

119TH CONGRESS  
1ST SESSION

**S.** \_\_\_\_\_

To improve the lead time, accuracy, and dissemination of forecasts of atmospheric rivers throughout the United States, and for other purposes.

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IN THE SENATE OF THE UNITED STATES

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Mr. PADILLA introduced the following bill; which was read twice and referred to the Committee on \_\_\_\_\_

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**A BILL**

To improve the lead time, accuracy, and dissemination of forecasts of atmospheric rivers throughout the United States, 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 “Improving Atmos-  
5 pheric River Forecasts Act”.

6 **SEC. 2. ATMOSPHERIC RIVERS FORECAST IMPROVEMENT**  
7 **PROGRAM.**

8 (a) IN GENERAL.—The Under Secretary, in collabo-  
9 ration with the weather enterprise in the United States  
10 and institutions of higher education, shall establish an at-

1 mospheric river forecast improvement program (in this  
2 section referred to as the “program”).

3 (b) PROGRAM ELEMENTS.—In carrying out the pro-  
4 gram, the Under Secretary shall seek to reduce the loss  
5 of life and property and economic losses from atmospheric  
6 rivers through the development and extension of, and re-  
7 search on, accurate, effective, and actionable forecasts and  
8 warnings, including by—

9 (1) establishing quantitative atmospheric river  
10 forecast skill metrics that include the benefits of dy-  
11 namical modeling, data assimilation, and machine  
12 learning improvements in the probabilistic forecasts  
13 of landfall location, extreme wind and precipitation,  
14 and cascading impacts;

15 (2) developing an atmospheric river forecast  
16 system within a unified forecast system, and advanc-  
17 ing next-generation coupled modeling systems, with  
18 the capability of providing seasonal to short-range  
19 atmospheric river forecasts that include forecasts of  
20 snow accumulation and other hydrologic compo-  
21 nents;

22 (3) advancing scientific understanding of the  
23 roles of atmospheric rivers in subseasonal-to-sea-  
24 sonal precipitation and probabilistic predictions at  
25 subseasonal and seasonal scales;

1           (4) developing tools and improved forecast  
2 products to predict periods of active or inactive at-  
3 mospheric river landfalls and inland penetration over  
4 the United States with a focus on addressing stake-  
5 holder and public needs related to perceiving, com-  
6 prehending, and responding to atmospheric river  
7 forecast improvements;

8           (5) enhancing the transition of research to op-  
9 erations through the testbeds of the National Oce-  
10 anic and Atmospheric Administration, including the  
11 evaluation of physical and social science, technology,  
12 and other research to develop products and services  
13 for implementation and use by relevant stakeholders;  
14 and

15           (6) incorporating social, behavioral, risk, com-  
16 munication, and economic sciences, including by col-  
17 lecting voluntary data regarding hazardous weather  
18 or water events.

19           (c) INNOVATIVE OBSERVATIONS, DATA ASSIMILA-  
20 TION, AND MODELING.—The Under Secretary shall en-  
21 sure the program periodically examines, tests, and evalu-  
22 ates the value of incorporating innovative observations,  
23 such as observations from radar, observations from crewed  
24 or uncrewed aircraft, novel airborne and satellite-based  
25 measurements, data from ocean buoys, data from soil

1 moisture monitoring systems, reservoir storage data, ob-  
2 servations from mesonets, or any observations, measure-  
3 ments, or data from other emerging technologies, with re-  
4 spect to the improvement of atmospheric river analyses,  
5 modeling, forecasts, predictions, and warnings.

6 (d) IMPROVED MODELING.—

7 (1) IN GENERAL.—Under the program, the  
8 Under Secretary may improve modeling for precipi-  
9 tation forecasts, with an emphasis on forecasting for  
10 complex terrain.

11 (2) IMPROVED PRECIPITATION FORECASTS.—

12 Improved precipitation forecasts pursuant to im-  
13 proved modeling under paragraph (1) should support  
14 improved water resource management and resilience  
15 to extreme water-related events, from floods to  
16 drought, which may include the use of enhanced  
17 streamflow prediction.

18 (3) ELEMENTS.—In improving modeling under  
19 paragraph (1), the Under Secretary may—

20 (A) develop, test, and operationalize proto-  
21 type high-resolution Atmospheric River Analysis  
22 and Forecasting System models through a re-  
23 search and operations partnership with partners  
24 outside the National Oceanic and Atmospheric  
25 Administration;

1 (B) enhance data assimilation of current  
2 and new satellite and ocean observations;

3 (C) improve data processing techniques;

4 (D) use artificial intelligence and machine  
5 learning methods as applicable;

6 (E) ensure the surface and subsurface ob-  
7 servations of the ocean meet the needs of at-  
8 mospheric river analysis and forecasting pre-  
9 dictions on time scales from days, to weeks, to  
10 months, to seasons; and

11 (F) improve or establish baseline weather  
12 monitoring service in areas that have histori-  
13 cally experienced, or are predicted to experi-  
14 ence, atmospheric rivers.

