

115TH CONGRESS
1ST SESSION

S. 141

AN ACT

To improve understanding and forecasting of space weather
events, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*

1 **SECTION 1. SHORT TITLE.**

2 This Act may be cited as the “Space Weather Re-
3 search and Forecasting Act”.

4 **SEC. 2. SPACE WEATHER.**

5 (a) IN GENERAL.—Subtitle VI of title 51, United
6 States Code, is amended by adding after chapter 605 the
7 following:

8 **“CHAPTER 607—SPACE WEATHER**

“60701. Space weather.

“60702. Observations and forecasting.

“60703. Research and technology.

“60704. Space weather data.

9 **“§ 60701. Space weather**

10 “(a) FINDINGS.—Congress makes the following find-
11 ings:

12 “(1) Space weather events pose a significant
13 threat to humans working in the space environment
14 and to modern technological systems.

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

1 “(3) Earth and space observations provide cru-
2 cial data necessary to predict and warn about space
3 weather events.

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

8 “(5) In October 2015, the National Science and
9 Technology Council published a National Space
10 Weather Strategy and a National Space Weather
11 Action Plan seeking to integrate national space
12 weather efforts and add new capabilities to meet in-
13 creasing demand for space weather information.

14 “(b) FEDERAL AGENCY ROLES.—

15 “(1) FINDINGS.—Congress finds that—

16 “(A) the National Oceanic and Atmos-
17 pheric Administration provides operational
18 space weather forecasting and monitoring for
19 civil applications, maintains ground and space-
20 based assets to provide observations needed for
21 forecasting, prediction, and warnings, and de-
22 velops requirements for space weather fore-
23 casting technologies and science;

24 “(B) the Department of Defense provides
25 operational space weather forecasting, moni-

1 toring, and research for the department’s
2 unique missions and applications;

3 “(C) the National Aeronautics and Space
4 Administration provides increased under-
5 standing of the fundamental physics of the
6 Sun-Earth system through space-based observa-
7 tions and modeling, develops new space-based
8 technologies and missions, and monitors space
9 weather for NASA’s space missions;

10 “(D) the National Science Foundation pro-
11 vides increased understanding of the Sun-Earth
12 system through ground-based measurements,
13 technologies, and modeling;

14 “(E) the Department of the Interior col-
15 lects, distributes, and archives operational
16 ground-based magnetometer data in the United
17 States and its territories, and works with the
18 international community to improve global geo-
19 physical monitoring and develops crustal con-
20 ductivity models to assess and mitigate risk
21 from space weather induced electric ground cur-
22 rents; and

23 “(F) the Federal Aviation Administration
24 provides operational requirements for space
25 weather services in support of aviation and for

1 coordination of these requirements with the
2 International Civil Aviation Organization, inte-
3 grates space weather data and products into the
4 Next Generation Air Transportation System,
5 and conducts real-time monitoring of the
6 charged particle radiation environment to pro-
7 tect the health and safety of crew and pas-
8 sengers during space weather events.

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

12 “(A) coordinate the development and im-
13 plementation of Federal Government activities
14 to improve the Nation’s ability to prepare,
15 avoid, mitigate, respond to, and recover from
16 potentially devastating impacts of space weath-
17 er events; and

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

21 “(c) SPACE WEATHER INTERAGENCY WORKING
22 GROUP.—In order to continue coordination of executive
23 branch efforts to understand, prepare, coordinate, and
24 plan for space weather, the National Science and Tech-

1 nology Council shall establish an interagency working
2 group on space weather.

3 “(d) MEMBERSHIP.—In order to understand and re-
4 spond to the adverse effects of space weather, the inter-
5 agency working group established under subsection (c)
6 shall leverage capabilities across participating Federal
7 agencies, including—

8 “(1) the National Oceanic and Atmospheric Ad-
9 ministration;

10 “(2) the National Aeronautics and Space Ad-
11 ministration;

12 “(3) the National Science Foundation;

13 “(4) the Department of Defense;

14 “(5) the Department of the Interior;

15 “(6) the Department of Homeland Security;

16 “(7) the Department of Energy;

17 “(8) the Department of Transportation, includ-
18 ing the Federal Aviation Administration; and

19 “(9) the Department of State.

