NOAA SCIENCE ADVISORY BOARD

2024 ENVIRONMENTAL INFORMATION SERVICES WORKING GROUP REPORT TO THE UNITED STATES CONGRESS

PRESENTED TO THE NOAA SCIENCE ADVISORY BOARD
BY THE ENVIRONMENTAL INFORMATION SERVICES WORKING GROUP (EISWG)

MARCH 19, 2024

2024 Environmental Information Services Working Group Report

to the United States Congress

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Section 1. INTRODUCTION

This is the seventh annual report to the United States Congress from the National Oceanic and Atmospheric Administration (NOAA) Science Advisory Board (SAB) Environmental Information Services Working Group (EISWG). It is made in accordance with Title IV, Sec. 401(c) of the Weather Research and Forecasting Innovation Act of 2017 (P.L. 115-25, signed 18 April 2017), and as amended (most recently by P.L. 115-423, 7 January 2019) (hereafter, the "Weather Act"), which assigns EISWG the responsibility to prepare and transmit an annual report, along with specific follow-on actions, to be completed as follows:

"ANNUAL REPORT.—Not less frequently than once each year, the Working Group shall transmit to the Science Advisory Board for submission to the Under Secretary a report on progress made by the National Oceanic and Atmospheric Administration in adopting the Working Group's recommendations. The Science Advisory Board shall transmit this report to the Under Secretary. Within 30 days of receipt of such report, the Under Secretary shall submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives a copy of such report."

The EISWG appreciates the Congressional interest in its work, and its members stand ready to meet with the Congress to provide additional details regarding the contents of this report.

NOTE: All EISWG reports referenced in this document can be found in the EISWG section of the SAB document repository https://sab.noaa.gov/report-library/ .

Section 2. REPORT OVERVIEW

The 2024 EISWG Report to Congress (RtC) is organized as follows:

- Section 3: States the urgent National need for NOAA's weather programs to meet rapidly increasing societal demands due, in part, to increasing environmental risk. The

section also places particular emphasis on the necessary and critical value of support provided by Congress.

- Section 4: Includes brief summaries of the three new EISWG reports with findings and recommendations approved by the SAB in 2023. The three reports are: (a) *the EISWG Report on a NESDIS Observing System Backbone; (b) the EISWG Report on Gap-Filling Radars; and, (c) the EISWG Report on the Global Oscillation Network Group (GONG) and its Successor Data Source for Space Weather.*
- Section 5: Highlights NOAA progress in adopting recent past EISWG recommendations (as required by the Weather Act). Attention is provided to specific areas where NOAA priorities, EISWG recommendations, and Congressional actions are aligned with significant positive impact.
- Section 6: Presents brief summary statements on three new EISWG topic areas that are in various stages of development within the EISWG action plan for 2024. They include: (a) Water and Drought, (b) Heat and Human Health, and (c) Deep Learning in Numerical Weather Prediction.
- Section 7: The report closes with a brief summary of priority takeaways and recommended next steps.

Section 3. URGENCY OF NOAA WEATHER PROGRAMS AND CONGRESSIONAL SUPPORT

The NOAA National Weather Service (NWS) mission includes providing observations, forecasts, and severe weather warnings covering the U.S., its territories, and its adjacent waters for the protection of life and property, and the enhancement of the nation's economy. NOAA's Billion Dollar Weather & Climate Disaster database tracks the most significant weather events impacting the U.S. economy, including wildfire, drought, extreme heat, flooding, severe storms (including tornadoes), tropical storms, winter storms, and freezes (https://www.ncei.noaa.gov/access/billions/). The 376 major disasters cataloged since 1980 have caused over $2.66 trillion in damage and over 16,000 deaths, affecting all 50 states and 3 territories. These are alarming statistics. Many efforts across NOAA programs offer critical mitigation against these increasingly extreme events, continuing to save countless lives, and preventing even greater economic losses.

