

115TH CONGRESS  
1ST SESSION

# S. 141

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

---

## IN THE SENATE OF THE UNITED STATES

JANUARY 12, 2017

Mr. PETERS (for himself, Mr. GARDNER, Mr. BOOKER, and Mr. WICKER) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

---

## A BILL

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,*

3 **SECTION 1. SHORT TITLE.**

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

6 **SEC. 2. SPACE WEATHER.**

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

1           **“CHAPTER 607—SPACE WEATHER**

“60701. Space weather.

“60702. Observations and forecasting.

“60703. Research and technology.

“60704. Space weather data.

2           **“§ 60701. Space weather**

3           “(a) FINDINGS.—Congress makes the following find-  
4 ings:

5                   “(1) Space weather events pose a significant  
6 threat to humans working in the space environment  
7 and to modern technological systems.

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

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

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

22                   “(5) In October 2015, the National Science and  
23 Technology Council published a National Space

1 Weather Strategy and a National Space Weather  
2 Action Plan seeking to integrate national space  
3 weather efforts and add new capabilities to meet in-  
4 creasing demand for space weather information.

5 “(b) FEDERAL AGENCY ROLES.—

6 “(1) FINDINGS.—Congress finds that—

7 “(A) the National Oceanic and Atmos-  
8 pheric Administration provides operational  
9 space weather forecasting and monitoring for  
10 civil applications, maintains ground and space-  
11 based assets to provide observations needed for  
12 forecasting, prediction, and warnings, and de-  
13 velops requirements for space weather fore-  
14 casting technologies and science;

15 “(B) the Department of Defense provides  
16 operational space weather forecasting, moni-  
17 toring, and research for the department’s  
18 unique missions and applications;

19 “(C) the National Aeronautics and Space  
20 Administration provides increased under-  
21 standing of the fundamental physics of the  
22 Sun-Earth system through space-based observa-  
23 tions and modeling, develops new space-based  
24 technologies and missions, and monitors space  
25 weather for NASA’s space missions;

1           “(D) the National Science Foundation pro-  
2           vides increased understanding of the Sun-Earth  
3           system through ground-based measurements,  
4           technologies, and modeling;

5           “(E) the Department of the Interior col-  
6           lects, distributes, and archives operational  
7           ground-based magnetometer data in the United  
8           States and its territories, and works with the  
9           international community to improve global geo-  
10          physical monitoring and develops crustal con-  
11          ductivity models to assess and mitigate risk  
12          from space weather induced electric ground cur-  
13          rents; and

14          “(F) the Federal Aviation Administration  
15          provides operational requirements for space  
16          weather services in support of aviation and for  
17          coordination of these requirements with the  
18          International Civil Aviation Organization, inte-  
19          grates space weather data and products into the  
20          Next Generation Air Transportation System,  
21          and conducts real-time monitoring of the  
22          charged particle radiation environment to pro-  
23          tect the health and safety of crew and pas-  
24          sengers during space weather events.

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

4           “(A) coordinate the development and im-  
5 plementation of Federal Government activities  
6 to improve the Nation’s ability to prepare,  
7 avoid, mitigate, respond to, and recover from  
8 potentially devastating impacts of space weath-  
9 er events; and

10           “(B) coordinate the activities of the Na-  
11 tional Space Weather Program members.

12           “(c) SPACE WEATHER INTERAGENCY WORKING  
13 GROUP.—In order to continue coordination of executive  
14 branch efforts to understand, prepare, coordinate, and  
15 plan for space weather, the National Science and Tech-  
16 nology Council shall establish an interagency working  
17 group on space weather that includes representatives of  
18 the Federal agencies participating in the National Space  
19 Weather Program, and of other Federal agencies, as ap-  
20 propriate.

