COMMITTEE ON
SCIENCE, SPACE AND TECHNOLOGY
CHAIRMAN BRIAN BABIN

SUBCOMMITTEE ON ENVIRONMENT
HEARING CHARTER

"Protecting Lives and Property: Harnessing Innovative Technologies to Enhance Weather Forecasting"

Wednesday, July 16, 2025
10:00 a.m.
2318 Rayburn House Office Building

Purpose
The purpose of this hearing is to examine emerging technologies for the collection of weather data and how the utilization of diverse sources of data can greatly enhance the accuracy and timeliness of weather forecasting.

Witnesses
- **Mr. Thomas Cavett**, Vice President of Government Affairs and Strategy, Tomorrow.io
- **Dr. John Nielsen-Gammon,** Texas State Climatologist; Director, Southern Regional Climate Center, Regents Professor
- **Dr. Waleed Abdalati,** Director, Cooperative Institute for Research in Environmental Science; Professor, Department of Geography, University of Colorado Boulder
- **Dr. Jayesh Kumar Gupta**, CEO, Silurian AI

Overarching Questions
- How well does the weather data currently being collected translate into forecasts that are useful to the communities that rely on them?
- Can weather data be better specialized to meet industry-specific needs of different economic sectors, emergency managers, and the meteorological community?
- How does the symbiosis of mesonet data and data collected and disseminated at the national level enhance the utility of weather forecasts?
- How does the scientific collaboration of academia and government advance forecasting capabilities?
- How can artificial intelligence (AI) and machine learning contribute to the suite of weather forecasting modeling tools currently in use?

- How accurate and timely were the forecasts before the flash floods in Kerr County, Texas, observed? What can be done to prevent a similar tragedy from occurring in the future?

Background

This hearing will include testimony from experts in the commercial weather, meteorological, research and development, and AI computing communities who contribute to the sustainability and accuracy of federally provided weather information. This conversation will explore what data is currently available and from which sources; how that data is used to generate local and regional weather products; the research underway and test beds that are demonstrating advances in observing systems; and how AI can improve weather forecast modeling and help fill gaps in the existing observation network.

Observational Data, Networks, and Providers

The value of weather observations to society has been recognized for centuries. However, it was not until the mid-1800s that such observations became useful for producing weather maps. Today, key drivers of progress in weather forecasting include improved observational data, data assimilation, and advanced modeling, including Numerical Weather Prediction and AI. Observation systems generally fall into four main categories: space-based remote sensing, atmospheric observations, surface observations, and ocean observations. Each plays a vital role in supporting accurate forecasts, as no single system can supply all the necessary data. Furthermore, data across these categories is not always interchangeable.

Since the launch of NASA's first weather observation satellite in 1960,[1] space-based remote sensing has largely been the purview of the federal government. However, Section 302 of the Weather Research and Forecasting Innovation Act of 2017 authorized the National Oceanic and Atmospheric Administration (NOAA) to procure commercial satellite data for use in its meteorological models.[2] The pilot program and contracting authority established under this law helped catalyze the expansion of the commercial weather data industry, transforming it into a significant provider of high-quality and timely data. This includes data collected from commercial weather satellites as well as instrumentation on commercial aircraft, offering both remote sensing and atmospheric observations. NOAA studies have concluded that the most cost-effective path forward to increasing the accuracy and timeliness of weather forecasting relies in part on a combination of government-owned and commercially provided high-quality data.[3]

Another critical source of observational data is the numerous mesonet networks that have coalesced under the National Mesonet Program (NMP) to provide vital local information, greatly enhancing weather predictions and warnings. The NMP is the central repository for the real-time collection and dissemination of non-federal surface, boundary layer, and tropospheric atmospheric weather observations in the U.S. It is made up of diverse public-private partnerships and acts as a resource to state and local agencies, businesses, researchers, and policymakers. The NMP's 35,000

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[1] Mersmann, K. (2023, July 26). Launch of TIROS 1, World's 1st Weather Satellite — This Week in Goddard History: March 31–April 6 - NASA. *NASA*. https://www.nasa.gov/history/launch-of-tiros-1-worlds-1st-weather-satellite-this-week-in-goddard-history-march-31-april-6/ Accessed July 1, 2025

[2] Weather Research and Forecasting Innovation Act of 2017, 15 U.S.C. 8501 (2017). PUBL025.PS

[3] *See* Nat'l Oceanic and Atmospheric Admin., The National Oceanic and Atmospheric Administration (NOAA) Satellite Observing System Architecture Study: Building a Plan for NOAA's 21st Century Satellite Observing System (May 31, 2018), *available at* https://www.regulations.gov/docket/NOAA-NESDIS-2018-0053/document.

stations/platforms significantly improve weather prediction, severe weather warnings, and emergency response for all regions of the country.[4]

Demand for accurate, timely weather forecasting continues to grow across a range of industries. Traditional users of such information are the agriculture, aviation, defense, utilities, and transportation sectors. But demand is also increasing in industries like mining, construction, entertainment (e.g., turf-related sports and amusement parks), renewable energy, and marine operations, where knowledge of weather conditions is critical to day-to-day decision-making and long-term planning.[5] These users rely not only on short-term forecasts but also on medium-range (such as seasonal and subseasonal time frames) and long-range predictions, as well as historical data.

