U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HEARING CHARTER

Weathering the Storm: Reauthorizing the National Windstorm Impact Reduction Program

Wednesday, November 10, 2021
10:00 a.m. – 12:00 p.m.
Zoom

PURPOSE

The purpose of this hearing is to review the activities of the National Windstorm Impact Reduction Program (NWIRP), including the importance of interagency collaboration. The Subcommittee will also consider new and evolving challenges to improved windstorm and windstorm impact resilience, and opportunities to improve the Program.

WITNESSES

- **Dr. Scott Weaver**, Director, National Windstorm Impact Reduction Program, National Institute of Standards and Technology
- **Dr. Linda Blevins**, Deputy Assistant Director, Directorate for Engineering, National Science Foundation
- **Mr. Michael Grimm**, Assistant Administrator for Risk Management, Federal Emergency Management Agency

KEY QUESTIONS

- How has NWIRP improved the understanding of windstorms and windstorm impacts, and increased resilience to windstorms?
- How does the collaboration between the NWIRP Program agencies help advance the goals of the Program?
- What are the additional needs in research, workforce, and research infrastructure for improved windstorm and windstorm impact resilience?
- What are the new and evolving challenges to improving windstorm resilience and how can NWIRP address those challenges? In particular, how can future risk to infrastructure from climate change be incorporated into current activities under NWIRP?
- What updates are needed to the existing NWIRP authorization to enable the Program to fully address any gaps and emerging challenges?

BACKGROUND

All 50 states and many U.S. territories are exposed to windstorms, including tornadoes, tropical cyclones, thunderstorms, and winter storms. In the last 40 years, windstorms and their associated flooding have caused over $1 trillion in economic losses and over 8,000 fatalities,[1] making them the largest loss-producing natural hazard in the United States.[2] Severe windstorms can disrupt supply chains; two of the largest ports by tonnage in the U.S., Houston and New Orleans, are both located in high hurricane hazard areas.[3] In addition to the supply chain disruptions, severe windstorms can pose a national security threat when they damage critical infrastructure such as communication and power grids, transportation, critical manufacturing, and defense and nuclear facilities.[4] Windstorms are increasing in frequency and intensity, causing greater economic damage. 2020 set a new record with 22 billion-dollar weather and climate disasters, more than half of which were windstorm-related, costing $95 billion and resulting in 262 fatalities.[5] The 2020 hurricane season was historically active with the 21-name Atlantic hurricane list being fully used and the Greek alphabet being used for the second time in history for nine more hurricanes.[6] Storm surge and wind-driven rain flooding are also becoming widespread with one recent example being the flooding in both the Southeast and Northeast from Hurricane Ida. According to the Congressional Budget Office, costs associated with hurricanes are projected to increase from 0.16% of GDP to 0.22% of GDP by 2075.[7] The COVID-19 pandemic has exacerbated the challenges of adequately planning for and sheltering from severe windstorms and hampered the relief and recovery efforts after storms.

CLIMATE CHANGE AND WINDSTORMS

Human-induced climate change is causing certain weather and climate extremes to increase in frequency and intensity across the U.S. and globe,[8] with windstorm phenomena affected in different ways and to different extents. Scientists have established the link between climate change and hurricane intensity, due to warmer oceans supercharging hurricanes.[9,10] It is less clear whether climate change could lead to an increase in the number of hurricanes.[11] 2020 saw a record number of Atlantic hurricanes impacting the Southeastern U.S., as well as more storms that intensified rapidly like Hurricane Laura. Climate change may also increase the likelihood of more frequent and intense derechos, or extreme wind events, as a result of increasing

