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The Weather Research and Forecasting Innovation Act of 2017: Congressional Direction to NOAA in P.L. 115-25

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Specialist in Energy and Natural Resources Policy

Updated May 10, 2017

Congressional Research Service

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www.crs.gov

R44838

Summary

Congress provides direction on a broad range of the National Oceanic and Atmospheric Administration's (NOAA's) weather-related activities in Titles I through IV of P.L. 115-25, the Weather Research and Forecasting Innovation Act of 2017, signed into law on April 18, 2017. The legislation aims to improve NOAA's weather forecasts and warnings, both for the protection of lives and property and for the enhancement of the national economy. The act also covers topics such as future weather satellite data needs, gaps in the Next Generation Weather Radar (NEXRAD) coverage, and improvements in the transfer of advances in research and development to National Weather Service (NWS) operations. Title V of P.L. 115-25 covers NOAA's tsunami program activities and is addressed in CRS Report R44834, *The U.S. Tsunami Program Reauthorization in P.L. 115-25: Section-by-Section Comparison to P.L. 109-479, Title VIII*.

Congress began holding hearings on many of the issues addressed in P.L. 115-25 nearly four years ago, and the final law incorporates components of various bills introduced in the House and Senate since the 113th Congress. For example, the issue of improving seasonal forecasts, reflected in Title II of P.L. 115-25, was introduced in S. 1331 in the 114th Congress. Congress also has held hearings on how NOAA could use commercially provided satellite weather data, and NOAA has responded by initiating a preliminary program on the use of commercial data. P.L. 115-25 codifies NOAA's authority to purchase commercial weather data and requires the agency to deliver a strategic plan for commercial data acquisition within 180 days of enactment. Members also have expressed interest in improving coordination and communication throughout the weather enterprise, topics both addressed in Title IV of P.L. 115-25.

This report provides an overview of each title in P.L. 115-25.

- Among other topics, Title I addresses the transfer of research and development (R&D) advances from NOAA's Office of Oceanic and Atmospheric Research (OAR) to operations at NWS. Title I also includes a sense of Congress that not less than 30% of the funding for weather R&D at NOAA should be made available to the nonfederal weather research community;
- Title II focuses on improving forecasts at NWS;
- Title III addresses the future of weather satellites and NOAA's use of commercially provided weather data ; and
- Title IV provides congressional direction to NOAA on coordinating weather data and observations; improving the exchange of expertise among NOAA entities; enhancing communication of watches and warnings of hazardous weather events; and conducting outreach to the nonfederal and federal entities in the broader weather enterprise, among other topics.

P.L. 115-25 also includes requirements for various reports to Congress and other goals and deliverables, many of which are due during the 115th Congress. As a result, Congress is expected to have many opportunities to track NOAA's progress in implementing P.L. 115-25. Ongoing questions include if appropriated amounts will be sufficient to meet authorized activities and priorities expressed in the law and to what degree NOAA will implement the activities and priorities provided in P.L. 115-25.

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Introduction

The Weather Research and Forecasting Innovation Act of 2017 (P.L. 115-25) addresses a broad range of National Oceanic and Atmospheric Administration (NOAA) activities in five titles: Titles I through IV primarily address weather-related programs, policies, and activities, and Title V amends the Tsunami Warning and Education Act (Title VIII of P.L. 109-479). This report discusses Titles I through IV; Title V of P.L. 115-25 is addressed in CRS Report R44834, *The U.S. Tsunami Program Reauthorization in P.L. 115-25: Section-by-Section Comparison to P.L. 109-479, Title VIII*.

In P.L. 115-25, Congress provides direction to NOAA regarding the agency's research and development (R&D) activities, with the broad goal of improving weather forecasting, warnings, and communication to recipients and users of weather information. Congress has held hearings and introduced legislation in the past two Congresses on topics that are incorporated into P.L. 115-25. Thus the law reflects many of the priorities and issues of interest to Members of Congress regarding improving forecasts, coordination, and communication in the weather enterprise; incorporating commercially available weather data into forecasts and warnings; and enhancing the research-to-operations pathway so that new scientific and technological advances can be incorporated more rapidly into forecasts and warnings, among other topics.