20 “(e) INTERAGENCY AGREEMENTS.—

21 “(1) SENSE OF CONGRESS.—It is the sense of
22 Congress that the interagency collaboration between
23 the National Aeronautics and Space Administration
24 and the National Oceanic and Atmospheric Adminis-

1 tration on terrestrial weather observations pro-
2 vides—

3 “(A) an effective mechanism for improving
4 weather and climate data collection while avoid-
5 ing unnecessary duplication of capabilities
6 across Federal agencies; and

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

9 “(2) INTERAGENCY AGREEMENTS.—The Ad-
10 ministrator of the National Aeronautics and Space
11 Administration and the Administrator of the Na-
12 tional Oceanic and Atmospheric Administration shall
13 enter into one or more interagency agreements pro-
14 viding for cooperation and collaboration in the devel-
15 opment of space weather spacecraft, instruments,
16 and technologies in accordance with this chapter.

17 **“§ 60702. Observations and forecasting**

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

21 “(b) INTEGRATED STRATEGY.—

22 “(1) IN GENERAL.—The Director of the Office
23 of Science and Technology Policy, in coordination
24 with the Administrator of the National Oceanic and
25 Atmospheric Administration, the Administrator of

1 the National Aeronautics and Space Administration,
2 the Director of the National Science Foundation,
3 and the Secretary of Defense, and in consultation
4 with the academic and commercial communities,
5 shall develop an integrated strategy for solar and
6 solar wind observations beyond the lifetime of cur-
7 rent assets, that considers—

8 “(A) the provision of solar wind measure-
9 ments and other measurements essential to
10 space weather forecasting; and

11 “(B) the provision of solar and space
12 weather measurements important for scientific
13 purposes.

14 “(2) CONSIDERATIONS.—In developing the
15 strategy under paragraph (1), the Director of the
16 Office of Science and Technology Policy shall con-
17 sider small satellite options, hosted payloads, com-
18 mercial options, international options, and prize au-
19 thority.

20 “(c) CRITICAL OBSERVATIONS.—In order to sustain
21 current space-based observational capabilities, the Admin-
22 istrator of the National Aeronautics and Space Adminis-
23 tration shall—

24 “(1) in cooperation with the European Space
25 Agency, maintain operations of the Solar and

1 Heliospheric Observatory/Large Angle and Spec-
2 trometric Coronagraph (referred to in this section as
3 ‘SOHO/LASCO’) for as long as the satellite con-
4 tinues to deliver quality observations; and

5 “(2) prioritize the reception of LASCO data.

6 “(d) ADDITIONAL CAPABILITY FOR SOLAR IMAG-
7 ING.—

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

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

19 “(3) CONSIDERATIONS.—In developing options
20 under paragraph (2), the Administrator of the Na-
21 tional Oceanic and Atmospheric Administration shall
22 consider commercial solutions, prize authority, aca-
23 demic and international partnerships, microsatellites,
24 ground-based instruments, and opportunities to de-

1 ploy the instrument or instruments as a secondary
2 payload on an upcoming planned launch.

3 “(4) COSTS.—In implementing paragraph (1),
4 the Administrator of the National Oceanic and At-
5 mospheric Administration shall prioritize a cost-ef-
6 fective solution.

7 “(5) OPERATIONAL PLANNING.—The Adminis-
8 trator of the National Oceanic and Atmospheric Ad-
9 ministration shall develop an operational contingency
10 plan to provide continuous space weather forecasting
11 in the event of a SOHO/LASCO failure.

12 “(6) BRIEFING.—Not later than 120 days after
13 the date of enactment of the Space Weather Re-
14 search and Forecasting Act, the Administrator of
15 the National Oceanic and Atmospheric Administra-
16 tion shall provide a briefing to the Committee on
17 Commerce, Science, and Transportation of the Sen-
18 ate and the Committee on Science, Space, and Tech-
19 nology of the House of Representatives on the op-
20 tions for building and deploying the instrument or
21 instruments described in paragraph (2) and the
22 operational contingency plan developed under para-
23 graph (5).

24 “(e) FOLLOW-ON SPACE-BASED OBSERVATIONS.—
25 The Administrator of the National Oceanic and Atmos-

1 pheric Administration, in coordination with the Secretary
2 of Defense, shall develop requirements and a plan for fol-
3 low-on space-based observations for operational purposes,
4 in accordance with the integrated strategy developed
5 under subsection (b).

