COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON ENVIRONMENT
U.S. HOUSE OF REPRESENTATIVES
HEARING CHARTER

"A Task of EPIC Proportions: Reclaiming U.S. Leadership in Weather Modeling and Prediction"

Wednesday, November 20, 2019
2:00 P.M.
2318 Rayburn House Office Building

PURPOSE

The purpose of this hearing is to assess the development and implementation of the Earth Prediction Innovation Center (EPIC), which was recently authorized under the National Oceanic and Atmospheric Administration (NOAA) in the National Integrated Drought Information System Reauthorization Act of 2018, P.L. 115-423. It will be an opportunity to discuss the origins of EPIC, NOAA's short and long-term goals for the program, and its organization, management, and governance. It will focus on the challenges and opportunities of a community approach to numerical weather prediction and modeling, and include perspectives from NOAA, academia, the private sector, and other key members of the weather community.

WITNESSES

- **Dr. Neil Jacobs**, Assistant Secretary of Commerce for Environmental Observation and Prediction, performing the duties of Under Secretary of Commerce for Oceans and Atmosphere, National Oceanic and Atmospheric Administration (NOAA)
- **Dr. Cliff Mass**, Professor of Atmospheric Sciences, University of Washington
- **Dr. Peter P. Neilley (Knee-Lee),** IBM Distinguished Engineer and Director of Weather Forecasting Sciences and Technologies, The Weather Company, An IBM Business
- **Dr. Thomas Auligné (Oh-Leen-Yay),** Director of the Joint Center for Satellite Data Assimilation, University Corporation for Atmospheric Research (UCAR)

OVERARCHING QUESTIONS

- What is EPIC, and how was it developed?
- What are NOAA's and the broader weather community's vision for EPIC, and what are the short and long-term goals to get us there?
- How will EPIC restore U.S. leadership in weather forecasting?
- What should EPIC's organization, structure, and governance look like?
- How is NOAA engaging with the broader weather community in developing and implementing EPIC and how is it taking recommendations into consideration?
- What is the timeline for next steps in implementing EPIC?

- What should the roles of the federal, academic, private industry, and other members of the U.S. weather enterprise be in EPIC?
- Where should EPIC be hosted; should it be a virtual or physical center?
- How will EPIC attract the best talent to address forecasting and modeling challenges, and how will it support workforce development?
- What additional resources (i.e. computing needs) does NOAA need to successfully implement EPIC?

BACKGROUND

In 2012, Hurricane Sandy made it clear that American weather forecasting abilities lagged those of Europe. The European model[1] accurately predicted the sharp left turn the hurricane would take, making landfall and wreaking havoc on the U.S. East coast. The American model failed to predict this, instead estimating that Sandy would fade out over the Atlantic.[2]

Post-Sandy, Congress allocated significantly more funding to improve forecasting and research to operations (R2O) at NOAA; however, the U.S. still ranks third or fourth in the world in terms of forecast accuracy.[3] In order to bolster the accuracy of U.S. models and reclaim global leadership in weather forecasting, Congress has directed NOAA to establish the Earth Prediction Innovation Center (EPIC). The goal of EPIC is to foster collaboration within the broader U.S. weather community to address the longstanding gaps in R2O and forecasting accuracy.[4]

To accomplish the stated goal of "creating a community global weather research modeling system," NOAA aims to utilize cloud computing to enable wider access to data and code, reduce computing bottlenecks, and allow for research activities to be scaled across various computational systems.[5]

EPIC Timeline

The Weather Research and Forecasting Innovation Act (Weather Act) of 2017 (P.L. 115-25) directs NOAA to "prioritize improving weather data, modeling, computing, forecasting, and warnings for the protection of life and property, and for the enhancement of the national economy."[6] The National Integrated Drought Information System (NIDIS) Reauthorization Act of 2018 (P.L. 115-423) amends the Weather Act and directs NOAA to establish EPIC to enhance community efforts to develop and translate scientific and technological advancements into numerical weather prediction (NWP) and forecast operations. Section 4 of NIDIS outlines the following responsibilities for the EPIC program:

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[1] Developed by the European Center for Medium-Range Weather Forecasts
[2] https://www.aip.org/fyi/2019/noaa-betting-%E2%80%98epic%E2%80%99-drive-us-weather-forecast-innovation
[3] https://arstechnica.com/science/2016/06/the-us-weather-model-is-now-the-fourth-best-in-the-world/
[4] Ibid.
[5] P.L. 115-423, January 7 ,2019.
[6] P.L 115-25, April 18, 2017.