In addition to emphasizing the transfer of R&D advances to operations at the National Weather Service (NWS), Title I of P.L. 115-25 includes a sense of Congress that not less than 30% of funding for weather R&D at NOAA's Office of Oceanic and Atmospheric Research (OAR) should be made available to the nonfederal weather research community, which includes academia, private-sector entities, and nongovernmental organizations.

Title II of P.L. 115-25 centers on improving NWS forecasts, specifically *subseasonal* and *seasonal* forecasts, defined in the law as forecasts of two weeks to three months and forecasts of three months to two years, respectively.

Title III focuses on weather satellites, including microsatellite constellations, and future needs of the weather satellite observing systems. Title III also includes direction on the acquisition of commercial weather data; it requires NOAA to evaluate whether commercial weather data from satellites could meet some or all of NOAA's future needs.

Title IV directs NOAA to coordinate weather data and observations; improve the exchange of expertise between R&D and operational activities; enhance communication of watches and warnings of hazardous weather events; improve outreach to the weather enterprise;¹ and study gaps in the national NEXRAD coverage,² among other topics.

This report discusses each title briefly by summarizing selected sections. Furthermore, the report identifies where NOAA is required to report to Congress on its progress in fulfilling the legislation's requirements. The summaries of each title in this report include information on these required studies and reports to Congress as well as on other new activities due prior to the

¹ The terms *weather enterprise* and *weather industry* are defined in P.L. 115-25 as including individuals and organizations from public, private, and academic sectors that contribute to the research, development, and production of weather forecast products and are primary consumers of the weather forecast products.

² NEXRAD is the **N**ext-**G**eneration **R**adar of the National Weather Service. The NEXRAD system comprises 160 sites in the United States and some overseas locations, consisting of high-resolution Doppler weather radar installations which detect precipitation and wind. See NOAA, *National Centers for Environmental Information*, NEXRAD, at <https://www.ncdc.noaa.gov/data-access/radar-data/nexrad>.

adjournment of the 115th Congress. Congress may exert its oversight capacity to evaluate NOAA's success in fulfilling congressional direction provided in the legislation.

Title I: United States Weather Research and Forecasting Improvement

Title I of P.L. 115-25 focuses on authorizing R&D efforts at NOAA, mostly led by the OAR, primarily to improve forecasts and warnings of potentially damaging weather events. Title I addresses a broad array of activities authorized in the legislation that would, if implemented, range from conducting basic R&D on weather to enhancing the observing systems to improve the data used for forecasts and warnings. Title I also requires NOAA to address the issue of how to improve the incorporation of research findings into NWS operations. The research-to-operations challenge also is addressed in other titles of P.L. 115-25.

Section 101 states that the priorities for the R&D efforts shall be the protection of life and property and the enhancement of the national economy.³ Section 102 authorizes a broad portfolio of R&D activities to address the priorities in Section 101, such as improving the fundamental understanding of weather; enhancing the understanding of how the public receives, interprets and responds to dangerous weather; and facilitating the transfer of knowledge, technologies, and applications to NWS.

Sections 103 and 104 focus on tornadoes and hurricanes, respectively. The goal of Section 103 is to reduce loss of life and economic damage from tornadoes by improving tornado forecasts, predictions, and warnings. The act requires NOAA to create a tornado warning improvement and extension program plan to achieve its goal and to submit to Congress a proposed budget for its tornado program plan activities each year. The goal of Section 104 is to improve hurricane forecasting to reduce loss of life, injuries, and economic damage. The section requires NOAA to maintain a project to improve hurricane forecasting, and to develop a plan to implement the hurricane project. The tornado plan and the hurricane plan are due within 180 days and one year of enactment, respectively (i.e., by October 2017 and April 2018).

