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Environment Subcommittee of the
Committee on Science, Space, and Technology
United States House of Representatives

The Future of Forecasting: Building a Stronger U.S. Weather Enterprise
May 16, 2019

Introduction

It is our honor to testify before you today on the current status of and future opportunities for U.S. weather forecasting capabilities. The Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) welcomes the opportunity to discuss this important topic. As a mission-driven, operational agency, NOAA's work spans observations and research to the delivery of critical forecasting products and services. NOAA's National Weather Service (NWS) works with NOAA's other line offices to realize our mission and implement the Weather Research and Forecasting Innovation Act of 2017 (Weather Act, Public Law 115-25), as passed by Congress in 2017 and reauthorized in part by Public Law 115-423 late last year.

NOAA is entrusted with the responsibility to provide environmental information and forecasts to the public, businesses, and governments to enable informed decisions on a range of issues and scales—local to global and short-term to long-term. The NWS provides a suite of products and services to the public, including the reliable and timely delivery of public weather and water forecasts and warnings. To do so, we work closely with the larger community of federal, state, local, tribal, and territorial emergency management officials, other federal agencies, the larger academic and research communities, and the commercial weather sector to deliver the best possible information. Put simply, NWS provides critical information that saves lives and property and enhances our national economy.

Evolving to Build a Weather-Ready Nation

The Department, NOAA, and NWS are strongly committed to ensuring that the United States is a Weather-Ready Nation[1] (WRN) in the face of threats related to extreme events. In 2010, Congress recognized that NWS' current operations were based on tools, workflows, and structures that are not designed to meet today's demands. Seeing the need for NWS to change, Congress directed that two studies be conducted.[2] The first examined the NWS Modernization and Restructuring of the 1990s as a background for moving forward and addressed "lessons learned to support future improvements to NWS capabilities." The follow-on study was directed by Congress in 2012 to focus on NWS operations and addressing user needs. The studies, completed in 2012 and 2013, reaffirmed NOAA's Weather-Ready Nation concept.

In response to these studies, NWS restructured its budget and headquarters to better align resources to function, enhance transparency, and link programmatic management structure to performance outcomes. This portfolio-based structure now reflects our core competencies – observations; central processing; analytics, forecast and support; dissemination; science and technology infusion; and facilities. Based on recommendations from the above Congressional studies, the NWS also contracted with a leading management and organization consultant to perform the Operations and Workforce Analysis (or OWA, 2017)[3,4].

The OWA focused on the NWS strategic vision to provide Impact-based Decision Support Services (IDSS) to build a Weather-Ready Nation, as codified in the Weather Act, and generated findings and ideas to implement that vision. In general, the analysis noted the high level of partner support for the NWS, its products and services, and the concept of IDSS. It found the NWS professional workforce is highly skilled, trained, and motivated in their mission delivery. The OWA also highlighted the previous contention from Congressional studies that the NWS structure, workflow, and operational processes should continue to be improved.

The OWA formed the basis for our ongoing "Evolve NWS" initiatives. A subset of these OWA recommendations have been transitioned to a testing and evaluation phase, including the GS-5-12 Career Progression, Weather Balloon Auto-launchers, and the Collaborative Forecast

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[1] https://www.noaa.gov/wrn

[2] "Weather Services for the Nation: Becoming Second to None," August 2012, National Academy of Sciences (NAS), https://www.nap.edu/catalog/13429/weather-services-for-the-nation-becoming-second-to-none ; "Forecast for the Future: Assuring the Capacity of the National Weather Service" 2013, National Academy of Public Administration (NAPA), https://www.napawash.org/studies/academy-studies/forecast-for-the-future-assuring-the-capacity-of-the-national-weather-servi..

[3] https://www.weather.gov/owa-catalog

[4] Congress funded this initiative starting in Fiscal Year 2014, stating its "[support for] efforts by NWS to develop a framework for continuous improvement." Congress reiterated that support in the NWS fiscal 2016 and 2017 budgets, and codified it in the Weather Act (April 2017):SEC. 409. NATIONAL WEATHER SERVICE; OPERATIONS AND WORKFORCE ANALYSIS. The Under Secretary shall contract or continue to partner with an external organization to conduct a baseline analysis of National Weather Service operations and workforce.

Process/National Blend of Models. We have briefed Congress previously on these Evolve NWS[2] initiatives, and we look forward to continuing to provide updates to Congress.

