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116–171

SPACE WEATHER RESEARCH AND FORECASTING ACT

R E P O R T

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ON

S. 881

DECEMBER 11, 2019.—Ordered to be printed

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

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SPACE WEATHER RESEARCH AND FORECASTING ACT

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Mr. WICKER, from the Committee on Commerce, Science, and Transportation, submitted the following

R E P O R T

[To accompany S. 881]

[Including cost estimate of the Congressional Budget Office]

The Committee on Commerce, Science, and Transportation, to which was referred the bill (S. 881) to improve understanding and forecasting of space weather events, and for other purposes, having considered the same, reports favorably thereon without amendment and recommends that the bill do pass.

PURPOSE OF THE BILL

The purpose of S. 881, as reported, is to improve understanding and forecasting of space weather events, and for other purposes.

BACKGROUND AND NEEDS

Space weather refers to naturally occurring variations in the space environment between the Sun and the Earth, including solar flares, solar energetic particles, solar wind, and coronal mass ejections.[1] These solar events can interact with Earth and its surrounding space, including the Earth's magnetic field.[2] Space weather is relevant to U.S. economic and social well-being because these naturally occurring variations could cause disruption to electrical power grids, navigation systems, communications networks, and satellite and aircraft operations. Therefore, space weather has economic, safety, health, and national security implications. As the

[1] National Science and Technology Council, National Space Weather Strategy, October 2015.
[2] Department of Homeland Security, The Strategic National Risk Assessment (SNRA) in Support of PPD 8: A Comprehensive Risk-Based Approach toward a Secure and Resilient Nation, December 2011.

United States becomes more and more dependent on communication networks, navigation systems, and electrical power grid technologies, the impact of space weather poses an increasing risk to infrastructure.

Historical records indicate that space weather events of great severity have occurred within the last 150 years. Notably, in March 1989, a large geomagnetic storm caused a power outage in Quebec, Canada, impacting 6 million people for 9 hours. The Great Geomagnetic Storm of May 1921, which produced ground currents as much as 10 times stronger than the 1989 Quebec storm, was used as a case study to model its effect on the modern power grid. The National Academy of Sciences (NAS) found there would be more than 350 transformers at risk of permanent damage and 130 million people without power if the 1921 storm happened today. The strongest geomagnetic storm on record is the Carrington Event of August–September 1859, which was ranked over 50 percent stronger than the storm of May 1921. A contemporary repetition of the Carrington Event would cause extensive social and economic disruptions,[3] including power outages, radio blackouts, and satellite malfunctions, and impacts to telecommunications, GPS navigation, banking and finance, and transportation. According to the NAS estimates, the total economic impact in the first year alone could reach up to $2 trillion, approximately 20 times greater than the costs of Hurricane Katrina.[4] Scientists do not know the likelihood of such an event recurring, or whether such an event is even the worst case scenario.

In October 2015, the National Science and Technology Council (NSTC) released both the National Space Weather Strategy and the National Space Weather Action Plan, the result of a multiagency task force led by the Office of Science and Technology Policy (OSTP), the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), and the Department of Homeland Security (DHS), seeking to enhance the integration of existing national efforts to understand, predict, prepare for, and mitigate space weather. In March 2019, NSTC released a follow on National Space Weather Strategy and Action Plan produced by its Space Weather Operations, Research, and Mitigation Working Group also co-chaired by OSTP, NOAA, and DHS.

S. 881 would help implement the National Space Weather Strategy and Action Plan by setting national priorities to increase and improve space weather observations, science, and forecasting abilities. If utility and satellite operators know a geomagnetic storm is coming, they could take measures to reduce damage, such as disconnecting wires, shielding vulnerable electronics, and powering down critical hardware.

Currently, the National Aeronautics and Space Administration's (NASA) Solar and Heliospheric Observatory (SOHO) spacecraft includes the Large Angle and Spectrometric Coronagraph (LASCO) instrument that provides data with an advanced warning of incoming solar flares of 24 hours to 72 hours depending on the energy

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[3] National Aeronautics and Space Administration, Severe Space Weather—Social and Economic Impacts (*http://science.nasa.gov/science-news/science-at-nasa/2009/21jan_severespaceweather/*) (accessed April 20, 2016).

