

119TH CONGRESS
1ST SESSION

S. 322

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

IN THE SENATE OF THE UNITED STATES

JANUARY 29, 2025

Mr. PADILLA (for himself and Ms. MURKOWSKI) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

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

1 and institutions of higher education, shall establish an at-
 2 mospheric river forecast improvement program (in this
 3 section referred to as the “program”).

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

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

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

23 (3) advancing scientific understanding of the
 24 roles of atmospheric rivers in subseasonal-to-sea-

1 sonal precipitation and probabilistic predictions at
 2 subseasonal and seasonal scales;

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

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

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

21 (c) INNOVATIVE OBSERVATIONS, DATA ASSIMILA-
 22 TION, AND MODELING.—The Under Secretary shall en-
 23 sure the program periodically examines, tests, and evalu-
 24 ates the value of incorporating innovative observations,
 25 such as observations from radar, observations from crewed

1 or uncrewed aircraft, novel airborne and satellite-based
 2 measurements, data from ocean buoys, data from soil
 3 moisture monitoring systems, reservoir storage data, ob-
 4 servations from mesonets, or any observations, measure-
 5 ments, or data from other emerging technologies, with re-
 6 spect to the improvement of atmospheric river analyses,
 7 modeling, forecasts, predictions, and warnings.

8 (d) IMPROVED MODELING.—

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

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

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

22 (A) develop, test, and operationalize proto-
 23 type high-resolution Atmospheric River Analysis
 24 and Forecasting System models through a re-
 25 search and operations partnership with partners

outside the National Oceanic and Atmospheric
Administration;

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

(C) improve data processing techniques;

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

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

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

(e) ATMOSPHERIC RIVER RECONNAISSANCE.—

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

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

1 (B) meet air reconnaissance and research
2 mission requirements of the National Oceanic
3 and Atmospheric Administration, including with
4 respect to tropical cyclones, high-impact weath-
5 er, sea ice, atmospheric chemistry, climate, air
6 quality for public health, fire weather research
7 and operations, and other missions, including
8 marine animal surveys, post-damage surveys,
9 and coastal erosion reconnaissance;

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

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

18 (E) develop data management strategies to
19 ensure that data and metadata are adequately
20 stewarded, maintained, and archived in accord-
21 ance with collective benefit, authority to control,
22 responsibility, and ethics principles (commonly
23 known as “CARE” principles), findable, acces-
24 sible, interoperable, and reusable principles
25 (commonly known as “FAIR” principles), and

1 the Foundations for Evidence-Based Policy-
2 making Act of 2018 (Public Law 115–435; 132
3 Stat. 5529) and the amendments made by that
4 Act, and preserve and curate such data and
5 metadata in accordance with chapter 31 of title
6 44, United States Code (commonly known as
7 the “Federal Records Act of 1950”);

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

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

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

1 (1) as appropriate, develop and refine methods
 2 to categorize the intensity of atmospheric rivers on
 3 a quantitative scale and the impacts of such a scale
 4 in hazard communication;

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

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

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

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

22 (1) develop a plan that details the specific re-
 23 search, development, data acquisition, partnerships
 24 with institutions of higher education, and technology
 25 transfer activities, as well as corresponding resources

1 and timelines, necessary to achieve the goals of the
 2 program under subsection (b);

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

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

8 (h) DEFINITIONS.—In this section:

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

13 (2) SEASONAL; SUBSEASONAL; UNDER SEC-
 14 RETARY; WEATHER ENTERPRISE.—The terms “sea-
 15 sonal”, “subseasonal”, “Under Secretary”, and
 16 “weather enterprise” have the meanings given those
 17 terms in section 2 of the Weather Research and
 18 Forecasting Innovation Act of 2017 (15 U.S.C.
 19 8501).

○