The NWS is excited about the ideas and actions generated by the OWA that will inform our Evolve initiatives, implement the directives within the Weather Act, and improve the NWS as we connect our forecasts and warnings to decision makers at every government level and work with our partners to build a Weather-Ready Nation. The new NWS Strategic Plan[5], issued in April 2019, continues to focus on ensuring the U.S. is a Weather-Ready Nation and enabling the NWS to provide IDSS for extreme weather events. Moving forward, the NWS is committed to ensuring the NWS keeps pace with stakeholder and societal needs for forecasting that protects life and property and enhances the national economy

Improving Forecasts for Extreme Weather

In order to achieve a Weather-Ready Nation and implement the vision set forth by Congress in the Weather Act, the NWS is focused on making improvements to our science and technology, services, workforce, and partnership relations. We are working to sustain our observations database, including observations from geostationary and polar orbiting satellites. NOAA's weather satellites are critical for providing data that feeds numerical weather prediction models that must meet the increasing demands for more accurate and reliable forecasts and warnings. We are refocusing the NWS workforce to meet the needs for IDSS for our core partners in the emergency management community. We need to streamline, while ensuring the robustness of, the multiple pathways of disseminating our forecasts, watches, and warnings. We are improving an integrated weather-water approach to advance environmental predictions, especially along our coasts. We are supporting an active and engaged collaboration across the entire weather, water, and climate enterprise.

In order to advance weather forecasting, NOAA will pull from advances across all of the interdisciplinary fields of earth science, research, technology, and observations. We must leverage partnerships within government, academia, and the commercial sector, and we must actively pursue, in concert, a balanced program to advance all of the factors critical to success.

NWS strives to integrate the best advances in science and technology in order to provide the most accurate and timely forecasts possible. Much of our success comes from scientific and technological breakthroughs made by research that spans across disciplines, time, and space scales. The dynamic systems of this planet are interconnected in rich and complex ways, and success in forecast improvement comes by looking broadly across those linkages.

[5] https://www.weather.gov/news/192203-strategic-plan

Furthermore, NWS has evolved to provide more than just short-term weather forecasts and warnings. This work is focused on the IDSS concept, especially for federal, state, local, tribal, and territorial emergency managers. Our prediction capabilities are becoming a fusion point that emergency managers, broadcasters, federal agencies, and the public increasingly turn to as a trusted source that distills scientific information into a focus on weather-related impacts. This is done by embracing a number of interrelated fields of physical and social sciences, examining the atmosphere, oceans, land, ice, and space, and determining the best ways to communicate forecasts and warnings to ensure preparedness and response that can save lives and protect property. Emergency managers have told us that our forecasts have changed the way they do their work. Emergency managers are becoming more proactive and IDSS allows decision makers at all levels of government to make more informed decisions in the face of extreme events.