[4] National Academy of Sciences, Severe Space Weather Events—Understanding Societal and Economic Impacts: A Workshop Report, 2008.

emitted. However, SOHO/LASCO was launched over 20 years ago on December 2, 1995, and has already exceeded its design life. Therefore, this bill would require NASA and NOAA to consider additional capabilities for solar imaging to provide continuous space weather forecasting in the event of a SOHO/LASCO failure. The Committee is pleased to see that the President's fiscal year 2020 budget includes funding for the Space Weather Follow-On, including funds for two compact coronagraphs.

SUMMARY OF PROVISIONS

If enacted, S. 881 would provide clear roles and responsibilities for Federal agencies, including NASA, NOAA, the National Science Foundation (NSF), the Federal Aviation Administration (FAA), and the Department of Defense (DOD) to better understand, predict, and forecast space weather. Specifically, the bill would direct NOAA and DOD to provide operational space weather forecasts and would direct NASA and NSF to conduct heliophysics research, develop next-generation technologies, and transfer scientific research findings, data, and models to operational forecasters.

The bill also would direct NOAA and NASA to immediately begin planning for back-up solar observations to prevent a single point of failure in the current satellite fleet and would direct the agencies to develop space weather benchmarks to characterize the nature, frequency, and intensity of expected space weather events. Additionally, the bill would direct DHS and national security agencies to assess the vulnerability of critical infrastructure and national security assets to space weather events and manage associated risks and impacts, and would direct FAA to assess safety implications and methods to mitigate the safety implications of space weather events to civil aviation.

LEGISLATIVE HISTORY

S. 881, the Space Weather Research and Forecasting Act, was introduced on March 26, 2019, by Senator Peters (for himself and Senator Gardner) and was referred to the Committee on Commerce, Science, and Transportation of the Senate. On April 3, 2019, the Committee met in open Executive Session and, by voice vote, ordered S. 881 reported favorably without amendment.

Similar legislation, S. 141, the Space Weather Research and Forecasting Act, was introduced in the 115th Congress on January 12, 2017, by Senator Peters (for himself and Senators Gardner, Booker, and Wicker) and was referred to the Committee on Commerce, Science, and Transportation of the Senate. Senators Klobuchar and Nelson were additional cosponsors. On January 24, 2017, the Committee met in Executive Session and, by voice vote, ordered S. 141 reported favorably with an amendment (in the nature of a substitute). On May 2, 2017, S. 141 passed the Senate with an amendment by unanimous consent, and on May 3, 2017, that bill was referred to five Committees of the House of Representatives (Science, Space, and Technology; Armed Services; Transportation and Infrastructure; Foreign Affairs; and Intelligence (Permanent Select)), and the short title as reported to the House of Representatives was the Space Weather Coordination Act. On January 3, 2019, the Committee on Science, Space, and Tech-

nology of the House of Representatives reported S. 141 favorably, as amended. On January 3, 2019, S. 141 was also discharged by the Committees on Armed Services, Transportation and Infrastructure, Foreign Affairs, and Intelligence (Permanent Select) of the House of Representatives, and placed on the Union Calendar.

ESTIMATED COSTS

In accordance with paragraph 11(a) of rule XXVI of the Standing Rules of the Senate and section 403 of the Congressional Budget Act of 1974, the Committee provides the following cost estimate, prepared by the Congressional Budget Office:

At a Glance

S. 881, Space Weather Research and Forecasting Act

As ordered reported by the Senate Committee on Commerce, Science, and Transportation on April 3, 2019

By Fiscal Year, Millions of Dollars	2019	2019-2024	2019-2029
Direct Spending (Outlays)	0	0	0
Revenues	0	0	0
Deficit Effect	0	0	0
Spending Subject to Appropriation (Outlays)	0	235	n.e.

Pay-as-you-go procedures apply?	No	**Mandate Effects**	
Increases on-budget deficits in any of the four consecutive 10-year periods beginning in 2030?	No	Contains intergovernmental mandate?	No
		Contains private-sector mandate?	No

n.e. = not estimated

The bill would

- Require the National Oceanic and Atmospheric Administration to maintain the capability to observe space weather by building and deploying at least one instrument to capture imagery of coronal mass ejections
- Codify existing multi-agency efforts under the National Space Weather Program

Estimated budgetary effects would primarily stem from

- The costs to acquire a coronagraph, spacecraft, and related equipment

Areas of significant uncertainty include

- The number of spacecraft and coronagraphs required to adequately capture coronal mass ejection imagery
- When the spacecraft and coronagraph would launch and what it could cost

Summary: S. 881 would require the National Oceanic and Atmospheric Administration (NOAA) to capture imagery of coronal mass ejections (CMEs). A CME is a release of a large quantity of matter and electromagnetic radiation from the sun. Currently, the National Aeronautics and Space Administration (NASA) operates several spacecraft that provide imagery of CMEs; however, those vehicles are outdated. S. 881 would require NOAA to assume that responsibility from NASA to ensure that the United States continues to capture images of CMEs.