Section 105 requires an R&D and research-to-operations plan within one year of enactment (i.e., by April 2018), with the goal of restoring and maintaining U.S. leadership in numerical weather forecasting and prediction. The section also requires NOAA to consult with the National Science Foundation, the U.S. weather industry, and academic partners to identify research necessary to enhance the integration of social science research into weather forecasts and warnings.⁴

Sections 106-109 deal with observation systems; observing system simulation experiments;⁵ computer resources; and activities to help operationalize R&D so that it can be used by NWS for forecasts and warnings.

³ This is also the mission statement of the National Weather Service, "The National Weather Service (NWS) provides weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy." See NOAA, National Weather Service, "National Weather Service Mission Statement," at <http://www.nws.noaa.gov/mission.php>.

⁴ For example, this type of research could lead to improvements in how citizens and communities receive, understand, and respond to forecasts and warnings so as to respond in ways to reduce injuries and fatalities.

⁵ These experiments are described in P.L. 115-25 as quantitative assessments of the relative value and benefits of observing capabilities and systems. They would be conducted prior to acquisition of observing systems, such as weather satellites, with lifecycle costs greater than \$500 million, and prior to the purchase of any new major commercially provided data with a lifecycle cost greater than \$500 million. P.L. 115-25 establishes two priority

Title I would authorize \$111.52 million per year for FY2017 and FY2018 for OAR R&D and an additional \$20 million per year for the technology transfer initiative authorized in Section 102.

Title II: Subseasonal and Seasonal Forecasting Innovation

Section 201 of Title II of P.L. 115-25 amends P.L. 99-198 (15 U.S.C. 313 note) to add eight subsections (c through j) with the primary goal of improving temperature and precipitation forecasts in *subseasonal forecasts* (forecasts of two weeks to three months) and *seasonal forecasts* (forecasts of three months to two years). This section of Title II amends the part of the *U.S. Code* that declares it is in the public interest that the federal government be involved in providing weather and climate information useful for agriculture and silviculture. Improving forecasts during the time spans defined as subseasonal and seasonal aligns with improving the forecasts needed by agricultural and silvicultural interests. The subsections summarized below expand on functions and requirements for these forecasts more broadly.

Subsection 201(c) requires that the Director of NWS collect and use information to make subseasonal and seasonal forecasts; use existing models and research to improve those forecasts; determine how those forecasted conditions will affect severe weather and other weather-related natural hazards; and develop an Internet clearinghouse to share the forecasts and accompanying information.

Subsection 201(d) requires the NWS director to provide the forecasts and accompanying information to the public. Subsection 201(e) requires NOAA to designate research and monitoring required for the subseasonal and seasonal forecasts as a priority in one or more of the solicitations of the Cooperative Institutes of Oceanic and Atmospheric Research; to contribute to the interagency Earth System Prediction Capability; and to consult with the Secretary of Defense and the Secretary of Homeland Security to determine the highest priorities for their departments regarding subseasonal and seasonal forecasts.

Subsection 201(f) requires NOAA to foster communication, understanding, and use of the forecasts by the intended users. It gives NOAA discretion to provide assistance to states for individuals who would be designated “forecast communication coordinators,” who would serve as liaisons among federal agencies and other entities of the weather enterprise and who would receive and disseminate the subseasonal and seasonal forecasts. NOAA support would be limited to \$100,000 per year per state and would require a 50% match (from the state, a university, a nongovernmental organization, a trade association, or the private sector).

Subsection 201(g) requires other federal agencies to cooperate with NOAA. Subsection 201(h) requires a report to Congress on implementation of the subseasonal and seasonal forecasts, due within 18 months of enactment (October 2018). Subsection 201(i) defines terms used in Section 201. Subsection 201(j) authorizes appropriations of \$26.5 million per year to carry out these activities in FY2017 and FY2018.

Title III: Weather Satellite and Data Innovation

Title III of P.L. 115-25 addresses two main issues: (1) weather satellites and (2) commercial weather data. The topics are interrelated. Title III provides direction for NOAA regarding current

experiments: (1) global navigation satellite system radio occultation and (2) geostationary hyperspectral sounder global constellation.

and future weather satellite data needs and authorizes NOAA to consider how commercially provided weather satellite data could enhance and improve observations, leading to better forecasts and warnings in the future.

