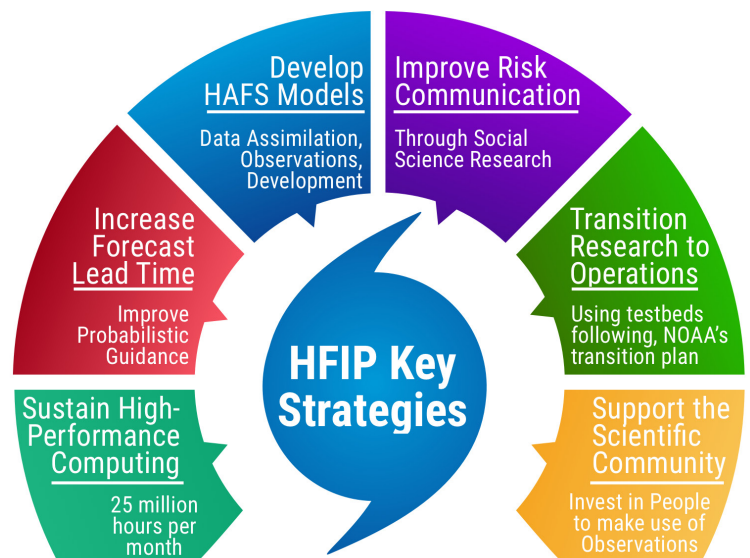


+8% INCREASE
Per-decade increase
in hurricane intensity.

The Hurricane Forecast Improvement Program Advances Forecasting with Key Strategies

The Hurricane Forecast Improvement Program is designed to accelerate the development and implementation of innovative new technologies and techniques from the research community into operations with six key strategies to improve forecasts:

1. Advance the operational Hurricane Analysis and Forecast System (HAFS) model
2. Improve probabilistic guidance
3. Enhance communication of risk and uncertainty
4. Increase High Performance Computing Allocation
5. Research to Operations enhancements
6. Broaden expertise and expand interaction with external community



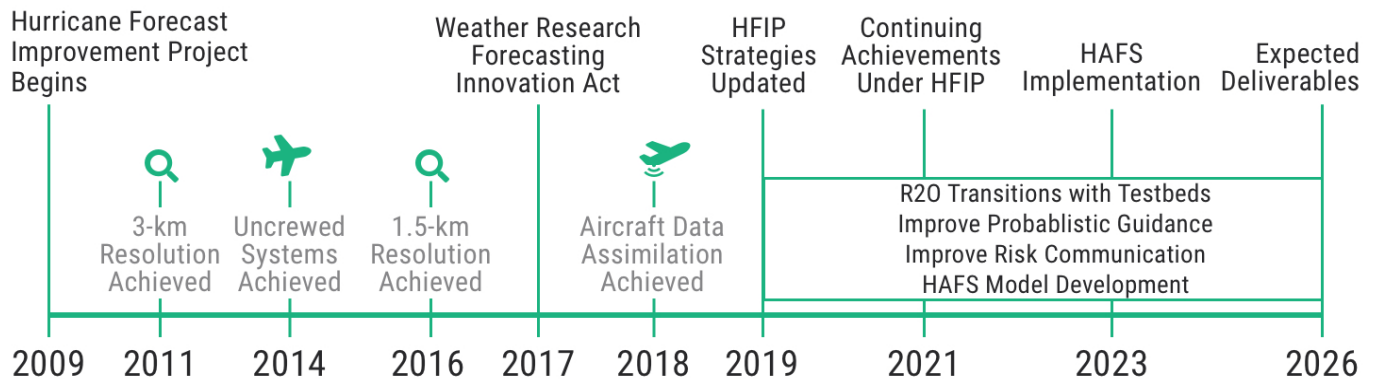
Primary Deliverables of the Hurricane Forecast Improvement Program

The Hurricane Forecast Improvement Program prioritizes several actions that will enable researchers to meet the key strategies:

- A next-generation hurricane prediction system, i.e., the Hurricane Analysis and Forecast System (HAFS), that will use the Unified Forecast System's FV3 dynamical core. This enhancement will provide updated track, intensity, and storm structure guidance up to 7 days.
- An analysis system that incorporates data assimilation advancements using improved observations from both satellite and aircraft to provide better initial conditions and situational awareness for the HAFS model.
- A HAFS ensemble that provides probabilistic guidance to quantify the risk and uncertainty for track, intensity, and storm size, as well as the timing and location of pre-formation disturbances. The ensemble will also

provide quantitative precipitation data from landfalling hurricanes in collaboration with NOAA's Water Initiative and the Consumer Option for an Alternative System to Allocate Losses (COASTAL) Act, as well as tornado information from landfalling hurricanes in collaboration with the Tornado Warning Improvement and Extension Program (TWIEP).

- Improved National Weather Service tropical products that incorporate social and behavioral science research to create a more effective hurricane hazard communication suite.
- Community involvement that augments HFIP's capacity to address physical, social, and behavioral science challenges accomplished through federal-funding opportunities with development testbeds, academic, external, and international partners.



Community Engagement and Critical Resources Provide High Return on Investment

The Hurricane Forecast Improvement Program will advance tropical cyclone forecasts using new resources, collaborations, and observations. A \$22 million-dollar investment provides a high return by providing key deliverables that, even if only 1% effective at reducing costs from landfalling hurricanes, would still provide \$500 million per year in savings. This includes savings due to more advanced planning and preparedness for emergency operations and coastal managers. NOAA found that the value provided by an accurate weather forecast is 6.2 times the cost of producing it¹. An investment in HFIP provides improved forecast guidance that could further save lives and reduce property damage.

Yearly Costs (in Millions) & Deliverables

\$6 M	Advance prediction capabilities to 7 days
\$2 M	Combine social-behavioral sciences to enhance warning products
\$2 M	Prioritize research targeted for operational improvements
\$3 M	Broaden community expertise to increase NOAA's R20 capacity
\$3 M	Incorporate dynamically-based uncertainty into hazard models
\$6 M	Maintain computing to support HFIP developments

¹ U.S. Department of Commerce/National Oceanic and Atmospheric Administration. (2018, June). NOAA By The Numbers: Economic Statistics Relevant to NOAA's Mission. Silver Spring, Maryland: United States.