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[1] https://www.ncdc.noaa.gov/billions/events
[2] https://www.nist.gov/system/files/documents/2018/09/24/nwirp_strategic_plan.pdf
[3] https://www.nist.gov/system/files/documents/2018/09/24/nwirp_strategic_plan.pdf
[4] https://www.nist.gov/system/files/documents/2018/09/24/nwirp_strategic_plan.pdf
[5] https://coast.noaa.gov/states/fast-facts/hurricane-costs.html
[6] https://coast.noaa.gov/states/fast-facts/hurricane-costs.html
[7] https://www.cbo.gov/publication/51518
[8] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf
[9] https://www.noaa.gov/media-release/record-breaking-atlantic-hurricane-season-draws-to-end#:~:text=In%20total%2C%20the%202020%20season,of%20111%20mph%20or%20greater).
[10] Kossin, J.P., et al. 2020. "Global increase in major tropical cyclone exceedance probability over the past four decades." PNAS. DOI: https://doi.org/10.1073/pnas.1920849117
[11] https://www.c2es.org/content/hurricanes-and-climate-change/

atmospheric instability. Derechos can cause devastating damage to agricultural crops, homes, property, and massive power outages.[12]

A link between climate change and tornadoes is not yet well established.[13] Tornadoes are localized events, which makes it difficult to link to global and regional climate trends. While the total annual number of tornadoes has not changed significantly over time, tornado seasons have become more variable since the 1970s, with more record-busy and record-calm months. Tornado outbreaks (periods of one to several days with at least six closely spaced EF1+ tornadoes) have become more frequent as well. Few studies have examined how tornadic thunderstorms might behave in warmer temperatures in the future; one challenge is that tornadoes are too small to be directly simulated in models.[14]

Building climate-resilient infrastructure that can withstand increasing intensity and frequency of certain extreme events is becoming increasingly important. NWIRP can play an important role in developing climate-resilient buildings and communities by integrating climate science and modeling into existing NWIRP activities.

NATIONAL WINDSTORM IMPACT REDUCTION PROGRAM

The National Windstorm Impact Reduction Program (NWIRP) was established in 2004 [P.L. 108-360].[15] The NWIRP mission is "to achieve measurable reductions in the losses of life and property through a coordinated federal effort, in cooperation with other levels of government, academia, and the private sector, aimed at improving the understanding of windstorms and their impacts and developing and encouraging the implementation of cost-effective mitigation measures to reduce those impacts."[16] The National Institute of Standards and Technology (NIST) has been designated as the lead agency for NWIRP since 2015, replacing the White House Office of Science and Technology Policy (OSTP), as part of the reauthorization of NWIRP through the *National Windstorm Impact Reduction Act Reauthorization of 2015* [P.L. 114-52].[17] The authorization for NWIRP expired in 2017.

There are four program agencies under NWIRP: NIST, the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), and the Federal Emergency Management Agency (FEMA). Research and development activities conducted by the Program fall under three primary components: improved understanding of windstorms; windstorm impact assessment; and windstorm impact reduction. The 2015 reauthorization of the Program established an Interagency Coordinating Committee (ICC) to oversee the planning and coordination of the Program. The ICC is chaired by the Director of NIST and consists of the agency heads of the other three Program agencies, the Office of Management and Budget (OMB)

[12] https://www.sciencenews.org/article/2020-extreme-weather-climate-change-hurricane-derecho-wildfire
[13] https://www.c2es.org/content/tornadoes-and-climate-change/
[14] https://yaleclimateconnections.org/2021/07/climate-change-and-tornadoes-any-connection/
[15] https://www.govinfo.gov/content/pkg/PLAW-108publ360/html/PLAW-108publ360.htm
[16] https://www.nist.gov/el/materials-and-structural-systems-division-73100/national-windstorm-impact-reduction-program-4
[17] https://www.congress.gov/114/plaws/publ52/PLAW-114publ52.pdf

as well as other appropriate federal agencies. Congress also requires the ICC to develop a strategic plan for the Program as well as a coordinated budget for the Program. The four Program agencies carry out research, development, and dissemination activities in support of the Program goals, however, NWIRP does not appear as a line item in the agencies' budgets. The 2015 reauthorization authorized $21.4 million total across the four Program agencies for each of Fiscal Years 2015-2017.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

NIST has two sets of responsibilities as part of NWIRP; the first of these pertain to its status as the lead agency for the Program. As lead agency, NIST has the primary responsibility for planning and coordinating the Program. In carrying out these responsibilities, NIST is responsible for ensuring the program includes the necessary components to promote the implementation of windstorm risk reduction measures; supporting the development of performance-based engineering tools and the commercial application of such tools; requesting the assistance of Federal agencies other than Program agencies as needed; coordinating all Federal post-windstorm investigations; and issuing recommendations to assist in the development of model codes.