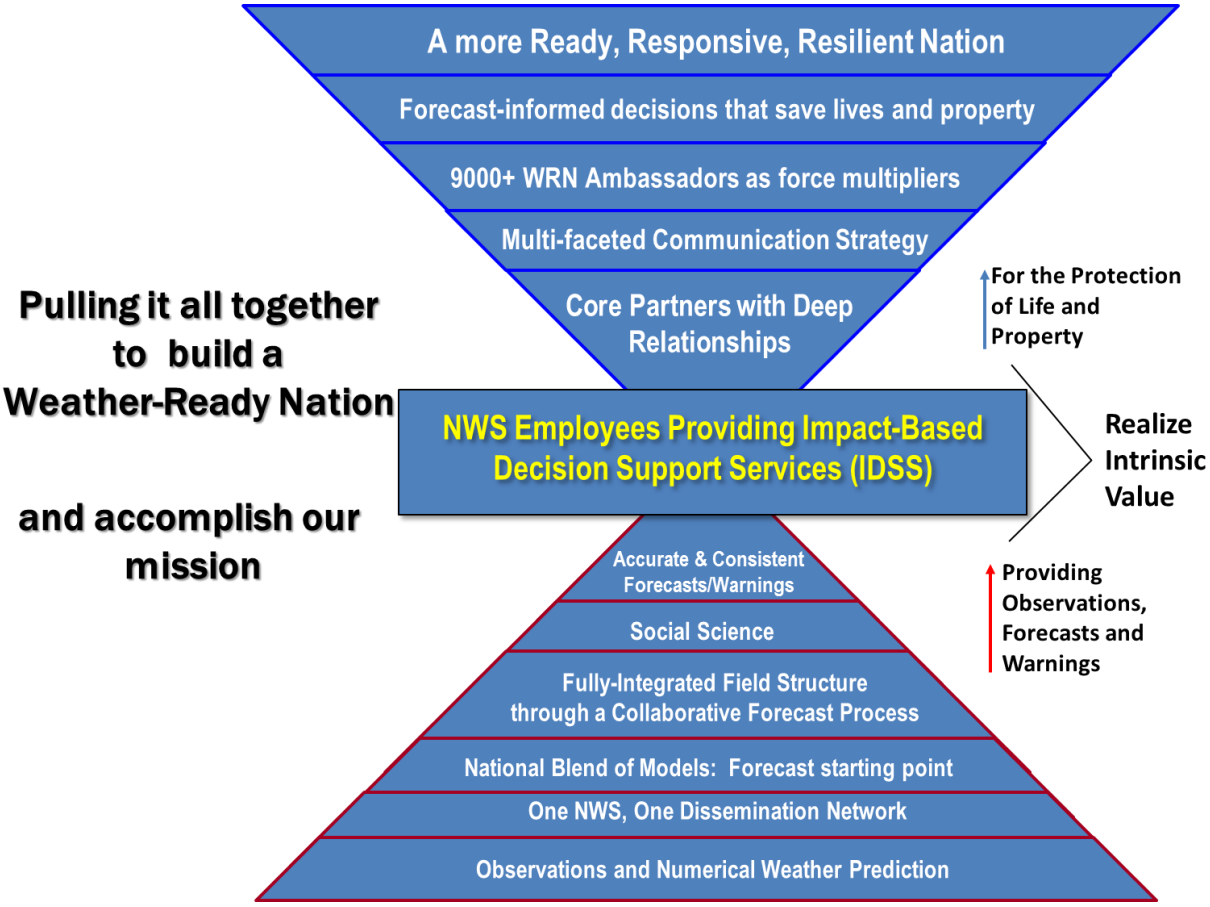
Several weather events over the past year have demonstrated the value of IDSS. In January of 2016, based on NWS forecasts and IDSS, New York City essentially closed ahead of a predicted major snowstorm. This allowed much quicker recovery efforts to bring the NYC area back to normal operations. This type of rapid recovery did not happen 10 or even 5 years ago. It's the confidence in the forecasts that are enabling these types of decisions.

We are constantly striving to better predict extreme weather events. Our forecasts of track, rainfall, and flooding for major hurricanes, Harvey, Maria, Michael, and Florence were excellent and our IDSS for the emergency managers proved critical. Hurricane Harvey was a particularly catastrophic storm for Texas. As the storm was making landfall near Corpus Christi, TX, the local fire chief was in constant dialogue with our local NWS office. There were people stranded on the barrier island. Our forecasters accurately predicted the timing of the eye's passage, allowing the fire chief to prepare and execute an evacuation. The fire chief credits the NWS decision support with saving over 200 lives. Also, for Harvey, the NWS predicted over 40 inches of rain that would cause catastrophic, record-setting flooding. Emergency managers in Houston took that extreme, unprecedented forecast to heart, making the decision to essentially close the city in advance of the heaviest rainfall.

This spring, the record floods in our Nation's heartland and northern plains were also accurately predicted by the NWS. NWS IDSS for key decision makers enabled them to make life and property saving decisions. In one example, after a meeting on March 7, 2019 the Grand Forks emergency manager immediately briefed Grand Forks city hall that he was planning to prepare for levee closures and contingencies for up to and including a Flood of Record based on NWS probabilistic outlooks updated that day. The Fargo, ND Metro area leaders took initial steps on March 18 to prepare for a community-wide fight against a potential Red River flood (almost two weeks before flooding began in the Fargo area). Fargo Mayor, Tim Mahoney, declared a state of

emergency[6] that day to initiate essential flood-fighting efforts as the city prepared for a possibility of a 40.3-foot crest.