Past EISWG Reports to Congress (e.g., the 2023 report) have further emphasized that the number of Billion Dollar Weather and Climate Disasters per year has increased by an order of magnitude, rising from an average of 3.3 events per year in the 1980s, to an average of 22 events per year in the 2020s. In 2023 alone, the U.S. logged a record 28 severe weather events that crossed the billion dollar damage threshold. On average, this is equivalent to experiencing a major weather-related economic disaster every two weeks. This disturbing trend requires the NWS to maintain a nearly continuous state of high alert,

moving quickly from initiating crisis-level support for the duration of one major disaster, to then preparing for the next event. In addition, this demand on NWS resources is only further exacerbated by follow-on impacts from an initial event (e.g., enhanced flash flooding due to burn scars following a wildfire).

Faced with these increasing demands for weather information, and the urgent need to continue to improve the accuracy, lead time, and communication of weather forecasts and warnings for all Americans, Congress requested, and the NOAA Science Advisory Board (SAB) delivered, the Priorities for Weather Research (PWR) report in December 2021 (https://sab.noaa.gov/wp-content/uploads/PWR-Report_December-2021.pdf). That report, assembled by over 150 subject matter experts in weather-related fields, was developed to provide Congress with the information necessary to prioritize federal investments in weather research and forecasting over the next decade. The PWR report identifies 11 overarching priority areas for investment, provides 33 recommendations, and identifies 102 specific critical actions. It includes 10 immediate first steps identifying foundational research and development needs, infrastructure investments, and areas where rapid actions will produce significant impacts. Critical investments are identified along the full environmental information value chain from data collection, through Earth system modeling, to communication of forecasts and warnings to people in need. Taken together, the recommendations provide a transformational roadmap for investment that NOAA continues to reference in its annual budgetary processes. The EISWG pays considerable attention to the PWR Report as a comparison benchmark when considering NOAA expressed actions and priorities, as well as when the EISWG is considering new areas for review.

Congress has also recognized the need for increased investments in NOAA to enable its mission of protecting lives and property, and of promoting economic prosperity and environmental resiliency, across all of America. That Congressional commitment is manifest through the investments enabled by the Bipartisan Infrastructure Law (BIL) of 2021 and the Inflation Reduction Act (IRA) of 2022. Despite these significant and transformational investments, challenges remain. Most notably, funding for the sustained operations of NOAA's infrastructure, including Earth system observing networks, forecast models, and communications systems, remains below that required to meet the increasing demand. The result is observational gaps that are not being filled, aging technologies that are not being replaced, advanced Earth-system and probabilistic models that lack computational resources for implementation, and data dissemination systems that are stressed in times of need. Lack of funding is also impacting staffing levels, resulting in not being able to fill critical staff vacancies. Additionally, increased staffing pressures are impacting existing staff, particularly as workload demands are

increasing due to more frequent extreme weather events, contributing to personnel “burn-out.”
An unfortunate but common response to EISWG recommendations is that NOAA concurs with the concept but lacks the sustained funds to implement them unless other essential programs are cut. A zero-sum game approach of adjusting how we carve up the existing financial resources can no longer satisfy the growing diversity of needs. We are falling behind in our investments to build the NWS of the future. It is past time to grow the pie.

One specific and critical action Congress is already taking is the reauthorization of the Weather Act, to both continue and refine a clear statement of National weather and forecast needs. The EISWG’s role in this process is codified in Section 401 of the 2017 Weather Act and it appreciates the continued Congressional interest in its work. The EISWG believes it has provided significant value in its advisory roles as specified in the Weather Act of 2017. The EISWG believes its continuing relevance and productivity would benefit from the explicit reiteration of its specific roles in the Weather Act Reauthorization under consideration by the current Congress. The version of the Weather Act Reauthorization approved by the House Committee on Science, Space, and Technology (H.R.6093) makes no mention of the EISWG.

