STATEMENT FOR THE RECORD

FROM

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

FOR A HEARING BEFORE THE HOUSE SCIENCE, SPACE, AND TECHNOLOGY SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY

ON

THE NATIONAL WINDSTORM IMPACT REDUCTION PROGRAM

NOVEMBER 10, 2021

Thank you for the opportunity to provide the National Oceanic and Atmospheric Administration's (NOAA) updates on the National Windstorm Impact Reduction Program (NWIRP). NWIRP is a science- and engineering-based program whose stated mission is to achieve major measurable reductions in losses of life and property from windstorms, through a coordinated federal effort in cooperation with other levels of government, academia, and the private sector. NOAA collaborates with three other designated NWIRP agencies- the National Institute of Standards and Technology (NIST), the National Science Foundation (NSF), and the Federal Emergency Management Agency (FEMA). Over the last 40 years, windstorms have caused over $1 trillion in economic losses and over 8,000 fatalities in the United States. The vast majority of these losses have occurred during the last two decades and climate change will continue to increase the frequency and severity of destructive windstorms. In light of this growing challenge, NWIRP agencies have made significant progress during this time of unprecedented increases in the occurrence and intensity of extreme weather and concomitant societal impacts. Highlights of this progress across the participating agencies include significant improvements in hurricane forecasts and increased tornado warning lead times, advancements in the science of wind mapping to inform engineering-based design standards, improved coordination practices and increased resources for scientific research in support of post-windstorm investigations. Furthermore, the NWIRP efforts have also resulted in the implementation of post-windstorm research-based recommendations into codes and standards for development processes such as provisions for windstorm resistant construction, a new storm shelter standard, and proposed inclusion of tornado wind loading factors for structural design.[1]

NOAA's NWIRP-supporting efforts benefit from a one-NOAA approach, with various line offices collaborating across research, operations, observations, data, and transition activities. Notable recent efforts are illustrated in this statement, but are not exhaustive. NOAA contributes to interagency collaboration via the NWIRP program and also through the recently-formed Interagency Council for Advancing Meteorological Services (ICAMS), co-chaired by NOAA and the White House Office of Science and Technology Policy. NOAA also bolsters its NWIRP-related science through collaboration with external community, through the Earth Prediction Innovation Center (EPIC) and other programs. Here we outline NOAA's accomplishments and support for NWIRP over the last several years and how NOAA is incorporating storm surge and climate modeling and forecasting into NWIRP efforts.

NOAA Accomplishments and Advances supporting NWIRP Objectives

[1] National Windstorm Impact Reduction Program Biennial Progress Report to Congress for Fiscal Years 2019 and 2020 (report pending)

New Observing Technologies. New observing technologies such as uncrewed aerial systems that gather data in the lower atmosphere and the Doppler wind lidar, which provides the capability to sample winds in precipitation-free regions that radars cannot measure, were tested and demonstrated as a part of NOAA's Intensity Forecasting Experiment (IFEX) in FY 2019. Due to the global pandemic, NOAA was unable to continue testing these technologies in FY 2020. NOAA's Office of Oceanic and Atmospheric Research (OAR) National Severe Storms Laboratory (NSSL) is demonstrating the capabilities of the Phased Array Radar (PAR) to aid the National Weather Service (NWS) in the forecast and warning decision process by providing new radar data more quickly. The last few years of research and development have been focused on the installation, calibration, and initial data collection using the Advanced Technology Demonstrator, and a full-scale demonstration radar capable of assessing the ability of phased array technology to address the operational meteorological requirements of the NWS.

Intensity Forecasting Experiment. NOAA's OAR Hurricane Research Division continues to improve hurricane-intensity forecasting through the IFEX. In FY 2019, the focus was on sampling storms that underwent rapid intensification as this was a NWS National Hurricane Center (NHC) science priority. FY 2020 proved to be a hyperactive hurricane season where NOAA aircraft sampled a record number of 13 storms of the 29 that season.