21           “(d) NATIONAL SPACE WEATHER PROGRAM.—In  
22 order to understand and respond to the adverse effects  
23 of space weather, the National Space Weather Program  
24 shall leverage capabilities across participating Federal  
25 agencies, including—

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

3           “(2) the National Aeronautics and Space Ad-  
4           ministration;

5           “(3) the National Science Foundation;

6           “(4) the Department of Defense;

7           “(5) the Department of the Interior;

8           “(6) the Department of Homeland Security;

9           “(7) the Department of Energy;

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

12          “(9) the Department of State.

13          “(e) INTERAGENCY AGREEMENTS.—

14                 “(1) SENSE OF CONGRESS.—It is the sense of  
15          Congress that the interagency collaboration between  
16          the National Aeronautics and Space Administration  
17          and the National Oceanic and Atmospheric Adminis-  
18          tration on terrestrial weather observations pro-  
19          vides—

20                         “(A) an effective mechanism for improving  
21          weather and climate data collection while avoid-  
22          ing unnecessary duplication of capabilities  
23          across Federal agencies; and

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

1           “(2) INTERAGENCY AGREEMENTS.—The Ad-  
2           ministrators of the National Aeronautics and Space  
3           Administration and the Administrator of the Na-  
4           tional Oceanic and Atmospheric Administration shall  
5           enter into one or more interagency agreements pro-  
6           viding for cooperation and collaboration in the devel-  
7           opment of space weather spacecraft, instruments,  
8           and technologies in accordance with this chapter.

9   **“§ 60702. Observations and forecasting**

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

13          “(b) INTEGRATED STRATEGY.—

14                 “(1) IN GENERAL.—The Director of the Office  
15                 of Science and Technology Policy, in coordination  
16                 with the Administrator of the National Oceanic and  
17                 Atmospheric Administration, the Administrator of  
18                 the National Aeronautics and Space Administration,  
19                 the Director of the National Science Foundation,  
20                 and the Secretary of Defense, and in consultation  
21                 with the academic and commercial communities,  
22                 shall develop an integrated strategy for solar and  
23                 solar wind observations beyond the lifetime of cur-  
24                 rent assets, that considers—

1           “(A) the provision of solar wind measure-  
2           ments and other measurements essential to  
3           space weather forecasting; and

4           “(B) the provision of solar and space  
5           weather measurements important for scientific  
6           purposes.

7           “(2) CONSIDERATIONS.—In developing the  
8           strategy under paragraph (1), the Director of the  
9           Office of Science and Technology Policy shall con-  
10          sider small satellite options, hosted payloads, com-  
11          mercial options, international options, and prize au-  
12          thority.

13          “(c) CRITICAL OBSERVATIONS.—In order to sustain  
14          current space-based observational capabilities, the Admin-  
15          istrator of the National Aeronautics and Space Adminis-  
16          tration shall—

17                 “(1) in cooperation with the European Space  
18                 Agency, maintain operations of the Solar and  
19                 Heliospheric Observatory/Large Angle and Spec-  
20                 trometric Coronagraph (referred to in this section as  
21                 ‘SOHO/LASCO’) for as long as the satellite con-  
22                 tinues to deliver quality observations; and

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

24          “(d) ADDITIONAL CAPABILITY FOR SOLAR IMAG-  
25          ING.—



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

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

12           “(3) CONSIDERATIONS.—In developing options  
13 under paragraph (2), the Administrator of the Na-  
14 tional Oceanic and Atmospheric Administration shall  
15 consider commercial solutions, prize authority, aca-  
16 demic and international partnerships, microsatellites,  
17 ground-based instruments, and opportunities to de-  
18 ploy the instrument or instruments as a secondary  
19 payload on an upcoming planned launch.

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

24           “(5) OPERATIONAL PLANNING.—The Adminis-  
25 trator of the National Oceanic and Atmospheric Ad-

1       ministration shall develop an operational contingency  
2       plan to provide continuous space weather forecasting  
3       in the event of a SOHO/LASCO failure.

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

16              “(e) FOLLOW-ON SPACE-BASED OBSERVATIONS.—  
17      The Administrator of the National Oceanic and Atmos-  
18      pheric Administration, in coordination with the Secretary  
19      of Defense, shall develop requirements and a plan for fol-  
20      low-on space-based observations for operational purposes,  
21      in accordance with the integrated strategy developed  
22      under subsection (b).