15 (e) ATMOSPHERIC RIVER RECONNAISSANCE.—

16 (1) IN GENERAL.—The Under Secretary shall  
17 acquire and sustain adequate crewed and uncrewed  
18 aircraft, scientific equipment, and personnel nec-  
19 essary to meet mission requirements annually from  
20 November 1 through March 31 to—

21 (A) ensure atmospheric river air reconnais-  
22 sance observations are available throughout the  
23 expected seasons of atmospheric rivers;

24 (B) meet air reconnaissance and research  
25 mission requirements of the National Oceanic

1 and Atmospheric Administration, including with  
2 respect to tropical cyclones, high-impact weath-  
3 er, sea ice, atmospheric chemistry, climate, air  
4 quality for public health, fire weather research  
5 and operations, and other missions, including  
6 marine animal surveys, post-damage surveys,  
7 and coastal erosion reconnaissance;

8 (C) ensure data and information collected  
9 by the aircraft are made available to all users  
10 for research and operations purposes;

11 (D) participate in the research and oper-  
12 ations partnership that guides flight planning  
13 and uses research methods to improve and ex-  
14 pand the capabilities and effectiveness of atmos-  
15 pheric river reconnaissance over time;

16 (E) develop data management strategies to  
17 ensure that data and metadata are adequately  
18 stewarded, maintained, and archived in accord-  
19 ance with collective benefit, authority to control,  
20 responsibility, and ethics principles (commonly  
21 known as “CARE” principles), findable, acces-  
22 sible, interoperable, and reusable principles  
23 (commonly known as “FAIR” principles), and  
24 the Foundations for Evidence-Based Policy-  
25 making Act of 2018 (Public Law 115–435; 132

1 Stat. 5529) and the amendments made by that  
2 Act, and preserve and curate such data and  
3 metadata in accordance with chapter 31 of title  
4 44, United States Code (commonly known as  
5 the “Federal Records Act of 1950”);

6 (F) maintain or establish within the Office  
7 of Oceanic and Atmospheric Research not fewer  
8 than one atmospheric river observatory, which  
9 shall include water vapor flux analyses and  
10 forecasts, radar and disdrometer precipitation  
11 analyses, and snow level radars in all States  
12 along the West Coast of the United States, in-  
13 cluding Alaska, to ensure equal and comprehen-  
14 sive coverage of that region; and

15 (G) undertake such other additional activi-  
16 ties as the Under Secretary, in consultation  
17 with the Secretary of the Air Force, considers  
18 appropriate to improve and grow the atmos-  
19 pheric river reconnaissance mission.

20 (f) IMPROVED ATMOSPHERIC RIVER HAZARD COM-  
21 MUNICATION.—Under the program, the Under Secretary  
22 shall consider research and development activities to—

23 (1) as appropriate, develop and refine methods  
24 to categorize the intensity of atmospheric rivers on

1 a quantitative scale and the impacts of such a scale  
2 in hazard communication;

3 (2) develop best practices for communication of  
4 atmospheric river events and hazards across regions  
5 of the United States;

6 (3) gather information from areas prone to at-  
7 mospheric rivers regarding levels of knowledge and  
8 preparedness, including responses to early forecasts  
9 and warnings by the National Oceanic and Atmos-  
10 pheric Administration; and

11 (4) explore strategies and effectiveness of com-  
12 municating that atmospheric river events are bene-  
13 ficial at lower intensities versus hazardous at higher  
14 intensities.

15 (g) PROGRAM PLAN.—Not later than 270 days after  
16 the date of the enactment of this Act, the Under Sec-  
17 retary, in consultation with the Secretary of the Air Force  
18 or the Commander of the 53rd Weather Reconnaissance  
19 Squadron of the Air Force Reserve Command, shall—

20 (1) develop a plan that details the specific re-  
21 search, development, data acquisition, partnerships  
22 with institutions of higher education, and technology  
23 transfer activities, as well as corresponding resources  
24 and timelines, necessary to achieve the goals of the  
25 program under subsection (b);



1           (2) submit that plan to the Committee on Com-  
2           merce, Science, and Transportation of the Senate  
3           and the Committee on Science, Space, and Tech-  
4           nology of the House of Representatives; and

5           (3) make that plan available to the public.

6           (h) DEFINITIONS.—In this section:

7           (1) INSTITUTION OF HIGHER EDUCATION.—The  
8           term “institution of higher education” has the  
9           meaning given that term in section 101(a) of the  
10          Higher Education Act of 1965 (20 U.S.C. 1001(a)).

11          (2) SEASONAL; SUBSEASONAL; UNDER SEC-  
12          RETARY; WEATHER ENTERPRISE.—The terms “sea-  
13          sonal”, “subseasonal”, “Under Secretary”, and  
14          “weather enterprise” have the meanings given those  
15          terms in section 2 of the Weather Research and  
16          Forecasting Innovation Act of 2017 (15 U.S.C.  
17          8501).