In addition to NIST's responsibilities as the lead agency for NWIRP, NIST carries out research in engineering and atmospheric sciences to improve the understanding of the behavior of windstorms and their impact on buildings, structures, and lifelines. NIST also conducts research on economic and social factors influencing windstorm risk reduction measures. The 2015 reauthorization of the Program authorized $4.12 million for each of Fiscal Years 2015-2017 for NIST. In Fiscal Years 2019 and 2020, NIST spent $5.595 million and $5.32 million, respectively. The spending in these two fiscal years includes an allocation to support NIST's investigation on the impact of Hurricane Maria on Puerto Rico. The focus of the investigation is on the performance of critical buildings, electrical and water infrastructure, and emergency communications.[18]

NATIONAL SCIENCE FOUNDATION

The National Science Foundation supports fundamental research in support of NWIRP's three primary components. NSF also supports windstorm research through its National Hazards Engineering and Research Infrastructure (NHERI) program that provides the natural hazards engineering community with access to research infrastructure, including wind engineering experimental facilities, cyberinfrastructure, computational modeling and simulation tools, and research data. There are currently seven NHERI facilities in the U.S., including the Wall of Wind located at Florida International University, the Large Wave Flume and Directional Wave Basin located at Oregon State University, and the Boundary Layer Wind Tunnel located the University of Florida. Congress appropriated $9.682 million for each of Fiscal Years 2015-2017 for NSF to

[18] https://www.nist.gov/news-events/news/2018/05/nist-launches-study-hurricane-marias-impact-puerto-rico

carry out activities under NWIRP. In Fiscal Years 2020 and 2021, NSF spent $37.296 and $41.181 million, respectively.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Under NWIRP, NOAA supports atmospheric science research to improve the understanding of the behavior of windstorms. NOAA conducts windstorm-related research to help improve wind-related forecasts and warnings, with a focus on improving research to operations integration. NOAA has several activities at the National Weather Service (NWS) and the Office of Oceanic and Atmospheric Research (OAR) that contribute to the goals of NWIRP. These research and operational activities largely fall into two categories: hurricanes and local severe weather. Current hurricane-related activities at NOAA that support the goals of NWIRP include the Hurricane Forecast Improvement Program[19] and the operation of both the National Hurricane Center's (NHC) Joint Hurricane Testbed[20] and the Atlantic Oceanographic Meteorological Laboratory's Hurricane Research Division.[21] NOAA's severe weather (tornadoes, derechos, and severe thunderstorms) activities that support NWIRP include improving hazardous weather and aviation weather forecasts through the continued development of "Warn-on-Forecast" to increase forecast lead times for severe weather events,[22] operation of the Storm Prediction Center[23] and its Hazardous Weather Testbed,[24] and the National Severe Storms Laboratory's (NSSL) Tornado and Severe Weather Research.[25] NOAA's Global Systems Laboratory conducts research and develops technologies such as the High-Resolution Rapid Refresh (HRRR) forecasts[26], Advanced Weather Interactive Processing System (AWIPS) Hazard Services[27], atmospheric science for renewable energy development, and aviation tools and products.