"(4) Advancing weather modeling skill, reclaiming and maintaining international leadership in the area of numerical weather prediction, and improving the transition of research into operations by—

    A. leveraging the weather enterprise to provide expertise on removing barriers to improving numerical weather prediction;

    B. enabling scientists and engineers to effectively collaborate in areas important for improving operational global numerical weather prediction skill, including model development, data assimilation techniques, systems architecture integration, and computational efficiencies;

    C. strengthening the National Oceanic and Atmospheric Administration's ability to undertake research projects in pursuit of substantial advancements in weather forecast skill;

    D. utilizing and leverage existing resources across the National Oceanic and Atmospheric Administration enterprise; and

    E. creating a community global weather research modeling system that—

        i. is accessible by the public;

        ii. meets basic end-user requirements for running on public computers and networks located outside of secure National Oceanic and Atmospheric Administration information and technology systems; and

        iii. utilizes, whenever appropriate and cost-effective, innovative strategies and methods, including cloud-based computing capabilities, for hosting and management of part or all of the system described in this subsection"[7]

In January 2019, NOAA and the National Center for Atmospheric Research (NCAR) signed a Memorandum of Agreement (MOA) establishing a partnership to create a common modeling infrastructure. The goal is for this infrastructure to be transparent, easily accessible, and used by both public and private researchers.[8] The MOA provides that NOAA and NCAR utilize existing investments to prioritize collaboration and is a step towards realizing EPIC's goal of community modeling.

On March 6-7, 2019, NOAA held an internal workshop with twenty employees to begin planning EPIC. There was a consensus from attendees that EPIC must provide a mechanism through which R2O can be advanced through community-developed improvements.[9]

In June 2019, NOAA distributed a Request for Information (RFI) to "gather ideas, recommendations, and best practices from industry on how to develop, meet the goals of and support a virtual" EPIC.[10] They specifically solicited advice on how to develop and execute the following seven areas of EPIC: software engineering, software infrastructure, user support services, cloud-based high performance computing, scientific innovation, management and planning, and external engagement and community modeling.

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[7] P.L. 115-423, January 7 ,2019.
[8] https://www.noaa.gov/media-release/noaa-and-ncar-partner-on-new-state-of-art-us-modeling-framework
[9] https://owaq.noaa.gov/portals/0/EPIC_Vision_paper_V5.0.pdf?ver=2019-06-04-103244-717
[10] https://www.fbo.gov/index?s=opportunity&mode=form&id=1c7429877ff32fa8c21a97985114e344&tab=core&_cview=0

On August 6-8, 2019, NOAA's Office of Weather and Air Quality (OWAQ), within Oceanic and Atmospheric Research (OAR), hosted a Community Workshop in Boulder, Colorado to engage the broader weather community and plan out the next steps for EPIC's development. More than 300 participants from government, academia, and industry participated to co-create a vision for the program and discuss pathways to advance community modeling and research to operations.[11] A report on the workshop is expected to be released in the near future.

The Future of EPIC

To make EPIC successful, the Environmental Information Services Working Group (EISWG) recommends that NOAA act quickly to implement EPIC's governance structure and processes, and to make EPIC's vision and values clear to the community.[12] EISWG recommends that NOAA engage the broader community in EPIC's development, including multiple agencies, the Cooperative Institutes, and other stakeholder groups. The group also notes that NOAA should invest immediately in cloud computing in order to bolster R2O and community involvement.[13]

The President's FY 2020 budget for NOAA requests an increase of $12,320,000 to support EPIC at a total of $15 million.[14] The Senate's FY 2020 Commerce, Justice, Science (CJS) appropriations bill sets aside no less than $7 million for NOAA to establish EPIC.[15] The House-passed FY 2020 CJS appropriations bill does not specifically call out EPIC but provides $10 million in High Performance Computing Initiatives to support NOAA research.[16]

