

To: Lynn Scarlett, Chair, NOAA Science Advisory Board

CC: Robert Winokur, SAB Liaison to the EISWG
Everette Joseph, SAB Liaison to the EISWG
Cynthia Decker, NOAA SAB Executive Director

Date: 3 September 2019

SUBJECT: Environmental Information Services Working Group report and recommendations to the NOAA Science Advisory Board concerning the Earth Prediction Innovation Center

Dear Ms. Scarlett:

Given the prominence of the Earth Prediction Innovation Center (EPIC) in the amendment of the Weather Research and Forecasting Innovation Act of 2017 (P.L. 115–25) by the National Integrated Drought Information System Reauthorization Act of 2018 (P.L. 115-423), the Environmental Information Services Working Group (EISWG) is compelled to inform the NOAA Science Advisory Board (SAB) of recent developments and make recommendations concerning this important emerging effort.

This past 28 June, the EISWG dedicated a portion of its meeting to an update on the EPIC program provided by senior NOAA professionals; see Attachment A for a short summary of that update. Following the June meeting, EISWG members were provided with documents relevant to EPIC from NOAA web pages and the Community Modeling Advisory Committee. Further, NOAA hosted the EPIC Community Workshop in Boulder, CO, 6-8 August 2019. Three EISWG members (Colman, Petty, and Ramamurthy) participated in this workshop. The purpose of this workshop was to gain insight from a diverse group of potential partners, high-performance and Cloud computing experts, and the broader weather R&D community (i.e., academia and private industry) in the planning, development, and strategic vision for the EPIC. Subsequent to the workshop, the EISWG worked virtually between 26 August and 3 September 2019 to hear from these three members and to develop observations and recommendations to pass on to the SAB. This letter is the result of those deliberations.

Based on the information obtained from the various sources described in the preceding paragraph, **the EISWG strongly endorses the EPIC initiative** [as described in the summary report presented by Carr and Kinter on 8 August at the end of the Community

To: Lynn Scarlett, Chair, NOAA Science Advisory Board

Date: 3 September 2019

Subject: Environmental Information Services Working Group report and recommendations to the NOAA Science Advisory Board concerning the Earth Prediction Innovation Center

Workshop (Attachment B)]. EPIC is a very timely and important endeavor for both the research and operational numerical weather prediction (NWP) communities; one that has the potential to direct the priorities of US NWP R&D and R2O/O2R for years to come.

To help ensure the success of this important initiative, the EISWG recommends NOAA take quick and aggressive action in the following areas:

- **It is recommended that NOAA implement EPIC's governance structure and processes as soon as possible, with a focus on the managing institution, leadership team, and advisory boards, and providing the community clear statements of the EPIC vision, mission, and values.** Governance is one of the fundamental components of standing up an effective, efficient Center. Governance will be instrumental in enabling several aspects of the Center deemed critical for its success, including but not limited to: community engagement and culture, talent acquisition and retention, and scientific direction and scope. During the EPIC Workshop there was considerable discussion and general alignment that the EPIC management structure should exist outside of NOAA. While the EISWG does not have a unique perspective here, this structure would require special attention be paid to ensure operational forecasting priorities are successfully communicated and incorporated into EPIC. Further, the Working Group emphasizes that regardless of where EPIC is located, it is critical that a leadership team be quickly put in place that has the necessary intellectual grasp of the big picture and the required technical expertise to garner broad community support and respect. This leadership team must be fully committed to the initiative and able to devote 100% of its time and energy toward EPIC's success. Without a proper and agile governance structure in place, EPIC will struggle to reach its envisioned state.

The success of EPIC will be closely linked to its ability to be a community-focused organization, one that encourages and values input from all stakeholders and positions; therefore, there is a need to institute a governance framework that is capable of successfully representing broad community interests while remaining true to the goals and objectives of the Center. Moreover, EPIC's governance structure, processes, and values must be such

To: Lynn Scarlett, Chair, NOAA Science Advisory Board

Date: 3 September 2019

Subject: Environmental Information Services Working Group report and recommendations to the NOAA Science Advisory Board concerning the Earth Prediction Innovation Center

that they help in creating a culture of collaborative and inclusive cross-sector involvement, recognizing and respecting the diverse contributions of individuals, institutions, and organizations, particularly on the topics of computing, software engineering, and numerical modeling. It is important to explicitly call out that this collaboration must extend to the ocean and full Earth system communities and include institutions like NOAA/NOS and existing government/academic/industry partnership groups like IOOS, and the Navy.

- **It is recommended that NOAA work with the broader community to develop inclusive community engagement processes, and to anticipate and articulate the appropriate roles NOAA and other entities will play in EPIC.** The roles of potentially important players in the EPIC program have not been clearly defined. These players include UCAR/NCAR, in general, and JCSDA and the DTC, in particular; the various NOAA OAR laboratories and programs; NWS Centers; the Cooperative Institutes (CIs); and researchers/developers in the academic and private sectors. The current lack of specificity has produced confusion in the academic and private sector communities as to how they are to be involved. This recommendation should not be construed as encouraging detailed assignments or restricted roles, but rather as an encouragement for engagement and discussion on how a diverse set of players can work together to best leverage existing programs and efforts to achieve EPIC's vision.
- **It is recommended that early and direct efforts be made to welcome into the Unified Forecast System (UFS) research and development sandbox contributions from other dynamic cores, physical parameterization schemes, Earth-system observation strategies and data assimilation techniques (atmosphere and ocean) and models (e.g., MPAS, UKMO Unified Model).** EISWG feels it is essential that the FV3 dynamic core be the focal point of the UFS and hence the focus of most R&D in EPIC. Yet, there is great value to be had in learning from the operational characteristics and experiences of other operational NWP systems. This will likely result in advancing more quickly along the R2O pathway. In addition, to reclaim leadership in Earth system coupled-model prediction, it is critical even in these early steps of formation that groundwork be laid to aggressively pursue