23              “(f) REPORT.—Not later than 180 days after the  
24      date of enactment of the Space Weather Research and  
25      Forecasting Act, the Director of the Office of Science and

1 Technology Policy shall submit to the Committee on Com-  
2 merce, Science, and Transportation of the Senate and the  
3 Committee on Science, Space, and Technology of the  
4 House of Representatives a report on the integrated strat-  
5 egy under subsection (b), including the plans for follow-  
6 on space-based observations under subsection (e).

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

10 “(1) maintain and improve, as necessary and  
11 advisable, ground-based observations of the Sun in  
12 order to help meet the priorities identified in section  
13 60703(a); and

14 “(2) provide space weather data by means of its  
15 set of ground-based facilities, including radars,  
16 lidars, magnetometers, radio receivers, aurora and  
17 airglow imagers, spectrometers, interferometers, and  
18 solar observatories.

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

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

24 “(2) develop experimental models for scientific  
25 purposes; and

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

3   **“§ 60703. Research and technology**

4           “(a) USER NEEDS.—

5           “(1) IN GENERAL.—The Administrator of the  
6           National Oceanic and Atmospheric Administration,  
7           the Secretary of the Air Force, and where prac-  
8           ticable in support of the Air Force, the Secretary of  
9           the Navy, in conjunction with the heads of other rel-  
10          evant Federal agencies, shall conduct a comprehen-  
11          sive survey to identify and prioritize the needs of  
12          space weather forecast users, including space weath-  
13          er data and space weather forecast data needed to  
14          improve services and inform research priorities and  
15          technology needs.

16          “(2) CONTENTS.—In conducting the com-  
17          prehensive survey under paragraph (1), the Adminis-  
18          trator of the National Oceanic and Atmospheric Ad-  
19          ministration, the Secretary of the Air Force, and  
20          where practicable in support of the Air Force, the  
21          Secretary of the Navy, at a minimum, shall—

22                  “(A) consider the goals for forecast lead  
23                  time, accuracy, coverage, timeliness, data rate,  
24                  and data quality for space weather observa-  
25                  tions;

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

5           “(C) identify opportunities for new tech-  
6 nologies and instrumentation to address the  
7 needs identified under paragraph (1); and

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

10          “(3) PUBLICATION.—Not later than 1 year  
11 after the date of enactment of the Space Weather  
12 Research and Forecasting Act, the Administrator of  
13 the National Oceanic and Atmospheric Administra-  
14 tion, the Secretary of the Air Force, and where prac-  
15 ticable in support of the Air Force, the Secretary of  
16 the Navy, shall—

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

19           “(B) notify the Committee on Commerce,  
20 Science, and Transportation of the Senate and  
21 the Committee on Science, Space, and Tech-  
22 nology of the House of Representatives of the  
23 publication under subparagraph (A).

24          “(b) RESEARCH ACTIVITIES.—

1           “(1) BASIC RESEARCH.—As part of the Na-  
2           tional Space Weather Program, the Director of the  
3           National Science Foundation, Administrator of the  
4           National Aeronautics and Space Administration, and  
5           Secretary of Defense shall continue to carry out  
6           basic research activities on heliophysics, geospace  
7           science, and space weather and support competitive,  
8           merit-based, peer-reviewed proposals for research,  
9           modeling, and monitoring of space weather and its  
10          impacts, including science goals outlined in Solar  
11          and Space Physics Decadal surveys conducted by the  
12          National Academy of Sciences.

13           “(2) MULTIDISCIPLINARY RESEARCH.—

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

19           “(B) MULTIDISCIPLINARY RESEARCH.—As  
20           part of the National Space Weather Program,  
21           the Director of the National Science Founda-  
22           tion, the Administrator of the National Oceanic  
23           and Atmospheric Administration, and the Ad-  
24           ministrator of the National Aeronautics and  
25           Space Administration shall pursue multidisci-

1 plinary research in subjects that further our  
2 understanding of solar physics, space physics,  
3 and space weather.