The figure below captures the whole NWS forecasting process, from observations and numerical weather prediction and culminating with the final decision making. The lynchpin is NWS IDSS:



Designing the World's Best Weather Modeling Program

The backbone of NWS forecasts and warnings are the numerical weather prediction - or computer weather models. NWS forecasts and warnings are only as good as the infrastructure supporting them—from the *in situ* and remotely-sensed observations, to the computer weather models and high-performance supercomputers on which they run, to the dissemination network, to the actual facilities themselves. All weather forecasts start with observations from around the globe: satellites, upper air (weather balloon) soundings, surface, aircraft, and others. These data, used to best-capture the current state of our environment, feed into our computer forecast

[6] https://www.valleynewslive.com/content/news/Mayor-Mahoney-declares-State-of-Emergency-sets-goal-of-one-million-sandbags-for-Flood-2019-507312361.html

models, which, using the best science and knowledge of atmospheric physics, generate "guidance" our forecasters use to issue their forecasts.

At the heart of the effort to improve this guidance is advancing NOAA's Next-Generation Global Prediction System (NGGPS). As we advance the NGGPS, we continue to advance NGGPS ensemble forecasts. While more observational data is typically better, no matter how much data we obtain, we still have gaps and errors in the initial conditions for numerical models. Furthermore, we cannot "model" the exact wind field everywhere or the exact temperature everywhere. Since we know that the best depiction we have is not perfect, we approximate these "initial conditions" and then rerun the models, based on our best estimated spread on this operational database. We do this dozens of times creating an "ensemble" of our model forecasts. This is done for many of our models, the global model, the regional models, and the short-term high-resolution models. Many of the solutions aligning within an envelope increases the confidence that the model solutions are pointing toward a specific event. If this does not happen, then most often there is more uncertainty in the forecast. A great example of "ensembles" is the hurricane spaghetti plots– with the tracks sometimes going every which way, and other times aligned within a narrow area.

NOAA is developing its next generation global prediction system, and at its heart is the Finite-Volume Cubed-Sphere dynamical core (FV3) modernizing NWS's approach to weather modelling. A dynamical core consists of a system of equations that can predict changes in temperature and movement in the atmosphere, such as moisture traveling through the water cycle, all the ingredients needed to describe changes in the weather. We expect the new model will be more accurate and more reliable, and be the global model that is used as a basis for all weather forecasts in the U.S. The FV3 core enables the model to provide localized forecasts for several weather events simultaneously, all while generating a global forecast every six hours. Looking 10 years ahead, the "American" Global Forecast System (or GFS) model with the FV3 core will run in higher resolution and be able to zoom in on smaller and smaller storm systems to provide forecasters better pictures of how storms will evolve.

NOAA is working toward a Unified Forecasting System which will facilitate the federal, academic, and private sectors to all work on the research version of the operational forecast model. NOAA's Earth Prediction Innovation Center (EPIC)—as codified by Congress in December 2018's reauthorization of the Weather Act—will advance U.S. weather modeling and reclaim international leadership in the area of numerical weather prediction. While strides have been made recently, in the past it has been difficult for the NWS to incorporate model developments from non-NOAA sources. EPIC will provide the framework for a "community modeling" effort to provide outside research partners the ability to test, evaluate and provide feedback on the American modeling system. This is expected to minimize the barrier between NOAA's modeling and the outside world and accelerate model development and improvements. EPIC will use cloud computing so multiple users could run the model simultaneously. As proposed, EPIC will be a center with no single physical location, but operated from within existing NOAA modeling groups and other institutions serving the larger research and academic

community. Where appropriate, NOAA will look to partner with other Federal agencies and institutions of higher learning/academia to further this initiative. The President's FY 2020 Budget proposes $15.0 million for EPIC (which includes $12.3 million in new appropriations and a $2.7 million transfer from the National Environmental Satellite, Data, and Information Service).

Building the Next-Generation Global Prediction System will take a tremendous amount of testing, analysis and verification. Model components, including the physics package, data assimilation, and post processing—all parts of the existing architecture—will be rebuilt and improved to work with new software as part of EPIC.

Another innovative forecasting tool available to NWS forecasters is NOAA's National Water Model (NWM). The NWM provided accurate flood forecast information for the catastrophic flood levels experienced in North Carolina during Hurricane Florence. NWS forecasts of record precipitation fed extremely accurate river flood level forecasts and duration, which helped emergency managers and responders plan for and respond to the flooding. The NWM simulates conditions for 2.7 million stream reaches across the continental U.S. and Hawaii every hour, and improves NOAA's ability to provide more frequent, accurate, and expanded water information used to save lives and protect property. The NWM is not yet fully operational and is being updated to incorporate the latest research and development that is occurring in the academic sector. The goal is to provide predictions of inundation from river and stream flooding for emergency managers and other decision makers for them to make informed decisions about potential impacts.