State of Florida Public Hurricane Loss Model.[2] NOAA continues to work on the State of Florida Public Hurricane Loss Model **(**FPHLM), an open, transparent computer model that is used by the Florida Office of Insurance Regulation to provide a baseline for evaluating rate change requests for windstorm insurance. Researchers at NOAA's OAR Atlantic Oceanographic and Meteorological Laboratory (AOML) and the Cooperative Institute for Marine and Atmospheric Studies partnered with Florida International University researchers to update and maintain the wind model. Analyses of Hurricanes Isaias and Sally that affected Florida are underway.

Forecast Improvement Programs.

- Three new projects are being conducted at the Joint Hurricane Testbed (JHT) – a NOAA testbed jointly managed by the NHC and AOML that tests new techniques, applications, and ensemble model enhancements to improve the analysis and prediction of tropical cyclones. The current projects focus on improvements to tropical cyclone genesis forecasts, observational targeting based on ensemble forecasts, and model upgrades for short-term tropical cyclone intensity forecasts.
- Scientists at the NOAA OAR Global Systems Laboratory (GSL) have developed a radar-initialized, thunderstorm-resolving, high-resolution, hourly-updating assimilation and modeling system through the High Resolution Rapid Refresh model. The operational version of HRRR (Version 3), implemented in July of 2018, included improved simulation of convective storms and clouds, reduced high bias for precipitation in both warm and cold seasons, improved 2-meter temperatures including over snow cover, extended length to 36 hours four times per day, and coverage over Alaska. More recently, Version 4 of HRRR was implemented in December of 2020. This newest version makes more use of ensemble modeling methods and includes many improvements to model physics.
- The StormReady Program, which celebrated its 20th anniversary in 2018, supports a Weather-Ready Nation[3] by preparing communities for the occurrence of high impact environmental events. Each year, the NWS targets 100 new StormReady communities, pending funding availability. In FY 2020 NOAA recognized 106 new StormReady communities.
- NSSL continues extensive work within NOAA testbeds and with operational units to evaluate an experimental Warn on Forecast methodology, allowing forecasters to use thunderstorm-resolving

[2] https://fphlm.cs.fiu.edu/.

[3] Weather-Ready Nation - https://www.weather.gov/wrn/

computer models.

- NOAA continues to develop a next generation hazardous weather forecast/warning paradigm called Forecasting a Continuum of Environmental Threats (FACETs), which will provide users a continuously updating suite of probabilistic information about hazardous weather threats.
- NOAA continues to develop the Unified Forecast System (UFS), which is a community-based, coupled comprehensive Earth system modeling system. The UFS numerical applications span local to global domains and predictive time scales from sub-hourly analyses to seasonal predictions. It is designed to support the Weather Enterprise and to be the source system for NOAA's operational numerical weather prediction applications. Through the UFS, NOAA can leverage external expertise to improve our forecasts.
- The Hurricane Forecast Improvement Program (HFIP) major development focus in 2019 was on building the next generation hurricane model - Hurricane Analysis and Forecast System (HAFS), primarily for track and intensity predictions. HAFS aims to provide reliable and skillful guidance on tropical cyclone track, intensity, and structure, including rapid intensity changes, genesis, and storm size. One recent HAFS development announced in February 2021 was the advancement of the model dynamical core to include high-resolution moving nests, which enables scientists to track the inner core region of tropical cyclones at 1-2 km resolution. This advancement lays the foundation for next generation advancements in hurricane forecasting.
- In April 2021, NOAA awarded a $45 million contract to Raytheon Technologies' intelligence and space business to design and establish the EPIC that will facilitate collaboration among government, academia and industry stakeholders for accelerated research and innovation in Earth modeling to improve weather forecasting. NOAA's EPIC will advance weather modeling skill, reclaiming and maintaining international leadership in the area of Numerical Weather Prediction, and improving Research to Operations by:
    - Leveraging the weather enterprise to provide expertise on removing barriers to improving Numerical Weather Prediction (NWP), with focus on the Unified Forecast System, NOAA's primary, community modeling architecture;
    - Enabling scientists and engineers to effectively collaborate in areas important for improving operational global NWP skill, including model development, data assimilation techniques, system architecture integration, and computational efficiencies;
    - Strengthening NOAA's ability to undertake research projects in pursuit of substantial advancements in weather forecast skill;
    - Utilizing and leveraging existing resources across NOAA's enterprise; and
    - Creating a community global weather research modeling system.
- The Consumer Option for an Alternative System to Allocate Losses (COASTAL Act, PL 112-141) requires NOAA to produce detailed post-storm assessments in the aftermath of a damaging tropical cyclone that strikes the U.S. or its territories. Using output from a hindcast model (termed the "Named Storm Event Model" by the Act), the assessments will indicate the strength and timing of damaging winds and water at a given location in the area impacted by the tropical cyclone. If the assessment results for the location of a total-loss property can be certified by NOAA as being greater than 90 percent accurate, those results will be input into a FEMA-managed formula that considers a variety of factors that may have contributed to structural damage. Based on this formula, FEMA will determine the appropriate loss allocation between wind and water. The Act further requires NOAA to create a "Coastal Wind and Water Event Database" (CWWED) to provide the public access to covered data (the observations collected during the storm to assist with the assessment). The CWWED will serve as the portal through which the gridded post-storm assessment results and metadata will also be accessed by the public
- Additionally NWIRP agencies are looking into derechos as a potential area of interest. A derecho is a fast-moving, violent wind event associated with a thunderstorm complex that produces continuous or intermittent damage along a path at least 60 miles wide and 400 miles long. Most recently, a derecho slammed into the Midwest on August 10, 2021, causing four deaths and over