The bill also would codify existing multi-agency efforts under the National Space Weather Program.

Estimated Federal cost: The estimated budgetary effect of S. 881 is shown in Table 1. The costs of the legislation fall within budget function 300 (natural resources and environment).

TABLE 1.—ESTIMATED INCREASES IN SPENDING SUBJECT TO APPROPRIATION UNDER S. 881

	By fiscal year, millions of dollars—						
	2019	2020	2021	2022	2023	2024	2019–2024
Estimated Authorization	0	20	70	120	25	10	245
Estimated Outlays Basis	0	15	50	95	60	15	235

Basis of estimate: For this estimate, CBO assumes that S. 881 will be enacted near the end of fiscal year 2019 and that the estimated amounts will be appropriated for each fiscal year beginning in 2020.

Background: Under current law, NOAA is implementing a program that would meet the requirements outlined in S. 881. The Space Weather Follow On (SWFO) program plans to launch two spacecraft in 2024. One will include a coronagraph (a telescope that can capture CME imagery by blocking glare from the sun's surface), and an instrument that can measure solar wind properties. The second spacecraft will include an additional coronagraph. In NOAA's plan, those spacecraft would be launched in 2024 as secondary payloads on two currently scheduled launches to minimize launch costs. In 2019, NOAA allocated $27 million to continue implementing the SWFO. Prior to 2019, The agency spent nearly $14 million for the SWFO program.

Spending subject to appropriation: Because NOAA has begun to implement the SWFO program, CBO's estimate of the amounts authorized to be appropriated under S. 881 is consistent with the amounts necessary to complete the SWFO program. Using information from NOAA, CBO estimates that securing that capability would cost $235 million over the 2019–2024 period (see Table 1). Those amounts would be used to:

- Acquire one coronagraph and one spacecraft at a cost of $105 million over the 20201–2024 period, and
- Develop, operate, and maintain the ground services that would be used to monitor CME imagery received from the coronagraph at a cost of $130 million over the 2020–2024 period.

CBO expects that acquisition and development of the equipment and necessary ground services would be completed by 2024 and that the coronagraph and spacecraft would be launched as a secondary payload on NASA's currently planned Interstellar Mapping and Acceleration Probe mission in that year.

CBO expects that most of that spending would occur in the years leading up to the launch as NOAA would need to acquire and establish the flight and ground systems necessary to operate the spacecraft well in advance of the launch. CBO also expects that spending prior to the 2024 launch would include amounts for testing the spacecraft and coronagraph to ensure they will function properly once launched. Additional amounts would be necessary in

2024 and beyond in order to operate and maintain the spacecraft, coronagraph, and ground services.

Other provisions in the bill would codify ongoing activities being carried out by several agencies under the National Space Weather Program and the Space Weather Operations, Research and Mitigation Working Group. In 2019, those agencies allocated a combined total of nearly $350 million to activities related to space weather. Because the activities could be conducted under existing authorities, CBO estimates that those provisions would not authorize additional appropriations.

Uncertainty: The uncertainty in this estimate stems largely from the number of space-based and ground-based instruments that would be necessary to provide real-time CME imagery and when spacecraft would be launched. S. 881 requires that NOAA deploy at least one instrument to capture CME imagery. For this estimate, CBO expects that one coronagraph would be sufficient to capture such CME imagery along with one spacecraft to house the coronagraph and one ground-based observation site to record and analyze the images. However, if additional equipment were required to adequately capture CME imagery then the costs of implementing S. 881 would be higher.

Pay-As-You-Go considerations: None.

Increase in long-Term deficits: None.

Mandates: None.

Estimate prepare by: Federal Costs: Robert Reeses; Mandates: Susan Willie.

Estimate reviewed by: Kim P. Cawley, Chief, Natural and Physical Resources Cost Estimates Unit; Theresa Gullo, Assistant Director for Budget Analysis.