6 “(f) REPORT.—Not later than 180 days after the
7 date of enactment of the Space Weather Research and
8 Forecasting Act, the Director of the Office of Science and
9 Technology Policy shall submit to the Committee on Com-
10 merce, Science, and Transportation of the Senate and the
11 Committee on Science, Space, and Technology of the
12 House of Representatives a report on the integrated strat-
13 egy under subsection (b), including the plans for follow-
14 on space-based observations under subsection (e).

15 “(g) GROUND-BASED OBSERVATIONS.—The Na-
16 tional Science Foundation, the Air Force, and where prac-
17 ticable in support of the Air Force, the Navy shall each—

18 “(1) maintain and improve, as necessary and
19 advisable, ground-based observations of the Sun in
20 order to help meet the priorities identified in section
21 60703(a); and

22 “(2) provide space weather data by means of its
23 set of ground-based facilities, including radars,
24 lidars, magnetometers, radio receivers, aurora and

1 airglow imagers, spectrometers, interferometers, and
2 solar observatories.

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

5 “(1) provide key data streams from the plat-
6 forms described in subsection (g) for research and to
7 support space weather model development;

8 “(2) develop experimental models for scientific
9 purposes; and

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

12 **“§ 60703. Research and technology**

13 “(a) USER NEEDS.—

14 “(1) IN GENERAL.—The Administrator of the
15 National Oceanic and Atmospheric Administration,
16 the Secretary of the Air Force, and where prac-
17 ticable in support of the Air Force, the Secretary of
18 the Navy, in conjunction with the heads of other rel-
19 evant Federal agencies, shall conduct a comprehen-
20 sive survey to identify and prioritize the needs of
21 space weather forecast users, including space weath-
22 er data and space weather forecast data needed to
23 improve services and inform research priorities and
24 technology needs.

1 “(2) CONTENTS.—In conducting the com-
2 prehensive survey under paragraph (1), the Adminis-
3 trator of the National Oceanic and Atmospheric Ad-
4 ministration, the Secretary of the Air Force, and
5 where practicable in support of the Air Force, the
6 Secretary of the Navy, at a minimum, shall—

7 “(A) consider the goals for forecast lead
8 time, accuracy, coverage, timeliness, data rate,
9 and data quality for space weather observa-
10 tions;

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

15 “(C) identify opportunities for new tech-
16 nologies and instrumentation to address the
17 needs identified under paragraph (1); and

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

20 “(3) PUBLICATION.—Not later than 1 year
21 after the date of enactment of the Space Weather
22 Research and Forecasting Act, the Administrator of
23 the National Oceanic and Atmospheric Administra-
24 tion, the Secretary of the Air Force, and where prac-

1 ticable in support of the Air Force, the Secretary of
2 the Navy, shall—

3 “(A) make the results of the comprehen-
4 sive survey publicly available; and

5 “(B) notify the Committee on Commerce,
6 Science, and Transportation of the Senate and
7 the Committee on Science, Space, and Tech-
8 nology of the House of Representatives of the
9 publication under subparagraph (A).

10 “(b) RESEARCH ACTIVITIES.—

11 “(1) BASIC RESEARCH.—The Director of the
12 National Science Foundation, Administrator of the
13 National Aeronautics and Space Administration, and
14 Secretary of Defense shall continue to carry out
15 basic research activities on heliophysics, geospace
16 science, and space weather and support competitive,
17 merit-based, peer-reviewed proposals for research,
18 modeling, and monitoring of space weather and its
19 impacts, including science goals outlined in Solar
20 and Space Physics Decadal surveys conducted by the
21 National Academy of Sciences.

22 “(2) MULTIDISCIPLINARY RESEARCH.—

23 “(A) FINDINGS.—Congress finds that the
24 multidisciplinary nature of solar and space
25 physics creates funding challenges that require

1 coordination across scientific disciplines and
 2 Federal agencies.

3 “(B) MULTIDISCIPLINARY RESEARCH.—
 4 The Director of the National Science Founda-
 5 tion, the Administrator of the National Oceanic
 6 and Atmospheric Administration, and the Ad-
 7 ministrator of the National Aeronautics and
 8 Space Administration shall pursue multidisci-
 9 plinary research in subjects that further our
 10 understanding of solar physics, space physics,
 11 and space weather.

12 “(C) SENSE OF CONGRESS.—It is the
 13 sense of Congress that the Administrator of the
 14 National Aeronautics and Space Administration
 15 and Director of the National Science Founda-
 16 tion should support competitively awarded
 17 Heliophysics Science Centers.

