



AMENDMENT NO. _____ Calendar No. _____

Purpose: In the nature of a substitute.

IN THE SENATE OF THE UNITED STATES—117th Cong., 2d Sess.

S. 3817

To improve the forecasting and understanding of tornadoes and other hazardous weather, and for other purposes.

Referred to the Committee on _____ and ordered to be printed

Ordered to lie on the table and to be printed

AMENDMENT IN THE NATURE OF A SUBSTITUTE intended to be proposed by _____

Viz:

1 Strike all after the enacting clause and insert the following:
2

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the "Tornado Observations
5 Research and Notification Assessment for Development of
6 Operations Act" or the "TORNADO Act".

7 **SEC. 2. DEFINITIONS.**

8 In this Act:

9 (1) **HAZARDOUS WEATHER AND WATER**
10 **EVENTS.**—The term "hazardous weather and water
11 events" means weather and water events that have
12 a high risk of loss of life or property, including—

1 (A) severe storms, such as hurricanes and
2 short-fused, small-scale hazardous weather or
3 hydrologic events produced by thunderstorms,
4 including large hail, damaging winds, torna-
5 does, and flash floods;

6 (B) winter storms, such as freezing or fro-
7 zen precipitation (including freezing rain, sleet,
8 and snow), or combined effects of freezing or
9 frozen precipitation and strong winds; and

10 (C) other weather hazards, such as ex-
11 treme heat or cold, wildfire, drought, dense fog,
12 high winds, river flooding and lakeshore flood-
13 ing.

14 (2) HISTORICALLY BLACK COLLEGE OR UNI-
15 VERSITY.—The term “historically Black college or
16 university” has the meaning given the term “part B
17 institution” in section 322 of the Higher Education
18 Act of 1965 (20 U.S.C. 1061).

19 (3) INSTITUTION OF HIGHER EDUCATION.—The
20 term “institution of higher education” has the
21 meaning given the term in section 101(a) of the
22 Higher Education Act of 1965 (20 U.S.C. 1001(a)).

23 (4) NATIONAL LABORATORY.—The term “Na-
24 tional Laboratory” has the meaning given the term

1 in section 2 of the Energy Policy Act of 2005 (42
2 U.S.C. 15801).

3 (5) TRIBAL GOVERNMENT.—The term “Tribal
4 government” means the recognized governing body
5 of any Indian or Alaska Native tribe, band, nation,
6 pueblo, village, community, component band, or com-
7 ponent reservation, individually identified (including
8 parenthetically) in the list published most recently as
9 of the date of enactment of this Act pursuant to sec-
10 tion 104 of the Federally Recognized Indian Tribe
11 List Act of 1994 (25 U.S.C. 5131).

12 (6) UNDER SECRETARY.—The term “Under
13 Secretary” means the Under Secretary of Commerce
14 for Oceans and Atmosphere.

15 **SEC. 3. HAZARDOUS WEATHER AND WATER EVENT RISK**
16 **COMMUNICATION.**

17 (a) IN GENERAL.—The Under Secretary shall main-
18 tain and improve the system of the National Oceanic and
19 Atmospheric Administration by which the risks of haz-
20 ardous weather and water events are communicated to the
21 general public, with the goal of informing action and en-
22 couraging response to prevent loss of life and property.

23 (b) HAZARD RISK COMMUNICATION IMPROVEMENT
24 AND SIMPLIFICATION.—

1 (1) IN GENERAL.—The Under Secretary shall
2 maintain a hazard risk communication office (in this
3 subsection referred to as the “Office”), for the pur-
4 poses of simplifying and improving the communica-
5 tion of hazardous weather and water event risks.

6 (2) TERMINOLOGY.—The Office shall identify,
7 eliminate, or modify unnecessary, redundant, or con-
8 fusing terms for hazardous weather and water event
9 communications and add new terminology, as appro-
10 priate.

11 (3) COMMUNICATIONS IMPROVEMENT.—The Of-
12 fice shall improve the form, content, and methods of
13 hazardous weather and water event communications
14 to more clearly inform action and increase the likeli-
15 hood that the public takes such action to prevent the
16 loss of life or property.

17 (4) EVALUATIONS.—The Office shall, in coordi-
18 nation with the performance branch of the National
19 Weather Service, develop metrics for that branch to
20 track and evaluate the degree to which hazardous
21 weather and water event communications result in
22 action and response.

23 (5) SUPPORT PLAN.—The Office shall develop a
24 plan for the purpose of supporting the activities de-
25 scribed in paragraph (3). The plan shall be periodi-

1 cally updated and informed by internal and extra-
2 mural research and the results of the evaluation of
3 hazardous weather and water event communications
4 conducted under paragraph (4).