REGULATORY IMPACT STATEMENT

In accordance with paragraph 11(b) of rule XXVI of the Standing Rules of the Senate, the Committee provides the following evaluation of the regulatory impact of the legislation, as reported:

NUMBER OF PERSONS COVERED

S. 881, as reported, would not create any new programs or impose any new regulatory requirements, and therefore would not subject any individuals or businesses to new regulations.

ECONOMIC IMPACT

The legislation is not expected to have a negative impact on the Nation's economy. On the contrary, it will likely reduce adverse economic impacts if space weather events occur by increasing preparedness.

PRIVACY

The reported bill is not expected to impact the personal privacy of individuals.

PAPERWORK

S. 881 would require the Director of the OSTP to submit a report to the Committee on Commerce, Science, and Transportation of the

Senate and the Committee on Science, Space, and Technology of the House of Representatives regarding the integrated strategy for solar and solar wind observations beyond the lifetime of current Federal assets. S. 881 also would direct the Space Weather Interagency Working Group to develop preliminary benchmarks to describe the nature, frequency, and intensity of space weather disturbances. The Space Weather Interagency Working Group would be directed to publish the final benchmarks not later than 18 months after the preliminary benchmarks are developed.

CONGRESSIONALLY DIRECTED SPENDING

In compliance with paragraph 4(b) of rule XLIV of the Standing Rules of the Senate, the Committee provides that no provisions contained in the bill, as reported, meet the definition of congressionally directed spending items under the rule.

SECTION-BY-SECTION ANALYSIS

Section 1. Short title.

This section would provide that the bill may be cited as the "Space Weather Research and Forecasting Act".

Section 2. Space weather.

This section would amend subtitle VI of title 51, United States Code, to add a new chapter 607. A new section 60701 of that chapter would include the findings of Congress and the Federal agency roles regarding space weather. NSTC, under OSTP, would be directed to establish an interagency working group on space weather to improve the ability of the United States to prepare for, avoid, mitigate, respond to, and recover from potentially devastating impacts of space weather events. The new section 60701 also would direct OSTP to coordinate responsibilities of the space weather interagency group based on agency capabilities. The new section 60701 also would direct OSTP, in coordination with NOAA, NASA, NSF, and DOD, and in consultation with academic and commercial communities, to develop an integrated strategy for solar and solar wind observations beyond the lifetime of current assets.

A new section 60702 of that chapter would direct NASA to maintain SOHO/LASCO operations for as long as the satellite continues to deliver quality observations. It would also direct NOAA to secure reliable secondary capability for near real-time coronal mass ejection imagery, prioritizing a cost-effective solution and considering options such as commercial solutions, prize authority, academic, and international partnerships. NOAA would be directed to develop an operational contingency plan to provide continuous space weather forecasting in the event of a SOHO/LASCO failure, and develop requirements and a plan for follow-on space-based observations for operational purposes.

The new section 60702 would direct NSF, the Air Force, and where practicable in support of the Air Force, the Navy to maintain and improve, as necessary and advisable, ground-based observations of the Sun in order to help meet identified priorities, and provide space weather data. It also would require NSF to provide key data streams for research and space weather model development,

to develop experimental models for scientific purposes, and to support the transition of experimental models to operations.

A new section 60703 of that chapter would direct NOAA, the Air Force, and, where practicable in support of the Air Force, the Navy to conduct and publish a survey to identify and prioritize the needs of space weather forecast users. It also would require NSF, NASA, and DOD to continue to carry out basic research activities on heliophysics, geospace science, and space weather, and require NSF, NOAA, and NASA to pursue multidisciplinary research in subjects that further our understanding of solar physics, space physics, and space weather.

The new section 60703 also would direct NASA to implement missions that meet the science objectives identified by NAS decadal surveys, and direct NASA, NSF, NOAA, the Air Force, and, where practicable in support of the Air Force, the Navy to develop a formal mechanism to transition research to operations and enhance coordination between modeling and forecasting centers. The new section 60703 would require NASA and NSF to support the development of technologies and instrumentation to improve space weather forecasting lead-time and accuracy.

Last, a new section 60704 of that chapter would direct NASA and NSF to make space weather data obtained for scientific research purposes available to space weather forecasters and operations centers. Additionally, NOAA would be required to make space weather obtained from operational forecasting available for scientific research.

Section 3. Space weather metrics.