Section 4. NEW EISWG REPORTS AND RECOMMENDATIONS

4.A. EISWG Report on an NESDIS Observing System Backbone

The EISWG presented its Report on a NESDIS Observing System Backbone Framework to the SAB, which was approved at its November 2023 meeting. The report was developed by the EISWG, in consultation with external subject matter experts and NOAA experts. In brief, an observing system backbone consists of a standard set of measurements that will reliably exist into the foreseeable future. Government and industry rely on NOAA to maintain an operational observing system, but it is possible that a portion of the observations could be provided by private industry. In discussions with the EISWG study team, NOAA indicated that access to alternative-source data is desirable, and the concept of a backbone could contribute to successfully accomplishing that objective.

An increasingly capable private industry can deliver competitive and innovative data sources, and Federal agencies are, at times, challenged to balance development with program continuity. This makes it, at times, appealing to acquire operational data from external-to-NOAA sources across the Enterprise. However, challenges arise due to a mismatch between priorities across these sectors. Operational systems require reliable, high-fidelity data with high assurance of continuity and stability; private industry is driven by the demands of the marketplace and must be agile and adaptable. This agility promotes

innovation, but can make it challenging to maintain continuity in support of an operational system.

The report documents findings from the study process, suggests a series of guidelines for establishing an observational backbone, and presents five recommendations to NOAA:
1. NOAA should employ a backbone approach to integrating alternative-source observations, with the nature of that backbone determined through a process involving a formal decision and implementation framework.
2. The backbone should be architected and implemented through a process that is data and use-centric, not sensor- or platform-centric. It should treat backbone and alternative-source observations as a system to be optimized across performance, cost, and risk, recognizing the benefits and risks of each component.
3. Observing system elements employing a backbone approach should design and implement the backbone as an enabler for the overall observational data element (ODE) system.
4. As much as possible, NOAA should define a strategy for continuously assessing and mitigating risks to alternative-source data availability and access as a part of its backbone approach.
5. The backbone approach is applicable to radio occultation (RO) in particular, with important backbone roles apparently as yet unfulfilled by alternative-source providers; NOAA should plan the RO element to include a backbone.

In addition, the report highlights the importance of any NOAA data-buy strategy needing to ensure open accessibility to all datasets as a core requirement. While this report reflects the initial charter to address needs within NESDIS for spaceborne observations, the recommendations can be reasonably extended to address similar needs throughout NOAA.

4.B. EISWG Report on Gap-Filling Radars

The NOAA NWS has identified future radar solutions as a “Top 10” priority. While the EISWG strongly supports this strategic priority, gaps or otherwise poor radar coverage, especially in traditionally underserved communities and where terrain limits the usefulness of the Weather Surveillance Radar 88 Doppler (WSR 88-D) Network (the current network of 160 high-resolution S-band Doppler weather radars jointly operated by the NWS, the Federal Aviation Administration (FAA), and the U.S. Department of Defense) is putting Americans at risk now.

In light of this immediate need for expanded radar coverage, especially with increasingly frequent and extreme weather (severe storms, rainfall, and floods), the EISWG submitted its Report on Radar Gaps to the SAB in November 2023. The report highlights how the

Nation's need for gap-filling radars has only grown since the 2021 PWR Report recommendations, and emphasizes the urgency of taking action given the social equity implications and extreme weather impacts on people in vulnerable communities. The report's findings outline: how current WSR 88-D radar coverage creates additional vulnerability for already underrepresented and vulnerable populations; differences between gap-filling radars and WSR 88-D radars; the origins of radar gaps; how gap-filling radars can help; and how this presents an opportunity for NOAA to help fulfill its responsibility to protect public safety.