5 (6) METHODS.—In carrying out this subsection,
6 the Office shall develop and implement recommenda-
7 tions that—

8 (A) are based on the best and most recent
9 understanding from social, behavioral, risk, and
10 communication science research;

11 (B) are validated by social, behavioral,
12 risk, and communication science, taking into ac-
13 count the importance of methods that support
14 reproduction and replication of scientific stud-
15 ies, use of rigorous statistical analyses, and, as
16 applicable, data analysis supported by artificial
17 intelligence and machine learning technologies;

18 (C) account for the needs of various demo-
19 graphics, vulnerable populations, and geo-
20 graphic regions;

21 (D) account for the differences between
22 various types of weather and water hazards;

23 (E) respond to the needs of Federal, State,
24 and local government partners and media part-
25 ners; and

1 (F) account for necessary changes in the
2 infrastructure, technology, and protocols for
3 creating and disseminating federally operated
4 watches and warnings.

5 (7) COORDINATION.—In implementing this Act,
6 the Office shall coordinate with—

7 (A) Federal partners, including National
8 Laboratories, Cooperative Institutes, and re-
9 gional integrated sciences and assessments pro-
10 grams;

11 (B) State and local government partners;

12 (C) Tribal governments;

13 (D) institutions of higher education; and

14 (E) media partners.

15 (8) TIMELINESS AND CONSISTENCY.—The Of-
16 fice shall develop best practices and guidance for en-
17 suring timely and consistent communication across
18 public facing platforms that disseminate hazardous
19 weather and water event information.

20 (c) HAZARD COMMUNICATION RESEARCH AND EN-
21 GAGEMENT.—

22 (1) IN GENERAL.—The Under Secretary shall
23 establish or maintain a research program—

24 (A) to modernize the creation and commu-
25 nication of risk-based, statistically reliable,

1 probabilistic hazard information to inform effec-
2 tive actions and responses to hazardous weather
3 and water events; and

4 (B) to improve the fundamental social, be-
5 havioral, risk, and communication science re-
6 garding hazardous weather and water event
7 communication.

8 (2) COORDINATION.—In carrying out the re-
9 search program required by paragraph (1), the
10 Under Secretary shall coordinate and communicate
11 with States, Tribal governments, localities, and
12 emergency managers on research priorities and re-
13 sults.

14 (3) PILOT PROGRAM FOR TORNADO HAZARD
15 COMMUNICATION REQUIRED.—

16 (A) IN GENERAL.—To further research
17 into hazard communication, the Under Sec-
18 retary, in collaboration with one or more eligible
19 institutions, shall establish a pilot program for
20 tornado hazard communication to test the effec-
21 tiveness of implementing the research conducted
22 under this subsection with respect to tornadoes.

23 (B) ELIGIBLE INSTITUTION DEFINED.—In
24 this paragraph, the term “eligible institution”
25 means any of the following:

1 (i) A historically Black college or uni-
2 versity located in an area of persistent pov-
3 erty that is subjected to frequent severe
4 weather, such as tornadoes, hurricanes,
5 and floods.

6 (ii) An institution of higher education
7 in close proximity to a National Weather
8 Service Weather Forecast Office of the Na-
9 tional Weather Service.

10 (d) DATA MANAGEMENT.—The Under Secretary
11 shall establish, maintain, and improve a central repository
12 system for the National Oceanic and Atmospheric Admin-
13 istration for social, behavioral, risk, and economic data re-
14 lated to the communication of hazardous weather and
15 water events, including data developed or received pursu-
16 ant to paragraphs (3), (4), and (5) of subsection (b).

17 (e) DIGITAL WATERMARKING.—The Under Secretary
18 shall develop methods to reduce the likelihood of unauthor-
19 ized tampering with online hazardous weather and water
20 event risk communication, such as developing digital wa-
21 termarks.

22 **SEC. 4. WARN-ON-FORECAST STRATEGIC PLAN.**

23 (a) IN GENERAL.—Not later than one year after the
24 date of the enactment of this Act, the Under Secretary
25 shall prepare and submit to Congress a strategic plan for

1 developing and prioritizing the implementation of high-
2 resolution probabilistic forecast guidance for hazardous
3 weather and water events using a next-generation weather
4 forecast and warning framework.

5 (b) PLAN ELEMENTS.—The strategic plan required
6 by subsection (a) shall include the following:

7 (1) A discussion of—

8 (A) the priorities and needs of vulnerable
9 populations and National Weather Service part-
10 ners; and

11 (B) high-performance computing, visualiza-
12 tion, and dissemination needs.

13 (2) A timeline and guidance for implementation
14 of—

15 (A) high-resolution numerical weather pre-
16 diction models;

17 (B) methods for meeting the high-perform-
18 ance computing, visualization, and dissemina-
19 tion needs discussed under paragraph (1)(B);

20 (C) real-time high-resolution probabilistic
21 forecasts;

22 (D) improved observations, including
23 through radars, satellites, and uncrewed aerial
24 systems;

1 (E) a flexible framework to communicate
2 clear and simple hazardous weather and water
3 event information to the public; and

4 (F) social, behavioral, risk, and commu-
5 nication research to improve the forecaster
6 operational environment and societal informa-
7 tion reception and response.