This section would define "space weather disturbance" and "space weather benchmark." It also would direct the Space Weather Interagency Working Group to assess existing data, historical records, models, and peer-reviewed studies on space weather and develop preliminary benchmarks for measuring solar disturbances, and update those benchmarks as necessary. This section would require the Space Weather Interagency Working Group to publish final benchmarks, and require NAS to review those benchmarks.

Section 4. Protection of critical infrastructure.

This section would direct NOAA, in consultation with the heads of other relevant Federal agencies, to provide information about space weather hazards to the DHS. It would direct DHS, in consultation with NOAA and the heads of other relevant agencies, to include an assessment of the vulnerability of critical infrastructure to space weather events and support critical infrastructure providers in managing risks and impacts associated with space weather.

Section 5. Protection of national security assets.

This section would direct the National Security Council, in consultation with the Director of National Intelligence, the Secretary of Defense, and the heads of other relevant Federal agencies, to assess the vulnerability of the national security community to space weather events and develop mechanisms to protect national security assets from space weather threats.

Section 6. Ensuring the safety of civil aviation.

This section would direct FAA, in consultation with the heads of other relevant Federal agencies, to assess safety implications and methods to mitigate the safety implications of space weather events to civil aviation. This section also would direct FAA, in consultation with the heads of other relevant Federal agencies, to develop methods to increase interaction between the aviation, space weather research, and service provider communities.

CHANGES IN EXISTING LAW

In compliance with paragraph 12 of rule XXVI of the Standing Rules of the Senate, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new material is printed in italic, existing law in which no change is proposed is shown in roman):

TITLE 51—NATIONAL AND COMMERCIAL SPACE PROGRAMS

Subtitle VI—Earth Observations

* * * * * * *

CHAPTER 607—SPACE WEATHER

Sec.
60701. Space weather.
60702. Observations and forecasting.
60703. Research and technology.
60704. Space weather data.

§ 60701. Space weather

(a) FINDINGS.—Congress makes the following findings:

(1) Space weather events pose a significant threat to ground-based and space-based critical infrastructure, modern technological systems, and humans working in space.

(2) The effects of severe space weather events on the electric power grid, satellites and satellite communications and information, aviation operations, astronauts living and working in space, and space-based position, navigation, and timing systems could have significant societal, economic, national security, and health impacts.

(3) Earth and space observations provide crucial data necessary to predict and warn about space weather events.

(4) Clear roles and accountability of Federal departments and agencies are critical for an efficient and effective response to threats posed by space weather.

(5) Space weather observation and forecasting are essential for the success of space exploration.

(6) In October 2015, the National Science and Technology Council published a National Space Weather Strategy and a National Space Weather Action Plan seeking to integrate national space weather efforts and add new capabilities to meet increasing demand for space weather information.

(b) FEDERAL AGENCY ROLES.—

(1) FINDINGS.—Congress makes the following findings:

(A) The National Oceanic and Atmospheric Administration—

(i) provides operational space weather forecasting and monitoring for civil applications;

(ii) maintains ground and space-based assets to provide observations needed for forecasting, prediction, and warnings;

(iii) provides research to support operation responsibilities; and

(iv) develops requirements for space weather forecasting technologies and science.

(B) The Department of Defense provides operational space weather forecasting, monitoring, and research for the department's unique missions and applications.

(C) The National Aeronautics and Space Administration provides increased understanding of the fundamental physics of the Sun-Earth system through space-based observations and modeling, develops new space-based technologies and missions, and monitors space weather for NASA's space missions.

(D) The National Science Foundation provides increased understanding of the Sun-Earth system through ground-based measurements, technologies, and modeling.

(E) The Department of the Interior collects, distributes, and archives operational ground-based magnetometer data in the United States and its territories, works with the international community to improve global geophysical monitoring, and develops crustal conductivity models to assess and mitigate risk from space weather induced electric ground currents.

(F) The Federal Aviation Administration provides operational requirements for space weather services in support of aviation and for coordination of these requirements with the International Civil Aviation Organization, integrates space weather data and products into the Next Generation Air Transportation System.

(2) OFFICE OF SCIENCE AND TECHNOLOGY POLICY.—The Director of the Office of Science and Technology Policy shall—

(A) coordinate the development and implementation of Federal Government activities to improve the ability of the United States to prepare, avoid, mitigate, respond to, and recover from potentially devastating impacts of space weather events; and

(B) coordinate the activities of the space weather interagency working group established under subsection (c).