To: Lynn Scarlett, Chair, NOAA Science Advisory Board

Date: 3 September 2019

Subject: Environmental Information Services Working Group report and recommendations to the NOAA Science Advisory Board concerning the Earth Prediction Innovation Center

contributions in the area of observations (ocean and atmosphere), data assimilation schemes, and boundary conditions between the different components of the Earth System. This also requires a significant amount of leveraging for the observations necessary for those who do the model-output comparisons, model validation, the data assimilation studies, and broad availability to the scientists and students who advance our understanding and improve the operational models.

- **It is recommended that NOAA initiate a multi-agency R&D partnership program into which NOAA and other agencies contribute significant multi-year resources.** The EPIC budget and related fiscal challenges are areas of general concern. The EPIC program had an initial \$5M for FY2019, \$15M in FY2020, and the same amount projected for FY2021. Given the scale of the problems to be addressed, and the cost of working in the Cloud, this is marginally enough money to open a small program office and establish a modest grants program. The \$15M/FY budget for the next two fiscal years is insufficient to grow the required vigorous program, so NOAA must recognize that to accomplish any real, sustainable gains quickly, it must not only request more funds through the federal budgeting process, but also entrain other entities across the federal meteorological R&D community. This will require EPIC leadership to consider carefully how EPIC benefits these other partnering agencies and ensure that each is considered an invested stakeholder into the effort.
- **It is recommended that NOAA organize its Cooperative Institutes that have existing capabilities in NWP and related areas into a nascent, distributed EPIC co-laboratory charged with quickly carrying out one or two narrowly focused R&D thrusts that have potential for near-term success.** EPIC must organize and move quickly to demonstrate that a distributed national collaboration can make significant contributions to improving model performance over the next 12 to 18 months (the time frame being driven by the federal budget cycle). Looking across NOAA, the types of (non-federal) personnel needed -- including some of the best and brightest recent graduates with MS and PhD degrees -- and the highly desirable linkages to the relevant NOAA laboratories are found in the NOAA Cooperative Institutes (CI). The CI's should inventory

To: Lynn Scarlett, Chair, NOAA Science Advisory Board

Date: 3 September 2019

Subject: Environmental Information Services Working Group report and recommendations to the NOAA Science Advisory Board concerning the Earth Prediction Innovation Center

existing programs and staff for alignment to EPIC priorities. In addition, if provided the necessary funds, the NOAA CIs have the ability to hire new staff quickly and to spin up new programs to expand and diversify the EPIC community, as they have existing administrative structures backed-up by the management of the host universities.

- **it is recommended that NOAA immediately invest in and execute a Cloud implementation plan to promote community engagement and in support of research-to-operations.** Attracting and maintaining broad community participation in the cloud environment where the UFS is hosted is another challenge that needs to be addressed early on. There will be a tendency for many members of the community to sit back and observe before committing to what has the potential to be an expensive and impactful transition from local modeling R&D to the cloud-hosted R&D that is a key part of EPIC. As such, EPIC needs core players and stakeholders to work together to remove obstacles, create incentives, and to be change agents or champions for the broader community.

For example, NOAA might appeal to the large commercial cloud providers for initial seed resources to reduce or eliminate the overhead required for researchers and developers to transition to the Cloud. This will be essential in the early stages of EPIC as well as a potentially smart investment by the commercial cloud providers. In addition, an effort to develop simple entry points for diverse graduate students, faculty and researchers, as well as thorough supporting documentation will be urgently needed. Further, within the Cloud environment, the more opportunities that can be provided to draw the community to participate the better. This could include investing in refactoring the existing code into Linux, or AIX of IBM, and ensuring it all remains open source. This would then become a fertile area of study for an inclusive and more diverse community of graduate students, faculty, and researchers. In order to facilitate community and collaborative development of the UFS, an extremely beneficial capability will be the availability of a GTS-like (Global Telecommunications System) capability in the cloud environment that delivers all needed observations and model output for real-time data assimilation and model initialization, testing, and evaluation.

To: Lynn Scarlett, Chair, NOAA Science Advisory Board

Date: 3 September 2019

Subject: Environmental Information Services Working Group report and recommendations to the NOAA Science Advisory Board concerning the Earth Prediction Innovation Center

In closing, the EISWG again strongly endorses the EPIC initiative. NOAA, and the broader Earth system modeling community, as well as its extensive stakeholder community, have the opportunity to make profound and valuable contributions to society by successfully implementing EPIC. The members of EISWG are both excited about and committed to supporting this effort and look forward to future conversations with NOAA leadership toward this end.

On behalf of the members of the EISWG,

John T. Snow

EISWG Co-Chair, and Dean Emeritus and Regents' Professor Emeritus of Meteorology,
The University of Oklahoma, Norman, OK

Brad Colman

EISWG Co-Chair, and Director of Weather Strategy, Bayer Crop Sciences - The
Climate Corporation, Seattle, WA

Attachments:

- A. Summary of EPIC update brief. June 2018 meeting of the EISWG
- B. Fred Carr and Jim Kinter, Summary and Recommendations from the EPIC Community Workshop in Boulder, CO, 6-8 August 2019