Section 301 of Title III of P.L. 115-25 addresses microsattellites, integration of data from the ocean observing system, and a study and report on future satellite data needs. Subsection 301(a) requires NOAA to complete and operationalize the microsattellite project called the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC-1 and COSMIC-2).⁶ NOAA is to deploy microsattellites in polar and equatorial orbits, integrate the satellite data into operational and research weather forecast models, and make the data free and available to everyone. The COSMIC satellite system makes use of a technique called radio occultation, using radio signals from global positioning satellites (GPS), which allows high-precision measurements of the global atmosphere. The data from the COSMIC mission, combined with other atmospheric data, likely would improve the precision and accuracy of weather forecasts and warnings.

Subsection 301(a) also requires the NWS director to integrate data collected by the Integrated Ocean Observing System into regional weather forecasts and to support the development of real-time data-sharing products and forecast products. It requires NOAA to identify where monitoring and observing systems have degraded and may have reduced the quality of weather forecasts. Subsection 301(a) requires NOAA to follow report recommendations, authorized under Subsection 301(b), on specifications for weather satellite systems.

Subsection 301(b) requires NOAA to enter into an agreement with the National Academy of Sciences (NAS) to conduct a study on future weather satellite needs. The resulting report is due within two years of entering into the agreement for the study. If an agreement cannot be achieved with NAS, Subsection 301(b) would allow NOAA to enter into an agreement with another nonfederal government entity with expertise and objectivity comparable to NAS. The legislation authorizes \$1 million total for the study and report during FY2018 and FY2019.

Subsection 302(a) authorizes NOAA to purchase weather data from commercial sources and to place NOAA weather satellites on government or private-sector payloads for launch into orbit. Subsection 302(b) directs NOAA, within 180 days of enactment (October 2017), to submit to Congress a strategic plan for procuring commercial weather data.

Congress has expressed interest in expanding NOAA's use of commercially available weather data for at least the previous two Congresses. Outstanding issues include whether and how commercially available data meet the requirements and specifications for use in NOAA's forecasts and warnings. Subsection 302(c) authorizes NOAA to address some of these issues. The subsection requires NOAA to publish data and metadata standards and specifications for space-based commercial weather data within 30 days of enactment (i.e., due by May 2017). It also requires NOAA to publish standards and specifications for geostationary hyperspectral sounder data as soon as possible.

Subsection 302(c) requires NOAA to conduct at least one pilot program by contracting with one or more private-sector data providers that can meet the standards and specifications that NOAA would develop and publish. Within three years of the pilot project contract agreement, Subsection 302(c) requires NOAA to submit a report to Congress on the pilot program's progress toward meeting the criteria developed and published earlier. The law authorizes appropriations of \$6 million annually for FY2017 through FY2020.

⁶ University Consortium for Atmospheric Research, *UCAR Community Programs*, COSMIC Program Office, at <http://www.cosmic.ucar.edu/>.

Subsection 302(d) requires NOAA to obtain commercial weather data from the private sector, depending on whether the pilot program is deemed successful. The subsection also requires NOAA to determine whether a government meteorological space system is required, if NOAA finds that commercial data sources can meet any or all of the observational requirements of such a system. This provision implies that if commercial vendors can provide data that meet all the requirements developed by NOAA, then NOAA would determine if a federal government weather satellite system is in the national interest. The legislation requires NOAA to report to Congress on its determination.

Subsection 302(e) requires that NOAA continue to meet its existing international meteorological agreements, including practices set forth in World Meteorological Organization Resolution 40.⁷ Section 303 requires NOAA to avoid unnecessary duplication between private and public sources of data.

Title IV: Federal Weather Coordination

Title IV of P.L. 115-25 contains 14 sections that deal with a wide range of NOAA activities, most of which address coordination, communication, and issues related to data sharing and exchanges of personnel to foster better interaction between research scientists and practitioners. Some of the authorized activities focus on improving NWS outreach to user communities, and other sections address specific issues that Congress previously has identified as possible weaknesses in the weather enterprise, namely possible gaps in ground-based radar coverage by NEXRAD systems.