(c) SPACE WEATHER INTERAGENCY WORKING GROUP.—The National Science and Technology Council shall establish an interagency working group on space weather (referred to in this section as the "interagency working group") to continue coordination of executive branch efforts to understand, prepare, coordinate, and plan for space weather.

(d) MEMBERSHIP.—In order to understand and respond to the adverse effects of space weather, the interagency working group shall leverage capabilities across participating Federal agencies, including—

(1) the National Oceanic and Atmospheric Administration;
(2) the National Aeronautics and Space Administration;
(3) the National Science Foundation;
(4) the Department of Defense;
(5) the Department of the Interior;
(6) the Department of Homeland Security;
(7) the Department of Energy;
(8) the Department of Transportation, including the Federal Aviation Administration; and
(9) the Department of State.

(e) INTERAGENCY AGREEMENTS.—

(1) SENSE OF CONGRESS.—It is the sense of Congress that the interagency collaboration between the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration on terrestrial weather observations provides—

(A) an effective mechanism for improving weather and climate data collection while avoiding unnecessary duplication of capabilities across Federal agencies; and

(B) an agency collaboration model that could benefit space weather observations.

(2) INTERAGENCY AGREEMENTS.—The Administrator of the National Aeronautics and Space Administration and the Administrator of the National Oceanic and Atmospheric Administration shall enter into one or more interagency agreements providing for cooperation and collaboration in the development of space weather spacecraft, instruments, and technologies in accordance with this chapter.

(f) SPACE WEATHER ADVISORY GROUP.—

(1) ESTABLISHMENT.—The interagency working group shall establish a space weather advisory group (in this chapter referred to as the "advisory group") to facilitate communication and knowledge transfer among Federal Government agencies, the academic community, the commercial sector, and space weather end users.

(2) COMPOSITION.—The advisory group shall be composed of not more than 15 members appointed by the interagency working group, of whom—

(A) 5 members shall be representatives of the academic community;

(B) 5 members shall be representatives of the commercial sector; and

(C) 5 members shall be nongovernmental representatives of the space weather end user community.

(3) CHAIR.—Not later than 30 days after the date on which the last member of the advisory group is appointed under paragraph (2), the interagency working group shall appoint 1 member as the Chair of the advisory group.

(4) TERMS.—The length of the term of each member of the advisory group shall be 3 years beginning on the date on which the member is appointed.

(5) TERM LIMITS.—

(A) IN GENERAL.—A member of the advisory group may not serve on the advisory group for more than 2 consecutive terms.

(B) CHAIR.—A member of the advisory group may not serve as the Chair of the advisory group for more than 2 terms, regardless of whether the terms are consecutive.

(6) DUTIES.—The duties of the advisory group shall be as follows:

(A) To facilitate advances in the space weather enterprise of the United States.

(B) To improve the ability of the United States to prepare for, avoid, mitigate, respond to, and recover from space weather events.

(C) To enable the coordination of research to operations and operations to research, as described in section 60703(d).

(D) To advise the interagency working group with respect to the development and implementation of the integrated strategy developed under section 60702(b) and subsequent updates and reevaluations.

§ 60702. Observations and forecasting

(a) POLICY.—It is the policy of the United States to establish and sustain a baseline capability for space weather observations.

(b) INTEGRATED STRATEGY.—

(1) IN GENERAL.—The Director of the Office of Science and Technology Policy, in coordination with the Administrator of the National Oceanic and Atmospheric Administration, the Administrator of the National Aeronautics and Space Administration, the Director of the National Science Foundation, and the Secretary of Defense, and in consultation with the academic community, the commercial sector, and the advisory group shall develop an integrated strategy for solar, solar wind, and geospace observations beyond the lifetime of current assets that considers the provision of solar, solar wind, and geospace measurements and other space weather measurements—

(A) essential to space weather forecasting; and

(B) important for scientific purposes.

(2) CONSIDERATIONS.—In developing the strategy under paragraph (1), the Director of the Office of Science and Technology Policy shall—

(A) consider small satellite options, hosted payloads, commercial options, international options, and prize authority; and

(B) leverage and build on work conducted before the date of the enactment of this chapter by the National Science and Technology Council with respect to space weather.

(c) CRITICAL OBSERVATIONS.—In order to sustain current space-based observational capabilities, the Administrator of the National Aeronautics and Space Administration shall—

(1) in cooperation with the European Space Agency and other international and interagency partners, maintain operations of the Solar and Heliospheric Observatory/Large Angle and Spectrometric Coronagraph (referred to in this section as "SOHO/LASCO") for as long as the satellite continues to deliver quality observations; and

(2) prioritize the reception of LASCO data.