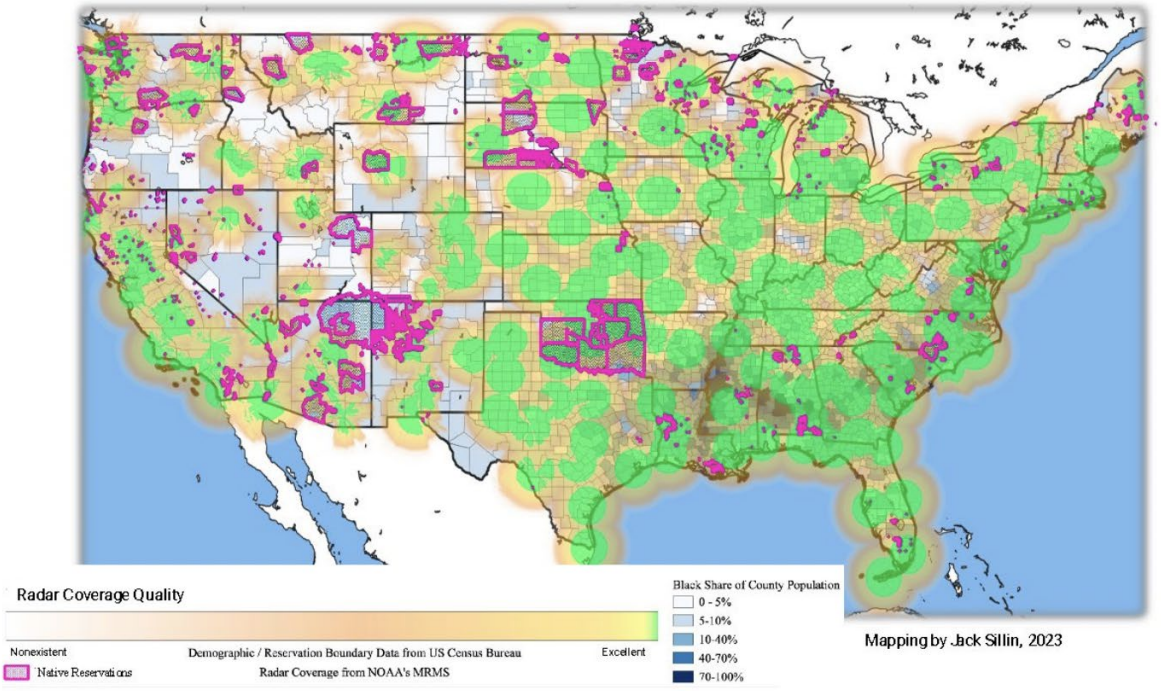

Figure 1. Radar coverage for American Indian Tribal Lands and for Black American-proportionate county populations.

Figure 1 shows the unfortunate juxtaposition of network radar coverage (at different altitudes) with two underrepresented and vulnerable populations, namely, native American tribal lands and black American population concentrations. While unintended, the poor coverage for these and other groups has real and significant impacts from undetected weather events.

Three recommendations were made in the report, including: (1) establish a gap-filling radar data strategy and architecture (following the NESDIS backbone approach), (2) more fully

integrate commercially available data directly into operations, and (3) act immediately to implement the gap-filling radar strategy.

Following the report's submission, the EISWG was briefed by the NWS Director that, in response to the report, the 0.2 degree lowest elevation angle was implemented at Mobile, AL, on 6 Mar 2024, and the 0.4 degree lowest elevation angle was implemented at Birmingham, AL, on 7 Mar 2024. Data from these low angles are live and available to the public.

This is an encouraging indicator that the NWS is doing all it can within the current budget on the current infrastructure. Unfortunately, with the aforementioned radar gaps along with an aging infrastructure, this only bandaids the issue and does not holistically address the overall strategic radar requirements. While not part of the EISWG report on radar gaps, increasing urgency is arising from the lack of a clear plan to replace the aging Weather Surveillance Radar 88 Doppler (WSR 88-D) Network. It is already beyond its initial life expectancy, with extensions becoming increasingly difficult and costly. Unfortunately, progress on a replacement strategy has been disappointingly slow and there is no identified replacement technology, network design strategy or funding plan.