Section 401 instructs NOAA to maintain its Environmental Services Working Group to provide advice for prioritizing weather research and for existing and emerging technologies, to identify opportunities to improve communications between all entities within the weather enterprise, and to advise on other issues. Section 401 requires the working group to be composed of at least 15 members, experts in all fields relevant to weather,⁸ and requires the working group to submit an annual report on NOAA's progress in implementing working group recommendations.

Section 402 requires the director of the White House Office of Science and Technology Policy to establish an Interagency Committee for Advancing Weather Services. The committee is charged with coordinating weather research and innovation activities across the federal government. The Federal Coordinator for Meteorology will serve as co-chair of the committee.

Section 403 allows the directors of OAR and NWS to detail up to 10 personnel from one office to the other in an exchange program to allow OAR scientists and NWS operational staff to interact. Section 404 allows the NWS director to host postdoctoral fellows and academic researchers—for up to one year—at any of the NOAA National Centers for Environmental Prediction,⁹ to allow forecasters and academic researchers to interact directly and to foster innovation at NWS.

⁷ See World Meteorological Organization (WMO), “WMO Policy and Practice for the Exchange of Meteorological and Related Data and Products Including Guidelines on Relationships in Commercial Meteorological Activities,” Resolution 40, at http://www.wmo.int/pages/prog/www/ois/Operational_Information/Publications/Congress/Cg_XII/res40_en.html.

⁸ These fields would include, for example, atmospheric chemistry, atmospheric physics, meteorology, hydrology, social science, risk communications, electrical engineering, and computer sciences.

⁹ The nine National Centers for Environmental Prediction are Aviation Weather Center, Climate Prediction Center, Environmental Modeling Center, Central Operations, National Hurricane Center, Ocean Prediction Center, Storm Prediction Center, Space Weather Prediction Center, and Weather Prediction Center. See NWS, “National Centers for Environmental Prediction,” at <http://www.ncep.noaa.gov/>.

Section 405 requires the NWS director to designate at least one warning coordination meteorologist at each weather forecast office to increase impact-based decision support services.¹⁰ The legislation requires that each warning coordination meteorologist (1) provide service to the geographic area covered by the weather forecast office; (2) work with all users of NWS products and services to evaluate their utility; (3) collaborate with state, local, and tribal agencies to improve products and services for those entities; (4) maintain severe weather call lists, severe weather policy and procedures, and severe weather dissemination methodologies and strategies; and (5) work with state, local, and tribal emergency managers to ensure better preparedness and response. The NWS director may assign other responsibilities in addition to the five required above. The NWS director also may place a warning coordination meteorologist with a state or local emergency manager.

Section 406 requires NOAA to assess its system for issuing hazardous weather and water event watches and warnings within two years of enactment (i.e., by April 2019) and to submit the resulting report to Congress. The assessment's focus is to include how best to communicate risks that would improve mitigation, enhance broad and rapid communication to the public, preserve benefits of the existing system, and maintain the system's utility for government and commercial users. The legislation requires NOAA to consult with a wide variety of individuals and entities within the weather enterprise and to make use of NAS, if practicable. The legislation also requires NOAA to make recommendations to Congress to improve the system, based on the results of the study.

Section 407 authorizes the NWS director to establish the NOAA Weather Ready All Hazards Award Program, which would provide annual awards to individuals or organizations that use or provide NOAA Weather Radio receivers or transmitters to save lives and protect property. Individuals and organizations that employ tools other than NOAA Weather Radios for early warnings also may qualify for the award.

Section 408 requires NOAA to submit a report to Congress within 60 days of enactment (i.e., by June 2017) that analyzes the impact of the U.S. Air Force withdrawal from the U.S. Weather Research and Forecasting Model.¹¹

Section 409 requires NOAA to continue its contract with an external organization to conduct a baseline analysis of NWS operations and workforce.