8 **SEC. 5. TORNADO RATING SYSTEM.**

9 (a) IN GENERAL.—The Under Secretary shall, in col-
10 laboration with such stakeholders as the Under Secretary
11 considers appropriate—

12 (1) evaluate the system used as of the date of
13 the enactment of this Act to rate the severity of tor-
14 nadoes; and

15 (2) determine whether updates to that system
16 are required to ensure that the ratings accurately re-
17 flect the severity of tornadoes.

18 (b) UPDATE REQUIRED.—If the Under Secretary de-
19 termines under subsection (a) that updates to the tornado
20 rating system are necessary, the Under Secretary shall up-
21 date the system.

22 **SEC. 6. POST-STORM SURVEYS AND ASSESSMENTS.**

23 (a) IN GENERAL.—The Under Secretary shall per-
24 form one or more post-storm surveys and assessments fol-
25 lowing each hazardous weather or water event determined

1 by the Under Secretary to be of sufficient societal impor-
2 tance to warrant a post-event survey and assessment.

3 (b) COORDINATION.—The Under Secretary shall co-
4 ordinate with Federal, State, and local governments, Trib-
5 al governments, private entities, and relevant institutions
6 of higher education when conducting post-storm surveys
7 and assessments under subsection (a) in order to optimize
8 data collection, sharing, and integration.

9 (c) DATA AVAILABILITY.—The Under Secretary shall
10 make the data obtained from each post-storm survey and
11 assessment conducted under subsection (a) available to the
12 public as soon as practicable after conducting the survey
13 and assessment.

14 (d) IMPROVEMENT.—The Under Secretary shall—

15 (1) investigate the role of uncrewed aerial sys-
16 tems in data collection during post-storm surveys
17 and assessments conducted under subsection (a);

18 (2) identify gaps in and update tactics and pro-
19 cedures to enhance the efficiency and reliability of
20 data obtained from post-storm surveys and assess-
21 ments; and

22 (3) increase the number of post-storm commu-
23 nity impact studies, including—

24 (A) surveying individual responses;

1 (B) conducting review of the accuracy of
2 prior risk evaluations;

3 (C) evaluating the efficacy of prior mitiga-
4 tion activity; and

5 (D) gathering survivability statistics.

6 (e) SUPPORT FOR EMPLOYEES.—The Under Sec-
7 retary shall provide training, resources, and access to pro-
8 fessional counseling to support the emotional and mental
9 health and well-being of employees conducting post-storm
10 surveys and assessments under subsection (a).

11 **SEC. 7. VORTEX-USA PROGRAM.**

12 (a) IN GENERAL.—Section 103 of the Weather Re-
13 search and Forecasting Innovation Act of 2017 (15 U.S.C.
14 8513) is amended—

15 (1) in the section heading, by striking “**TOR-**
16 **NADO WARNING IMPROVEMENT AND EXTEN-**
17 **SION**” and inserting “**VORTEX-USA**”;

18 (2) in subsection (a), by striking “establish a
19 tornado warning improvement and extension pro-
20 gram” and inserting “maintain a program for rap-
21 idly improving tornado forecast and warnings”;

22 (3) by striking subsections (c) and (d); and

23 (4) by adding at the end the following:

24 “(e) INNOVATIVE OBSERVATIONS.—The Under Sec-
25 retary shall ensure that the program required by sub-

1 section (a) periodically examines the value of incorporating
2 innovative observations with respect to the improvement
3 of tornado forecasts, predictions, and warnings, such as
4 acoustic or infrasonic measurements, observations from
5 phased array radars, and observations from mesonets.

6 “(d) WARNINGS.—The program required by sub-
7 section (a) shall—

8 “(1) continue the research necessary to develop
9 and deploy probabilistic weather forecast guidance
10 technology for tornadoes; and

11 “(2) incorporate, as appropriate, hazard com-
12 munication research.

13 “(e) RESEARCH.—

14 “(1) IN GENERAL.—The Under Secretary shall,
15 through the program required by subsection (a),
16 award grants for research that focuses on improv-
17 ing—

18 “(A) the social, behavioral, risk, commu-
19 nication, and economic sciences related to
20 vulnerabilities, risk communication, and delivery
21 of information critical for saving lives and prop-
22 erty related to tornadoes; and

23 “(B) the physical sciences, engineering,
24 and technology related to tornado formation,
25 the interactions of tornadoes with the built and

1 natural environment, and the interaction of tor-
2 nadoes and hurricanes.