(d) ADDITIONAL CAPABILITY FOR SOLAR IMAGING.—

(1) IN GENERAL.—The Administrator of the National Oceanic and Atmospheric Administration shall secure reliable secondary capability for near real-time coronal mass ejection imagery.

(2) OPTIONS.—The Administrator of the National Oceanic and Atmospheric Administration, in coordination with the Secretary of Defense and the Administrator of the National Aeronautics and Space Administration, shall develop options to build and deploy one or more instruments for near real-time coronal mass ejection imagery.

(3) CONSIDERATIONS.—In developing options under paragraph (2), the Administrator of the National Oceanic and Atmospheric Administration shall consider commercial solutions, prize authority, academic and international partnerships, microsatellites, ground-based instruments, and opportunities to deploy the instrument or instruments as a secondary payload on an upcoming planned launch.

(4) COSTS.—In implementing paragraph (1), the Administrator of the National Oceanic and Atmospheric Administration shall prioritize a cost-effective solution.

(5) OPERATIONAL PLANNING.—The Administrator of the National Oceanic and Atmospheric Administration shall develop an operational contingency plan to provide continuous space weather forecasting in the event of a SOHO/LASCO failure.

(6) BRIEFING.—Not later than 120 days after the date of enactment of the Space Weather Research and Forecasting Act, the Administrator of the National Oceanic and Atmospheric Administration shall provide a briefing to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives on the options for building and deploying the instrument or instruments described in paragraph (2) and the operational contingency plan developed under paragraph (5).

(e) FOLLOW-ON SPACE-BASED OBSERVATIONS.—The Administrator of the National Oceanic and Atmospheric Administration, in coordination with the Secretary of Defense, shall develop requirements and a plan for follow-on space-based observations for operational purposes, in accordance with the integrated strategy developed under subsection (b).

(f) REPORT.—Not later than 180 days after the date of enactment of the Space Weather Research and Forecasting Act, the Director of the Office of Science and Technology Policy shall submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives a report on the integrated strategy under subsection (b), including the plans for follow-on space-based observations under subsection (e).

(g) GROUND-BASED OBSERVATIONS.—The National Science Foundation, the United States Geological Survey, the Air Force, and where practicable in support of the Air Force, the Navy shall each—

(1) maintain and improve, as necessary and advisable, ground-based observations of the Sun to help meet the priorities identified in section 60703(a); and

(2) provide space weather data by means of its set of ground-based facilities, including radars, lidars, magnetometers, radio

receivers, aurora and airglow imagers, spectrometers, interferometers, and solar observatories.

(h) GROUND-BASED OBSERVATIONS DATA.—The National Science Foundation shall—

(1) make available to the public key data streams from the platforms described in subsection (g) for research and to support space weather model development;

(2) develop experimental models for scientific purposes; and

(3) support the transition of the experimental models to operations where appropriate.

§ 60703. Research and technology

(a) USER NEEDS.—

(1) IN GENERAL.—The Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, in conjunction with the heads of other relevant Federal agencies, shall conduct a comprehensive survey to identify and prioritize the needs of space weather forecast users, including space weather data and space weather forecast data needed to improve services and inform research priorities and technology needs.

(2) CONTENTS.—In conducting the comprehensive survey under paragraph (1), the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, at a minimum, shall—

(A) consider the goals for forecast lead time, accuracy, coverage, timeliness, data rate, and data quality for space weather observations;

(B) identify opportunities to address the needs identified under paragraph (1) through collaborations with academia, the private sector, and the international community;

(C) identify opportunities for new technologies and instrumentation to address the needs identified under paragraph (1); and

(D) publish a report on the findings under subparagraphs (A) through (C).

(3) PUBLICATION.—Not later than 1 year after the date of the enactment of the Space Weather Research and Forecasting Act, and every 3 years thereafter, the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, shall—

(A) make the results of the comprehensive survey publicly available; and

(B) notify the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives of the publication under subparagraph (A).

(b) RESEARCH ACTIVITIES.—

(1) BASIC RESEARCH.—The Director of the National Science Foundation, the Administrator of the National Aeronautics and Space Administration, and the Secretary of Defense shall continue to carry out basic research activities on heliophysics, geo-

space science, and space weather and support competitive, merit-based, peer-reviewed proposals for research, modeling, and monitoring of space weather and its impacts, including science goals outlined in Solar and Space Physics Decadal surveys conducted by the National Academy of Sciences.