4 “(C) SENSE OF CONGRESS.—It is the  
5 sense of Congress that the Administrator of the  
6 National Aeronautics and Space Administration  
7 and Director of the National Science Founda-  
8 tion should support competitively awarded  
9 Heliophysics Science Centers.

10 “(c) SCIENCE MISSIONS.—The Administrator of the  
11 National Aeronautics and Space Administration shall seek  
12 to implement missions that meet the science objectives  
13 identified in Solar and Space Physics Decadal surveys con-  
14 ducted by the National Academy of Sciences.

15 “(d) RESEARCH TO OPERATIONS.—

16 “(1) IN GENERAL.—The Administrator of the  
17 National Aeronautics and Space Administration, the  
18 Director of the National Science Foundation, the  
19 Administrator of the National Oceanic and Atmos-  
20 pheric Administration, the Secretary of the Air  
21 Force, and where practicable in support of the Air  
22 Force, the Secretary of the Navy, shall—

23 “(A) develop a formal mechanism to tran-  
24 sition National Aeronautics and Space Adminis-  
25 tration, National Science Foundation, Air

1 Force, and Navy research findings, models, and  
2 capabilities, as appropriate, to National Oceanic  
3 and Atmospheric Administration and Depart-  
4 ment of Defense space weather operational fore-  
5 casting centers; and

6 “(B) enhance coordination between re-  
7 search modeling centers and forecasting cen-  
8 ters.

9 “(2) OPERATIONAL NEEDS.—The Adminis-  
10 trator of the National Oceanic and Atmospheric Ad-  
11 ministration and the Secretary of Defense, in coordi-  
12 nation with the Administrator of the National Aero-  
13 nautics and Space Administration and the Director  
14 of the National Science Foundation, shall develop a  
15 formal mechanism to communicate the operational  
16 needs of space weather forecasters to the research  
17 community.

18 “(e) TECHNOLOGY DEVELOPMENT.—

19 “(1) FINDINGS.—Congress finds that observa-  
20 tions and measurements closer to the Sun and ad-  
21 vanced instrumentation would provide for more ad-  
22 vanced warning of space weather disturbances (as  
23 defined in section 3 of the Space Weather Research  
24 and Forecasting Act).



1           “(2) TECHNOLOGY AND INSTRUMENTATION DE-  
 2           VELOPMENT.—The Administrator of the National  
 3           Aeronautics and Space Administration and the Di-  
 4           rector of the National Science Foundation shall sup-  
 5           port the development of technologies and instrumen-  
 6           tation to improve space weather forecasting lead-  
 7           time and accuracy to meet the needs identified by  
 8           the Administrator of the National Oceanic and At-  
 9           mospheric Administration.

10   **“§ 60704. Space weather data**

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

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

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

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

23           (b) TECHNICAL AND CONFORMING AMENDMENTS.—

24                   (1) REPEAL OF SECTION 809.—Section 809 of  
 25                   the National Aeronautics and Space Administration

1 Authorization Act of 2010 (42 U.S.C. 18388) and  
 2 the item relating to that section in the table of con-  
 3 tents under section 1(b) of that Act (124 Stat.  
 4 2806) are repealed.

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

“607. Space weather ..... 60701”.

9 **SEC. 3. SPACE WEATHER METRICS.**

10 (a) DEFINITIONS.—In this section:

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

15 (2) SPACE WEATHER BENCHMARK.—The term  
 16 “space weather benchmark” means the physical  
 17 characteristics and conditions describing the nature,  
 18 frequency, and intensity of space weather disturb-  
 19 ances.