Section 410 requires NOAA to submit a report to Congress within 180 days of enactment (October 2017) on the use of contractors at NWS for the FY2017 fiscal year. The section also requires that NOAA include eight different types of information in this report and make that information publicly available each year within 180 days after the end of the fiscal year.

Section 411 requires the NWS director to review the service's research, products, and services regarding modeling and forecasting in the urban environment and to submit a report to Congress on the findings.

Section 412 authorizes NOAA to establish outreach mechanisms to the weather enterprise by assessing the agency's forecasts and forecast products and by determining the highest forecast needs of the weather-enterprise community.

¹⁰ NWS regional organization is at <http://www.weather.gov/organization/regional>. Currently, there are 122 weather forecast offices.

¹¹ The U.S. Weather Research and Forecasting Model is a weather prediction system designed for both research and operations. The Weather Research & Forecasting Model, at <http://www.wrf-model.org>.

Section 413 requires NOAA to acquire backup capabilities for its WP-3D Orion and G-IV hurricane hunter aircraft.¹²

Section 414 requires the Secretary of Commerce to complete a study within 180 days of enactment (October 2017) on gaps in coverage of NEXRAD. The section requires the Secretary to identify areas that have limited or no NEXRAD coverage for which no or insufficient warnings were given for hazardous weather events or for which degraded forecasts resulted in deaths, injuries, or substantial property damage. It also requires the Secretary to submit a report on the study's findings to Congress and to submit within 90 days of the study's completion (i.e., by January 2018) the Secretary's recommendations for improving hazardous weather detection and forecasting in the areas identified as having limited or no NEXRAD coverage.

Concluding Observations

Congress provides broad and far-ranging direction regarding weather-related activities for NOAA and NWS in the first four titles of P.L. 115-25. Some might argue that this law may represent the most widely varied set of provisions addressing weather issues at NOAA in a single bill since NOAA was first organized. Throughout P.L. 115-25, Congress requires reports on progress in meeting its authorizations over time frames from 30 days to several years. The reports will allow Congress to track NOAA's progress in implementing the specific requirements outlined in the law over the short term. The law's long-term goal is to improve weather forecasts and warnings to reduce damage to property and decrease the number of injuries and fatalities from severe weather events.

Some of the issues Congress might consider in the short term include whether the level of enacted appropriations for activities authorized in P.L. 115-25 is commensurate with the scale and scope of those activities. Over the long term, Congress may choose to assess whether the law's research-to-operations focus is resulting in improved forecasts and warnings. In addition, congressional interest in the use of commercially provided weather data has spurred NOAA to examine the viability of commercial data sources. The new law aims to give Congress more information to help evaluate the potential for commercial data sources to represent an increasingly greater share of data useful for improving forecasts and warnings. Conversely, the activities authorized under P.L. 115-25 also may indicate the limitations for using commercial data in producing better forecasts and warnings, whether those limitations arise for financial, data-quality, availability, or other reasons.

Title IV of P.L. 115-25 addresses more than a dozen different weather-related issues, most of which pertain to improving coordination and communication between NOAA and the weather enterprise. In the future, Congress could conduct hearings and other activities related to its oversight responsibilities, to seek information from stakeholders outside the federal government to help gauge the effectiveness of NOAA's implementation of activities authorized in Title IV. The test of whether congressional direction in P.L. 115-25 is effective ultimately will be gauged by how improvements in forecasts and warnings ameliorate the amount of damage from severe weather and reduce the numbers of injuries and fatalities from dangerous storms.

¹² Hurricane hunters are specially equipped aircraft that collect data during a hurricane to help forecasters make accurate hurricane predictions and better understand storm processes. NOAA, *Office of Marine & Aviation Operations*, NOAA Hurricane Hunters, at <http://www.oma.noaa.gov/learn/aircraft-operations/about/hurricane-hunters>.

Author Contact Information

(name redacted)
Specialist in Energy and Natural Resources Policy
/redacted/@crs.loc.gov-....

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