Collaborative Forecast Process & the National Blend of Models

The OWA reports also point to weather forecast *process* improvements necessary for building a Weather-Ready Nation. While working with emergency managers, our forecasters often hear about the need to have consistent forecast information from one Weather Forecast Office to the next, and from national centers to the local level. One way to achieve this goal—as recommended by the OWA—is the NWS's development of a Collaborative Forecast Process (CFP). This process ensures NWS provides weather and water data, forecasts, and warnings for the protection of life and property and the enhancement of the national economy in the most efficient, effective, and consistent way possible. The CFP develops a single authoritative source for forecasts by layering national and local expertise onto a common starting point. By making the best use of models and technology described above, this process can reduce duplication and increase consistency. A central tool the NWS is developing to facilitate consistency and allow forecasters to work more with decision makers is the National Blend of Models (NBM).

Before diving into the process in selecting this approach, understanding what makes up a "blend of models" is important. As previously noted, NOAA runs ensembles of weather models on our high-performance supercomputing system and non-NOAA entities also run weather models. The output of all of these models individually provide guidance to issue weather forecasts. Research

has shown that by averaging the output of various model parameters (i.e. temperature, wind, pressure, etc.) the "blended" or ensemble forecast guidance provides increased skill and accuracy.

The use of blends has been around for more than a decade and some NWS regions have adopted regional blends and policies that encourage the use of the blend as a common starting point for the forecast. While a regional blended model approach has improved forecasts locally, forecast inconsistencies between regions can still occur. In response to these inconsistencies, the development of a national blended model output is required and is nearing operational implementation In the aftermath of Hurricane Sandy, Congress recognized the potential benefits of this approach and funded NOAA to develop and implement a national blend of models through the Disaster Relief Supplemental Appropriations Act of 2013.

In response to various recommendations and assessments, the NBM Project was officially launched in 2013. This project is an effort to develop a nationally consistent set of foundational gridded guidance products based on well-calibrated NWS and non-NWS model information. Today, the NBM is currently operating in an experimental status in accordance with the approval memo for the Experimental Implementation of Guidance from the National Blend of Models in August 2016. On October 3, 2018, NBM v3.1 was successfully implemented on NOAA's operational high-performance weather supercomputing system. The model is supported operationally for experimental use by NWS offices.

The NBM includes all operational numerical weather prediction models including GFS, Navy, Canadian, European Center for Medium Range Weather Forecasting (ECMWF or "Euro"), including both deterministic global models as well as global ensembles. In addition, regional ensembles including High Resolution Rapid Refresh (HRRR) and High Resolution Ensemble Forecast (HREF), also are included in the NBM.

Ensuring a Robust Weather Observations and Infrastructure Backbone

Observations

Observations are critical to effective forecasts. Observations integrated into the models and NWS forecast operations range from surface observing stations (including mesonet data), ocean, coastal, and Great Lakes buoys, radars, weather balloon (radiosonde) launches, aircraft-collected readings, and satellite remotely-sensed data.

The bellwether observation tool for tornado, flash flood, and severe weather warnings is the Next Generation Doppler Weather Radar (NEXRAD). The Federal NEXRAD program is a tri-agency effort among the Department of Defense, Federal Aviation Administration, and the Department of Commerce/NOAA. The NEXRADs were deployed in the early-mid 1990s and recently reached their designed 20-year service life. The three agencies are close on schedule and about three years away from completing a Service Life Extension Program (SLEP) for the NEXRADs

providing a technology refresh and overhaul of necessary parts and subsystems to ensure the system can perform reliably for another 20 years. The SLEP replaces the signal processor, the transmitter, the pedestal and the shelter.