18 “(c) SCIENCE MISSIONS.—The Administrator of the
 19 National Aeronautics and Space Administration shall seek
 20 to implement missions that meet the science objectives
 21 identified in Solar and Space Physics Decadal surveys con-
 22 ducted by the National Academy of Sciences.

23 “(d) RESEARCH TO OPERATIONS.—

24 “(1) IN GENERAL.—The Administrator of the
 25 National Aeronautics and Space Administration, the

1 Director of the National Science Foundation, the
2 Administrator of the National Oceanic and Atmos-
3 pheric Administration, the Secretary of the Air
4 Force, and where practicable in support of the Air
5 Force, the Secretary of the Navy, shall—

6 “(A) develop a formal mechanism to tran-
7 sition National Aeronautics and Space Adminis-
8 tration, National Science Foundation, Air
9 Force, and Navy research findings, models, and
10 capabilities, as appropriate, to National Oceanic
11 and Atmospheric Administration and Depart-
12 ment of Defense space weather operational fore-
13 casting centers; and

14 “(B) enhance coordination between re-
15 search modeling centers and forecasting cen-
16 ters.

17 “(2) OPERATIONAL NEEDS.—The Adminis-
18 trator of the National Oceanic and Atmospheric Ad-
19 ministration and the Secretary of Defense, in coordi-
20 nation with the Administrator of the National Aero-
21 nautics and Space Administration and the Director
22 of the National Science Foundation, shall develop a
23 formal mechanism to communicate the operational
24 needs of space weather forecasters to the research
25 community.

1 “(e) TECHNOLOGY DEVELOPMENT.—

2 “(1) FINDINGS.—Congress finds that observa-
3 tions and measurements closer to the Sun and ad-
4 vanced instrumentation would provide for more ad-
5 vanced warning of space weather disturbances (as
6 defined in section 3 of the Space Weather Research
7 and Forecasting Act).

8 “(2) TECHNOLOGY AND INSTRUMENTATION DE-
9 VELOPMENT.—The Administrator of the National
10 Aeronautics and Space Administration and the Di-
11 rector of the National Science Foundation shall sup-
12 port the development of technologies and instrumen-
13 tation to improve space weather forecasting lead-
14 time and accuracy to meet the needs identified by
15 the Administrator of the National Oceanic and At-
16 mospheric Administration.

17 **“§ 60704. Space weather data**

18 “(a) IN GENERAL.—The Administrator of the Na-
19 tional Aeronautics and Space Administration and the Di-
20 rector of the National Science Foundation shall—

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

24 “(2) support model development and model ap-
25 plications to space weather forecasting.

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

5 (b) TECHNICAL AND CONFORMING AMENDMENTS.—

6 (1) REPEAL OF SECTION 809.—Section 809 of
 7 the National Aeronautics and Space Administration
 8 Authorization Act of 2010 (42 U.S.C. 18388) and
 9 the item relating to that section in the table of con-
 10 tents under section 1(b) of that Act (124 Stat.
 11 2806) are repealed.

12 (2) TABLE OF CHAPTERS.—The table of chap-
 13 ters of title 51, United States Code, is amended by
 14 adding after the item relating to chapter 605 the fol-
 15 lowing:

“607. Space weather 60701”.

16 **SEC. 3. SPACE WEATHER METRICS.**

17 (a) DEFINITIONS.—In this section:

18 (1) SPACE WEATHER DISTURBANCE.—The term
 19 “space weather disturbance” includes geo-electric
 20 fields, ionizing radiation, ionospheric disturbances,
 21 solar radio bursts, and upper atmospheric expansion.

22 (2) SPACE WEATHER BENCHMARK.—The term
 23 “space weather benchmark” means the physical
 24 characteristics and conditions describing the nature,

1 frequency, and intensity of space weather disturb-
2 ances.

3 (b) BENCHMARKS.—

4 (1) PRELIMINARY.—Not later than 90 days
5 after the date of enactment of this Act, the Space
6 Weather Interagency Working Group, established
7 under section 60701 of title 51, United States Code,
8 in consultation with academic and commercial ex-
9 perts, shall—

10 (A) assess existing data, the historical
11 record, models, and peer-reviewed studies on
12 space weather; and

13 (B) develop preliminary benchmarks, based
14 on current scientific understanding and the his-
15 torical record, for measuring solar disturbances.