20 (b) BENCHMARKS.—

21 (1) PRELIMINARY.—Not later than 90 days  
 22 after the date of enactment of this Act, the Space  
 23 Weather Interagency Working Group, established  
 24 under section 60701 of title 51, United States Code,

1 in consultation with academic and commercial ex-  
2 perts, shall—

3 (A) assess existing data, the historical  
4 record, models, and peer-reviewed studies on  
5 space weather; and

6 (B) develop preliminary benchmarks, based  
7 on current scientific understanding and the his-  
8 torical record, for measuring solar disturbances.

9 (2) FINAL.—Not later than 18 months after  
10 the date the preliminary benchmarks are developed  
11 under paragraph (1), the Space Weather Inter-  
12 agency Working Group shall publish final bench-  
13 marks.

14 (3) REVIEW.—The Administrator of the Na-  
15 tional Aeronautics and Space Administration shall  
16 contract with the National Academy of Sciences to  
17 review the benchmarks established under paragraph  
18 (2).

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

23 (A) the results of the review under para-  
24 graph (3);

1 (B) any significant new data or advances  
2 in scientific understanding that become avail-  
3 able; or

4 (C) the evolving needs of entities impacted  
5 by solar disturbances.

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

7 (a) IN GENERAL.—The Administrator of the Na-  
8 tional Oceanic and Atmospheric Administration, in con-  
9 sultation with the heads of other relevant Federal agen-  
10 cies, shall provide information about space weather haz-  
11 ards to the Secretary of Homeland Security for purposes  
12 of this section.

13 (b) CRITICAL INFRASTRUCTURE.—The Secretary of  
14 Homeland Security, in consultation with sector-specific  
15 agencies, the Administrator of the National Oceanic and  
16 Atmospheric Administration, and the heads of other rel-  
17 evant agencies, shall—

18 (1) include, in meeting national critical infra-  
19 structure reporting requirements, an assessment of  
20 the vulnerability of critical infrastructure to space  
21 weather events, as described by the space weather  
22 benchmarks under section 3; and

23 (2) support critical infrastructure providers in  
24 managing the risks and impacts associated with  
25 space weather.

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

6           (d) DEFINITION OF SECTOR-SPECIFIC AGENCY.—In  
7     this section, the term “sector-specific agency” has the  
8     meaning given the term in Presidential Policy Directive–  
9     21 of February 12, 2013 (Critical Infrastructure Security  
10    and Resilience), or any successor.

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

12           (a) IN GENERAL.—The National Security Council, in  
13     consultation with the Office of the Director of National  
14     Intelligence, the Secretary of Defense, and the heads of  
15     other relevant Federal agencies, shall—

16                 (1) assess the vulnerability of the national secu-  
17     rity community to space weather events, as described  
18     by the space weather benchmarks under section 3;  
19     and

20                 (2) develop national security mechanisms to  
21     protection national security assets from space weath-  
22     er threats.

23           (b) COOPERATION.—The Secretary of Defense, in  
24     consultation with the heads of other relevant Federal  
25     agencies, shall provide information about space weather

1 hazards to the National Security Council, Director of Na-  
2 tional Intelligence, and heads of Defense Agencies for pur-  
3 poses of this section.

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

5 (a) IN GENERAL.—The Administrator of the Federal  
6 Aviation Administration, in consultation with the heads of  
7 other relevant Federal agencies, shall—

8 (1) assess the safety implications and vulner-  
9 ability of the national airspace system by space  
10 weather events, as described by the space weather  
11 benchmarks under section 3;

12 (2) assess methods to mitigate the safety impli-  
13 cations and effects of space weather on aviation  
14 communication systems, aircraft navigation systems,  
15 satellite and ground-based navigation systems, and  
16 potential health effects of radiation exposure; and

17 (3) assess options for incorporating space  
18 weather into operational training for pilots, cabin  
19 crew, dispatchers, air traffic controllers, meteorolo-  
20 gists, and engineers.

21 (b) SPACE WEATHER COMMUNICATION.—The Ad-  
22 ministrator of the Federal Aviation Administration, in  
23 consultation with the heads of other relevant Federal  
24 agencies, shall develop methods to increase the interaction

- 1 between the aviation community and the space weather re-
- 2 search and service provider community.