Of the data actually assimilated into NWS numerical weather prediction models that are used to produce the longer-term weather forecasts three days and beyond, over 93 percent comes from satellites, of which over 80 percent are from polar-orbiting satellites. Polar orbiting satellites that feed these models include: NOAA's Joint Polar Satellite System program satellite (NOAA-20), which became operational on May 30, 2018 and the National Aeronautics and Space Administration (NASA)/NOAA Suomi National Polar-orbiting Partnership (Suomi NPP) satellite, both in the afternoon orbit, and EUMETSAT's Metop satellites in the mid-morning orbit. This data is supplemented by legacy satellite data from NOAA's Polar-orbiting Operational Environmental Satellites (POES), the NASA Earth Observing Satellites (EOS), and the Department of Defense's Defense Meteorological Satellite Program (DMSP). Satellites from the Geostationary Operational Environmental Satellites-R Series program (GOES-R Series) are providing valuable data in the GOES East and West positions, along with the NEXRAD, to assist operational weather forecasters with monitoring existing conditions and providing essential information over data-sparse areas, including the oceans. NOAA is committed to providing high quality satellite data through the Joint Polar Satellite System and GOES-R Series programs. The FY20 President's Budget requests funds to begin the multi-year process of developing NOAA's satellite observing systems architecture, which will lead to a more cost-effective and resilient satellite architecture.

Dissemination

Fulfilling the NWS mission depends on transmitting critical data to forecasters within NWS, as well as delivering forecast products and services to the public and the Weather Enterprise. The NWS mission will not be met if the information is not delivered in a reliable and timely manner. In FY 2014, the NWS established the Integrated Dissemination Program (IDP). The goal of the IDP is to transform the organization's dissemination capabilities from a collection of independent communications stovepipes to an integrated, common, operational dissemination service.

NWS defined the scope of IDP focusing on a set of the most critical systems needed to deliver NWS watches and warnings. The goals for IDP included 100 percent primary and backup dissemination services with a geographically-diverse footprint for NWS critical systems; improved communications bandwidth, resilience, scalability, and security; and an increased access to environmental data using diverse methods and data formats.

The technology infrastructure created through the IDP is deployed at two distinct and geographically diverse locations. This 100 percent backup capability for delivery of NWS reliable and timely critical observations, model guidance, forecast, and watches and warning

information was achieved for the first time in history. The OneNWS Network[7] is operationally used at all local, regional, and national NWS forecast units (including all Weather Forecast Offices, River Forecast Centers, Regional Headquarters, and National Centers for Environmental Prediction) to support mission-critical coordination. Data delivery services were upgraded and the bandwidth was increased tenfold.

IDP has proven to be a powerful resource for the NWS. This was evident during the 2017 and 2018 hurricane seasons, when the IDP infrastructure, upgraded OneNWS Network, and a newly implemented video-enabled hurricane hotline communication system performed flawlessly during the most critical times. However, the level of demand the NWS anticipated on the system has been far exceeded. The IDP infrastructure—planned and developed just five years ago—is reaching its maximum capacity and user demands continue to grow. NWS is exploring the potential of using public cloud-based computing services to meet the demands for IDP.

Facilities

The NWS Office of Facilities is responsible for maintaining adequate physical infrastructure across all NWS offices. There are approximately 190 complexes that are maintained through upgrades or physical improvements, system replacements, or considered for relocation. Many of the NWS-owned facilities were constructed during the Modernization and Restructuring of the NWS in 1990s and are beginning to show their wear. The Joint Explanatory Statement Report accompanying the Consolidated Appropriations Act, 2018 (Public Law 115-141) included language requiring NWS to submit a report prioritizing NWS deferred facilities maintenance needs based on condition assessments, as well as estimated costs associated with these facilities.

This report was delivered to Congress in July 2018. NOAA is currently updating the report for FY 2019. This update will address NWS' prioritized approach to deferred maintenance requests and infrastructure improvements. However, NOAA is also doing a NOAA-wide assessment of all of its facilities, which will allow us to make informed decisions regarding our facilities portfolio that improve agency operations overall, including for NWS.

Improving Staffing and Labor Relations

Hiring staff for critical, operational positions remains a top priority of the NWS. Vacancies in operational units cause significant strain on our ability to consistently operate 24/7/365 and deliver the life-safety services the public and our partners expect.

After several years of a downward trend, we have begun to turn the corner by addressing deficiencies in NOAA and DOC's workforce management and security clearance process.

[7] https://www.weather.gov/news/181207-one-nws-network

Staffing levels are currently at approximately 91.5 percent of our appropriated level. Working with the NOAA Office of Human Capital Services (OHCS, formerly the NOAA Workforce Management Office), NWS is hiring staff as quickly as possible within appropriated funding levels. Per Congressional direction in recent Appropriations bills, NWS has focused on expediting new hires, and our efforts are bearing fruit. During calendar year 2018, NWS hires exceeded attrition for the first time since 2011. While the NWS continues to demonstrate significant improvement in hiring staff for FY18 (544 hiring actions) and the beginning of FY 2019 (194 hired to date), hiring activity was stalled during the lapse in appropriations earlier this year and recovery will take time. There are currently 434 funded vacancies in the NWS and there are 252 hiring actions in progress at this time, with those actions expected to rise. Concurrently, we are analyzing the vacant positions and determining how the associated resources would best benefit NOAA.