(2) MULTIDISCIPLINARY RESEARCH.—

(A) FINDINGS.—Congress finds that the multidisciplinary nature of solar and space physics creates funding challenges that require coordination across scientific disciplines and Federal agencies.

(B) MULTIDISCIPLINARY RESEARCH.—The Director of the National Science Foundation, the Administrator of the National Oceanic and Atmospheric Administration, and the Administrator of the National Aeronautics and Space Administration shall pursue multidisciplinary research in subjects that further our understanding of solar physics, space physics, and space weather.

(C) SENSE OF CONGRESS.—It is the sense of Congress that the Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation should support competitively awarded Heliophysics Science Centers.

(c) SCIENCE MISSIONS.—The Administrator of the National Aeronautics and Space Administration shall seek to implement missions that meet the science objectives identified in Solar and Space Physics Decadal surveys conducted by the National Academy of Sciences.

(d) RESEARCH TO OPERATIONS; OPERATIONS TO RESEARCH.—

(1) IN GENERAL.—The Administrator of the National Aeronautics and Space Administration, the Director of the National Science Foundation, the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, shall—

(A) develop a formal mechanism to transition National Aeronautics and Space Administration, National Science Foundation, United States Geological Survey, Air Force, and Navy research findings, models, and capabilities, as appropriate, to National Oceanic and Atmospheric Administration and Department of Defense space weather operational forecasting centers; and

(B) enhance coordination between research modeling centers and forecasting centers.

(2) OPERATIONAL NEEDS.—The Administrator of the National Oceanic and Atmospheric Administration and the Secretary of Defense, in coordination with the Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation, shall develop a formal mechanism to communicate the operational needs of space weather forecasters to the research community.

(e) TECHNOLOGY DEVELOPMENT.—

(1) FINDINGS.—Congress finds that observations and measurements closer to the Sun or at the Sun-Earth Lagrangian L5 point with advanced instrumentation would provide for more advanced warning of space weather disturbances (as defined in

section 3(a) of the Space Weather Research and Forecasting Act).

(2) TECHNOLOGY AND INSTRUMENTATION DEVELOPMENT.—The Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation shall support the development of technologies and instrumentation to improve space weather forecasting lead-time and accuracy to meet the needs identified by the Administrator of the National Oceanic and Atmospheric Administration.

§ 60704. Space weather data

(a) IN GENERAL.—The Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation shall—

(1) make space weather related data obtained for scientific research purposes available to space weather forecasters and operations centers; and

(2) support model development and model applications to space weather forecasting.

(b) RESEARCH.—The Administrator of the National Oceanic and Atmospheric Administration shall make space weather related data obtained from operational forecasting available for scientific research.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT OF 2010

[Public Law 111–267; 124 Stat. 2805]

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SEC. 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "National Aeronautics and Space Administration Authorization Act of 2010".

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

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TITLE VIII—SPACE SCIENCE

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[42 U.S.C. 18388]

[SEC. 809. SPACE WEATHER.

[(a) FINDINGS.—The Congress finds the following:

[(1) Space weather events pose a significant threat to modern technological systems.

[(2) The effects of severe space weather events on the electric power grid, telecommunications and entertainment sat-

ellites, airline communications during polar routes, and space-based position, navigation and timing systems could have significant societal, economic, national security, and health impacts.

[(3) Earth and Space Observing satellites, such as the Advanced Composition Explorer, Geostationary Operational Environmental Satellites, Polar Operational Environmental Satellites, and Defense Meteorological Satellites, provide crucial data necessary to predict space weather events.

[(b) ACTION REQUIRED.—The Director of OSTP shall—

[(1) improve the Nation's ability to prepare, avoid, mitigate, respond to, and recover from potentially devastating impacts of space weather events;

[(2) coordinate the operational activities of the National Space Weather Program Council members, including the NOAA Space Weather Prediction Center and the U.S. Air Force Weather Agency; and

[(3) submit a report to the appropriate committees of Congress within 180 days after the date of enactment of this Act that—

[(A) details the current data sources, both space- and ground-based, that are necessary for space weather forecasting; and

[(B) details the space- and ground-based systems that will be required to gather data necessary for space weather forecasting for the next 10 years.]

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