$11.7 billion worth of damage.

Incorporating storm surge and its impact into NWIRP efforts

While storm surge is not presently part of NOAA's direction in the NWIRP statute, the NWIRP interagency program has begun to address coordinating on storm surge efforts. NOAA contributes to NWIRP-relevant storm surge efforts through the provision of real-time storm surge products, including the Potential Storm Surge Flooding Map and the Storm Surge Watch/Warning. These products first become available 48 hours prior to the onset of storm surge or tropical-storm-force winds (whichever is expected to occur first) for the U.S. East and Gulf Coasts. The Storm Surge Watch/Warning is also issued for Puerto Rico and the U.S. Virgin Islands. NOAA is working to improve guidance on storm size that is expected to translate to improvements in storm surge forecasting to an actionable lead time of up to three days. NOAA is also working to expand real-time tropical cyclone storm surge forecasting capabilities to the Pacific to increase consistency in the products and services available for areas of NWS responsibility.

Incorporating climate modeling and forecasting into NWIRP efforts

- Since 2012 the NWS Storm Prediction Center, in collaboration with the NWS Climate Prediction Center, NOAA OAR/NSSL, NOAA's Cooperative Institutes, and academia is improving the understanding of the links between large-scale climate variability and windstorm and tornado activity. Studies of 40 years of high-resolution reanalyses[4] show that stronger convective inhibition has caused a decline in the frequency of thunderstorm environments over the southern U.S., particularly in summer. Conversely, increasingly favorable conditions for tornadoes have been observed during winter across the Southeast. NOAA research campaigns continue to investigate these phenomena.
- NWS Climate Services Program provides timely and reliable climate information, including observations and data stewardship, operational climate predictions, real-time climate monitoring and assessments, and decision-support resources at global, national, regional, state and local scales. The Climate Services Program can support NWIRP in response planning pertaining to impactful wind events through:
    - The Climate Prediction Center uses state-of-the-art models and associated retrospectives to develop probabilistic, reliable forecasts of hazardous winds during the Week-2 (two week ahead forecast) period.
    - The Climate Prediction Center's Global Tropics Hazards Outlook currently provides outlooks for tropical cyclone formation during the next two weeks. Extension of this product into the Week-3 (three weeks ahead forecast) period is currently being tested.

NWIRP Budget [1]

NOAA Contributions to National Windstorm Impact Reduction Program (NWIRP) Activities	FY 2019 Actuals ($K)	FY 2020 Enacted ($K)	FY 2021 Request ($K)	FY 2021 Actuals ($K)
NOAA*	16,964	16,848	16,309	17,992

*NOAA totals are not reflective of hurricane supplemental funds; NOAA does not receive direct appropriations for the program; all numbers reported in the coordinated budget reflect otherwise funded activities that agencies have determined contribute to meeting NWIRP strategic objectives.

[4] https://journals.ametsoc.org/view/journals/bams/102/2/BAMS-D-20-0004.1.xml