Windstorms are often associated with flooding, whether inland due to heavy precipitation, or along the coastlines, primarily due to storm surge. NOAA conducts flood research, monitoring, forecasting, and communication. Storm surge, which is caused primarily by onshore winds associated with a storm, is often the greatest threat to life and property along the coast from a hurricane. NHC utilizes the hydrodynamic Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model to forecast storm surge and model storm surge vulnerability.[28] NHC's Storm Surge Unit also performs post-storm analyses, storm surge model verification, and conducts education and outreach to alert the public of the dangers of storm surge.[29] For inland flooding, NWS's River Forecast Centers issue flood forecasts for some streams and rivers.[30] NSSL

[19] https://hfip.org/
[20] https://www.nhc.noaa.gov/jht/
[21] https://www.aoml.noaa.gov/hurricane-research-division/
[22] https://www.nssl.noaa.gov/projects/wof/
[23] https://www.spc.noaa.gov/
[24] https://hwt.nssl.noaa.gov/
[25] https://www.nssl.noaa.gov/
[26] https://rapidrefresh.noaa.gov/hrrr/
[27] https://esrl.noaa.gov/gsd/eds/hazardservices/
[28] https://www.nhc.noaa.gov/surge/slosh.php
[29] https://www.nhc.noaa.gov/surge/ssu.php
[30] https://www.drought.gov/data-maps-tools/national-weather-service-river-forecast-centers

conducts research and development to improve the science and forecasting behind heavy rainfall and flash flooding.[31]

NOAA also conducts and utilizes social and behavioral science to improve the delivery of its forecasts. NSSL is working to integrate the social/behavioral/economic sciences with physical sciences to modernize its forecast and warning process through Forecasting a Continuum of Environmental Threats (FACETs). FACETs will produce continuous high-resolution environmental hazard information to enable better decision making and communication of hazards.[32]

While NOAA does not have a specific NWIRP appropriation or budget line, NOAA is authorized for activities that support NWIRP as previously described. Congress authorized $2.266 million to be appropriated to NOAA for each of fiscal years 2015 through 2017 to carry out NWIRP activities. In FY 2019 and FY 2020, NOAA spent approximately $16.9 million in support of the NWIRP-related activities listed above, not including hurricane supplemental funds. NOAA's FY 2021 request is $16.309 million for NWIRP-related activities.

FEDERAL EMERGENCY MANAGEMENT AGENCY

As part of its activities under NWIRP, FEMA is tasked with supporting 1.) the development of risk assessment tools and effective mitigation techniques; 2.) windstorm-related data collection and analysis; 3.) public outreach and information dissemination; and 4.) promotion of windstorm preparedness and mitigation measures. FEMA's Hazus program provides standardized tools for estimating risk, including from windstorms. Hazus can help quantify and map risk information such as physical damage, economic loss, social impacts, and cost-effectiveness of common mitigation strategies.[33] As part of NWIRP, FEMA also works closely with national standards and model building code organizations, in conjunction with NIST, to promote better building practices within the building design and construction industry. Congress authorized $2.26 million to be appropriated for each of Fiscal Years 2015-2017 to FEMA for activities carried out under NWIRP. FEMA spent $435,000 and $450,000 on NWIRP activities for Fiscal Years 2019 and 2020, respectively. The agency is still compiling spending information for Fiscal Year 2021.

ADVISORY COMMITTEE RECOMMENDATIONS

As part of the reauthorization of NWIRP in 2015, NIST was directed to establish an Advisory Committee on Windstorm Impact Reduction (ACWIR) with representatives from research and academic institutions, industry standards development organizations, emergency management agencies, state and local government, and business communities, including the insurance industry. The ACWIR report was issued in 2017 and made recommendations for the program,[34] including:

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[31] https://www.nssl.noaa.gov/research/flood/
[32] https://www.nssl.noaa.gov/projects/facets/
[33] https://www.fema.gov/flood-maps/tools-resources/flood-map-products/hazus/about
[34] https://www.nist.gov/system/files/documents/2017/10/12/nacwir_assessments_and_recommendations_for_nwirp.pdf

1.) *Place a greater emphasis on developing tools for evaluating the windstorm resistance of existing buildings and other infrastructure and for providing practical cost-effective guidance on retrofitting these buildings and other infrastructure to improve their windstorm resilience;*
2.) *Conduct and promote social science research that provides a greater understanding of the portfolio of public policy approaches for promoting windstorm mitigation; and*
3.) *Expand to consider all effects of land falling hurricanes, including water intrusion and water induced forces from waves, surge, and flooding, including rainfall related flooding, near the coast.*