The difference between climate and weather lies in time scale. Weather refers to the short-term atmospheric conditions at any given moment, while climate describes long-term patterns of weather that occur in a specific area over years, decades, or centuries.[6] State climatologists operate in 47 states and Puerto Rico, serving as essential conduits for delivering up-to-date information, data, and expertise directly from the federal government, primarily from NOAA and in state mesonets, to state agencies, legislators, and the public. In addition to acting as a central clearinghouse for national, state, and local data, state climatologists also provide guidance on the placement of new instruments and observational networks.[7]

Research

To continue advancing the accuracy and timeliness of weather forecasts, 17 NOAA Cooperative Institutes (CI), comprised of academic and non-profit resources, conduct research that supports NOAA's mission and strategic plan. For example, state agencies and local communities are particularly interested in subseasonal to seasonal forecasts. Subseasonal forecasts span approximately two weeks to three months, while seasonal forecasts cover three months to two years. Research in this area aims to improve predictive skills and expand available products, helping to bridge the gap between traditional weather and seasonal lead times. CIs also play a significant role in advancing observing system science. Through the development of regional testbeds, they help transition innovations from research to operational use, leading to improved forecasts of extreme precipitation events and flooding.

Emerging Technologies

The rapid rise of AI has profoundly influenced the evolution of weather forecasting and modeling. In February 2025, the European Center for Medium-Range Weather Forecasting (ECMWF) launched the Artificial Intelligence Forecasting System (AIFS), the first fully operational, open-access weather prediction model powered by machine learning. The AIFS covers the widest range of parameters to date, including vital fields such as wind and temperature, as well as details on

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[4] National Mesonet, *The National Mesonet Program,* https://nationalmesonet.us/

[5] *U.S. Weather Forecasting Services Market Size Report, 2030*. (n.d.). https://www.grandviewresearch.com/industry-analysis/us-weather-forecasting-services-market-report Accessed July 2, 2025.

[6] *What's the difference between climate and weather?* (n.d.). National Oceanic and Atmospheric Administration. https://www.noaa.gov/explainers/what-s-difference-between-climate-and-weather Accessed July 1, 2025.

[7] Foster, S., Fiebrich, C., Mahmood, R., AASC, Brinson, K., Edwards, N., Andresen, J., Lin, X., Atkins, J., Schargorodski, M., Redmond, C., Guinan, P., & Cooper, S. (2019). *Recommendations and best practices for mesonets*. https://stateclimate.org/docs/AASC%20Recommendations%20and%20Best%20Practices%20for%20Mesonets%20-%20Final,%20Ver%201;%20approved%2026%20Jun%2019.pdf

precipitation types from snow to rain. The system currently operates with a grid spacing of 28 km.[8]

In the U.S., several major tech companies, including Google, Nvidia, and Huawei, have developed AI-based forecasting models. The most recent is Aurora, an AI-driven weather model developed by Microsoft. The Aurora model can generate accurate 10-day forecasts at smaller scales than many other models. It was created to handle not only weather, but also any Earth system for which data is available.[9] That means it can be trained, relatively easily, to forecast things like air pollution and wave height in addition to weather events like tropical cyclones. While these AI-generated forecasts are still in the testing and development phase, and not yet used in operational settings, they represent a promising advancement in the future of weather system prediction.

Flash Floods in Kerr County, Texas and Ruidoso, New Mexico

The recent flash floods in central Texas and New Mexico are a stark reminder of the necessity for accurate and timely weather forecasts. Just as important is ensuring that those emergency forecasts reach emergency responders, local and state authorities, and the general public. More than 100 people died when the Guadalupe River rose 26 feet in a 45-minute period.[10] The National Weather Service (NWS) provided timely forecasts that started in earnest on the afternoon of Thursday, July 3, and became more urgent as additional forecasts were generated. The rain did not begin in the area until approximately 11:00 pm. The first Flash Flood Warning was issued at 11:41 pm, and a second warning with a considerable tag (more urgent) was issued at 1:14 am on Friday, July 4.[11] These warnings were broadcast three hours before the flooding began at low water crossings through Wireless Emergency Alerts on mobile phones and weather radios. However, incomplete cell phone coverage and lack of weather radios hamper the ability of NWS and local and state emergency managers to inform the public of impending danger. It is not known at this time where the disconnect occurred between the issuing of the flash flood warnings and people evacuating flood-prone areas.

Days later, the Ruidoso River in New Mexico rose 20 feet in less than an hour. NWS issued a Flash Flood Watch at approximately 8:55 am on Tuesday, July 8. This was upgraded to a Flash Flood Warning at 2:20 pm and a Flash Flood Emergency Warning at 2:47 pm.[12] The river did not start rising until 3:30 pm. Throughout the day, local authorities in the Village of Ruidoso issued alerts in concert with the NWS warnings. Three people tragically died as a result of the flash flood.

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[8] Lentze, G. (2025, February 25). *ECMWF's AI forecasts become operational*. ECMWF. https://www.ecmwf.int/en/about/media-centre/news/2025/ecmwfs-ai-forecasts-become-operational

[9] Dzombak, R. (2025, May 21). A.I. is poised to revolutionize weather forecasting. A new tool shows promise. - The 5 New York Times. https://www.nytimes.com/2025/05/21/climate/ai-weather-models-aurora-microsoft.html

[10] Sanders, B. (2025, July 7). *Texas flash floods: Timeline of disaster, rescue, and aftermath*. Laredo Morning Times. https://www.lmtonline.com/news/article/texas-hill-country-flash-flood-timeline-20759272.php

[11] Hua, K., Kelly, J., Nolan, N., & Cohen, P. (2025, July 7). *Timeline shows when emergency alerts warned of Texas flood disaster*. CBS News. https://www.cbsnews.com/news/texas-flood-emergency-alerts-timeline/

[12] Rodriguez, V. (2025, July 9). Timeline of the flash flood that hit Ruidoso. *KOAT*. https://www.koat.com/article/ruidoso-new-mexico-flood-timeline/65353875