However, the NWS and NOAA's OHCS, combined with oversight, assistance, and innovations from DOC Enterprise Services, are working hard to improve hiring performance. To assist with NWS hiring, DOC has hired a contractor (YRCI), which has demonstrated excellent customer service and a quick turnaround time for hiring actions. YRCI's worked with NWS to implement hiring process efficiencies that drove NWS's "time- to- hire" to the lowest time among NOAA line offices. These OHCS-approved efficiencies included use of a nationwide 120-day open announcement for lead forecasters, standardized position descriptions across the agency, bundled junior meteorologist announcements, and released nationwide vacancy announcements three times per year. These actions will enable vacancies to be more quickly filled from a qualified applicant pool.

GS 5-12 Career Progression

NWS has been working for several years on initiatives to increase the agility of the workforce within forecast offices as we provide improved IDSS to our key partners. We have briefed congressional staff previously on this component of the Evolve initiative. In coordination with the National Weather Service Employees Organization (NWSEO), we are now implementing a General Schedule (GS) 5-12 career progression. This will place our field meteorologists into a single career track and allows them to progress non-competitively from the GS -5 level to the GS-12 level, based on completing competencies at each progressive level.

Moving to a single career progression for meteorologists provide staff with a clear career path, and opportunity to advance, and the ability to contribute to the office operations based on their competencies. Having all meteorologists in one career progression will provide more flexibility to field units when assigning work, allowing offices more resources to provide IDSS to the communities and partners they support. We expect this initiative will also reduce the administrative burden involved with hiring and promoting field staff and lower the yearly relocation costs NWS pays for internal promotions.

Many employees throughout the NWS have expressed support for this initiative. With this change, all 1340-series NWS employees will be called 'Meteorologists' instead of 'Interns.,' In the past, the "Intern" designation was very confusing to those outside the NWS given that employees in those positions typically possess years of training (and sometimes decades of previous experience with the military). All will have new promotion potential to a higher grade, and a clear pathway on how to achieve it.

Throughout the remainder of FY2019, we expect to transition over 1,000 employees into new position descriptions and performance plans and begin competency training and assessments for the new career progression. We have initiated management training on the new career progression that the 5-12 initiative offers and on their responsibilities related to managing the transition process for the workforce.

NWS management will continue to provide direct communications to NWSEO and our employees on this effort as well as engage with our employees through regular announcements, a dedicated webpage, and internal feedback mechanisms.

NWS management and NWSEO had success agreeing to move forward with the GS 5-12 Career Progression initiative and we continue to work with the union on this and other issues pertaining to the workforce. We are continuing to negotiate with NWSEO on a new Collective Bargaining Agreement that will modernize the current, outdated agreement.

Implementing the Weather Research and Forecasting and Innovation Act

Weather Research and Forecasting Innovation Act of 2017 (Public Law 115-25), and its recent reauthorization and extension in December 2018, provides excellent direction for NOAA and the NWS, as noted throughout this testimony. The Weather Act will continue to drive innovation, enhanced research-to-operations coordination, and NOAA's efforts to build a weather-ready nation. Implementing the Act is one of NOAA's highest priorities, and we look forward to continuing to work with Congress to execute its vision to the fullest extent.

Conclusion

NWS forecasts, warnings, and community-based preparedness programs are vital in enhancing the economy and saving lives and property. It all starts with a commitment to environmental observations, to research and improved forecasting and warnings, to our people—forecasters, modelers, technicians and managers and it ends with a Weather-Ready Nation in which businesses, governments, and people are prepared to use those forecasts to mitigate impacts. In spite of our best efforts, severe weather events still cause loss of life and significant damage. We recognize that there is always room for improvement. We are proud of the NWS, especially our people who are on the front lines delivering critical products and services every day to help keep our citizens safe.

The protection of the people of the United States from the devastation that weather can bring is a duty given to NOAA. Together, we must ensure NWS services and operations lives up to this duty. We have come a long way, but there is more we need to do to become a Weather-Ready Nation—to be ready for the event, to be responsive, and to be resilient