Key Terms

Cloud-Based Computing Needs

EPIC will need to establish the first operational end-to-end NWP system that will be accessible to scientists and researchers in and outside of NOAA as part of the its high-performance computing (HPC) strategy.[17] As HPC is a limited resource, a cloud-based computing network could be the way forward to develop a system that can be scaled up and made accessible to those in and outside of NOAA, without requiring an increase in the "big iron" HPC machinery that is currently being used.[18] Cloud computing refers to the availability of computing services over the

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[11] https://owaq.noaa.gov/Resources/News/ArtMID/446/ArticleID/54

[12] https://sab.noaa.gov/sites/SAB/Documents/Meetings/SAB%20Meetings%202019/September%202019/EISWG-EPIC%20Letter%20Report%20to%20the%20SAB%20FINAL.pdf?ver=2019-09-03-130727-177

[13] https://sab.noaa.gov/sites/SAB/Documents/Meetings/SAB%20Meetings%202019/September%202019/EISWG-EPIC%20Letter%20Report%20to%20the%20SAB%20FINAL.pdf?ver=2019-09-03-130727-177

[14] https://www.corporateservices.noaa.gov/nbo/fy20_bluebook/NOAA-FY20-Congressional-Justification.pdf

[15] https://www.congress.gov/116/crpt/srpt127/CRPT-116srpt127.pdf

[16] https://www.congress.gov/116/crpt/hrpt101/CRPT-116hrpt101.pdf

[17] https://owaq.noaa.gov/portals/0/EPIC_Vision_paper_V5.0.pdf?ver=2019-06-04-103244-717

[18] Ibid.

Internet ("the cloud"), and can potentially offer faster processing and more data storage than traditional computing machinery.

At the EPIC Community Workshop in August 2019, there was a consensus that far more computer resources are required to succeed in world class weather prediction. Moreover, participants recognized the potential that cloud computing offers for NOAA and the community to co-develop a common modeling system. They stressed the importance of ensuring EPIC be readily adaptable to an evolving computing landscape.[19]

Community Modeling

Central to EPIC's vision of improving U.S. NWP and forecasting is building a community-based model that involves NOAA internal and external partners to increase the rate of knowledge transfer from research to an operational system. To accomplish the goal, NOAA is looking to design a community modeling infrastructure that public and private researchers can access and use.[20] To leverage the modeling skills that exist within the broader weather community, a common model is needed. At present, those in academia, the private sector, and any other non-federal entities face many barriers to accessing the models that NOAA uses for U.S. weather forecasts. These barriers prevent expertise that exists outside of NOAA to be incorporated into NWP models and forecasts, which hinders U.S. weather forecasting abilities. NOAA aims to remedy this by creating EPIC as a community-developed modeling center.[21]

Numerical Weather Prediction (NWP)

Numerical Weather Prediction (NWP) uses current observations of weather characteristics and processes them with computer models to forecast future weather conditions.[22] Numerical computer models process weather observations utilizing data assimilation to produce outputs such as temperature, precipitation, wind, and others. As outlined in the NIDIS Reauthorization Act of 2018, EPIC's purpose is to accelerate scientific and technological enhancements into the operational applications for numerical weather prediction. As outlined in NOAA's vision paper for EPIC, the initial focus is on improving NOAA's currently operational global medium range NWP application, called the Global Forecast System (GPS).[23]

Recommended Reading

NOAA's "A Vision Paper for the Earth Prediction Innovation Center (EPIC)" (updated 5/28/19)[24]

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[19] https://owaq.noaa.gov/Programs/EPIC
[20] https://www.noaa.gov/media-release/noaa-and-ncar-partner-on-new-state-of-art-us-modeling-framework
[21] https://www.noaa.gov/media-release/noaa-and-ncar-partner-on-new-state-of-art-us-modeling-framework
[22] https://www.ncdc.noaa.gov/data-access/model-data/model-datasets/numerical-weather-prediction
[23] Ibid.
[24] https://owaq.noaa.gov/portals/0/EPIC%20Vision%20paper%20V5.0.pdf?ver=2019-06-11-064803-163