3 “(2) PRIORITY INSTITUTIONS.—

4 “(A) IN GENERAL.—In awarding grants
5 under paragraph (1), the Under Secretary shall
6 prioritize awarding grants to minority-serving
7 institutions.

8 “(B) DEFINITION OF MINORITY-SERVING
9 INSTITUTION.—In this paragraph, the term ‘mi-
10 nority-serving institution’ means—

11 “(i) a part B institution (as defined in
12 section 322 of the Higher Education Act
13 of 1965 (20 U.S.C. 1061));

14 “(ii) a Hispanic-serving institution (as
15 defined in section 502(a) of that Act (20
16 U.S.C. 1101a(a));

17 “(iii) a Tribal College or University
18 (as defined in section 316(b) of that Act
19 (20 U.S.C. 1059c(b)));

20 “(iv) an Alaska Native-serving institu-
21 tion (as defined in section 317(b) of that
22 Act (20 U.S.C. 1059d(b)));

23 “(v) a Native Hawaiian-serving insti-
24 tution (as defined in section 317(b) of that
25 Act (20 U.S.C. 1059d(b)));

1 “(vi) a Predominantly Black Institu-
2 tion (as defined in section 318(b) of that
3 Act (20 U.S.C. 1059e(b)));

4 “(vii) an Asian American and Native
5 American Pacific Islander-serving institu-
6 tion (as defined in section 320(b) of that
7 Act (20 U.S.C. 1059g(b))); or

8 “(viii) a Native American-serving,
9 nontribal institution (as defined in section
10 319(b) of that Act (20 U.S.C. 1059f(b))).

11 “(f) AUTHORIZATION OF APPROPRIATIONS.—There
12 is authorized to be appropriated to the Under Secretary
13 to carry out this section \$7,500,000 for each of fiscal
14 years 2023 through 2030, of which not less than
15 \$2,000,000 each fiscal year shall be used for grants
16 awarded under subsection (e).”.

17 (b) CLERICAL AMENDMENT.—The table of contents
18 in section 1(b) of the Weather Research and Forecasting
19 Innovation Act of 2017 (Public Law 115–25; 131 Stat.
20 91) is amended by striking the item relating to section
21 103 and inserting the following:

 “Sec. 103. VORTEX-USA program.”.

22 **SEC. 8. REPORTS.**

23 (a) WEATHER RESEARCH AND FORECASTING INNO-
24 VATION ACT OF 2017.—

1 (1) IN GENERAL.—Section 403 of the Weather
2 Research and Forecasting Innovation Act of 2017
3 (15 U.S.C. 8543) is amended by striking subsection
4 (d).

5 (2) TECHNICAL AMENDMENT.—Section 403(a)
6 of such Act (15 U.S.C. 8543(a)) is amended by in-
7 serting “the” after “Director of”.

8 (b) NATIONAL OCEANIC AND ATMOSPHERIC ADMIN-
9 ISTRATION AUTHORIZATION ACT OF 1992.—Section 106
10 of the National Oceanic and Atmospheric Administration
11 Authorization Act of 1992 (Public Law 102–567; 106
12 Stat. 4274) is amended by striking subsection (e) (15
13 U.S.C. 1537).

14 **SEC. 9. GOVERNMENT ACCOUNTABILITY OFFICE REPORT**
15 **ON HAZARDOUS WEATHER AND WATER**
16 **ALERT DISSEMINATION.**

17 (a) IN GENERAL.—Not later than 540 days after the
18 date of the enactment of this Act, the Comptroller General
19 of the United States shall submit to the Committee on
20 Commerce, Science, and Transportation of the Senate and
21 the Committee on Science, Space, and Technology of the
22 House of Representatives a report that examines the infor-
23 mation technology infrastructure of the National Weather
24 Service of the National Oceanic and Atmospheric Adminis-
25 tration, specifically regarding the system for timely public

1 notification of hazardous weather and water event alerts
2 and updates.

3 (b) ELEMENTS.—The report required by subsection
4 (a) shall include the following:

5 (1) An analysis of the information technology
6 infrastructure of the National Weather Service, in-
7 cluding software and hardware capabilities and limi-
8 tations, including an examination of server and data
9 storage methods, broadband, data management, and
10 data sharing.

11 (2) An identification of secondary and tertiary
12 fail-safes for the timely distribution of hazardous
13 weather and water event alerts to the public.

14 (3) A determination of the extent to which pub-
15 lic notifications are delayed and an identification of
16 corrective measures that do not add additional noti-
17 fication time.

18 (4) An assessment of whether collaboration with
19 other Federal offices, States, or private entities
20 could reduce delays in notifications to the public.

21 (5) A description of actions being undertaken to
22 better identify critical steps in the hazards notifica-
23 tion process that may be vulnerable to disruption or
24 failure in the event of communication, technologic,
25 or computational failure.