16 (2) FINAL.—Not later than 18 months after
17 the date the preliminary benchmarks are developed
18 under paragraph (1), the Space Weather Inter-
19 agency Working Group shall publish final bench-
20 marks.

21 (3) REVIEW.—The Administrator of the Na-
22 tional Aeronautics and Space Administration shall
23 contract with the National Academy of Sciences to
24 review the benchmarks established under paragraph
25 (2).

1 (4) REVISIONS.—The Space Weather Inter-
 2 agency Working Group shall update and revise the
 3 final benchmarks under paragraph (2), as necessary,
 4 based on—

5 (A) the results of the review under para-
 6 graph (3);

7 (B) any significant new data or advances
 8 in scientific understanding that become avail-
 9 able; or

10 (C) the evolving needs of entities impacted
 11 by solar disturbances.

12 **SEC. 4. PROTECTION OF CRITICAL INFRASTRUCTURE.**

13 (a) IN GENERAL.—The Administrator of the Na-
 14 tional Oceanic and Atmospheric Administration, in con-
 15 sultation with the heads of other relevant Federal agen-
 16 cies, shall provide information about space weather haz-
 17 ards to the Secretary of Homeland Security for purposes
 18 of this section.

19 (b) CRITICAL INFRASTRUCTURE.—The Secretary of
 20 Homeland Security, in consultation with sector-specific
 21 agencies, the Administrator of the National Oceanic and
 22 Atmospheric Administration, and the heads of other rel-
 23 evant agencies, shall—

24 (1) include, in meeting national critical infra-
 25 structure reporting requirements, an assessment of

1 the vulnerability of critical infrastructure to space
2 weather events, as described by the space weather
3 benchmarks under section 3; and

4 (2) support critical infrastructure providers in
5 managing the risks and impacts associated with
6 space weather.

7 (c) PROHIBITION ON NEW REGULATORY AUTHOR-
8 ITY.—Nothing in subsection (b) may be construed to grant
9 the Secretary of Homeland Security any authority to pro-
10 mulgate regulations that was not in effect on the day be-
11 fore the date of enactment of this Act.

12 (d) DEFINITION OF SECTOR-SPECIFIC AGENCY.—In
13 this section, the term “sector-specific agency” has the
14 meaning given the term in Presidential Policy Directive—
15 21 of February 12, 2013 (Critical Infrastructure Security
16 and Resilience), or any successor.

17 **SEC. 5. PROTECTION OF NATIONAL SECURITY ASSETS.**

18 (a) IN GENERAL.—The National Security Council, in
19 consultation with the Office of the Director of National
20 Intelligence, the Secretary of Defense, and the heads of
21 other relevant Federal agencies, shall—

22 (1) assess the vulnerability of the national secu-
23 rity community to space weather events, as described
24 by the space weather benchmarks under section 3;
25 and

1 (2) develop national security mechanisms to
2 protection national security assets from space weath-
3 er threats.

4 (b) COOPERATION.—The Secretary of Defense, in
5 consultation with the heads of other relevant Federal
6 agencies, shall provide information about space weather
7 hazards to the National Security Council, Director of Na-
8 tional Intelligence, and heads of Defense Agencies for pur-
9 poses of this section.

10 **SEC. 6. ENSURING THE SAFETY OF CIVIL AVIATION.**

11 (a) IN GENERAL.—The Administrator of the Federal
12 Aviation Administration, in consultation with the heads of
13 other relevant Federal agencies, shall—

14 (1) assess the safety implications and vulner-
15 ability of the national airspace system by space
16 weather events, as described by the space weather
17 benchmarks under section 3;

18 (2) assess methods to mitigate the safety impli-
19 cations and effects of space weather on aviation
20 communication systems, aircraft navigation systems,
21 satellite and ground-based navigation systems, and
22 potential health effects of radiation exposure; and

23 (3) assess options for incorporating space
24 weather into operational training for pilots, cabin

1 crew, dispatchers, air traffic controllers, meteorolo-
2 gists, and engineers.

3 (b) SPACE WEATHER COMMUNICATION.—The Ad-
4 ministrator of the Federal Aviation Administration, in
5 consultation with the heads of other relevant Federal
6 agencies, shall develop methods to increase the interaction
7 between the aviation community and the space weather re-
8 search and service provider community.

Passed the Senate May 2, 2017.

Attest:

Secretary.

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