4.C. Global Oscillation Network Group (GONG) and its Successor Data Source for Space Weather

The report discusses the important role of the GONG in today's operational space weather program. The GONG is a network of six solar observatories distributed around the globe providing continuous observations of the sun. This network plays a key role in forecasting solar drivers of geomagnetic storms and associated geomagnetic activity, which can impact global positioning systems (GPS), electric power transmission, satellite communications, and satellite drag. Anticipating the onset of these events is one of the major priorities for the NOAA Space Weather Prediction Center (SWPC). The current GONG network is reaching the end of its operational life (unlikely to continue beyond 2032), risking a significant setback in today's operational space weather program. The National Solar Observatory (NSO) has planned for the design of a next generation Ground-based solar Observing Network (ngGONG). The proposal, pending at the National Science Foundation (NSF), has yet to receive funding, at least partly due to the absence of an expressed NOAA operational interest.

The EISWG report concludes that "GONG provides a vital data source for space weather operations, and it is nearing end of life. The ngGONG project is the most straightforward replacement. It will maintain present operational capabilities and provide observations for future requirements. The time window to complete ngGONG prior to the demise of GONG is closing." The report recommends that NOAA/NWS financially support the design phase

for ngGONG to ensure the initiation of the project in a timely manner. In March 2024, NOAA provided a letter of support to NSF reaffirming NOAA's commitment to continue to work with NSF and other Federal space weather partners during the design phase and, consistent with current practices, continue the operational support of GONG and its successor ngGONG.

Section 5: NOAA PROGRESS IN ADOPTING EISWG RECOMMENDATIONS

The 2023 EISWG Report to Congress included a comprehensive list and review of all past top-level recommendations. In this year's report, new responses from NOAA on recent studies are discussed first, followed by a short subset of other reports highlighting related recent NOAA progress.

5.A. Subseasonal and Seasonal (S2S) Forecasting Innovation

In October 2020, NOAA provided the S2S report to Congress as required by the Weather Act of 2017, entitled "Subseasonal and Seasonal Forecasting Innovation: Plans for the Twenty-First Century." The EISWG reviewed this report and provided its review to NOAA (via the SAB) in August 2022. As described in the 2023 EISWG Report to Congress, the EISWG concluded that overall, NOAA's S2S report was responsive to Congressional tasking, and NOAA's S2S programs and plans provide an excellent framework to continue advancing S2S forecast products and decision support services. The EISWG review provided eight Summary Recommendations and thirteen Specific Review Result Recommendations.

In July 2023, NOAA provided its response to the EISWG's review. NOAA concurred with nearly all recommendations provided by the EISWG, and indicated its intent and plans to act on each specific recommendation. Nonetheless, there was little actual reported progress. This is likely the result of multiple underlying factors, including insufficient funding and/or insufficient adjustments in priorities. The EISWG will continue to monitor NOAA's plans and actions with regard to this response, and make further recommendations via the SAB as warranted. The EISWG has been pleased with NOAA's increased emphasis on Social, Behavioral and Economic Sciences (SBES) across all mission areas, and will continue to stress their importance in the development and prioritization of S2S products and services. One excellent example recently briefed to EISWG is the Global Systems Laboratory's Fire Weather Testbed where an SBES focus on user needs supports research to operations transitions.

5.B. Data Dissemination Challenges Statement

In June 2021, the EISWG submitted the *Statement Concerning the Ongoing NWS Data Dissemination Challenges.* It was a comprehensive statement of concern regarding

challenges in reliability, scalability, and timeliness of critical NOAA foundational data. This effort was directly triggered by a series of alarming failures and NOAA actions (e.g., throttling private industry data access and failures in operational chat services). As noted in earlier reports (including the Report to Congress in 2023), NOAA's rapid response successfully mitigated the immediate crisis to the credit of both NOAA and the Congress. We return to this statement here as we continue to see that subsequent longer term work (described below) continues to improve the situation.

The 2023 EISWG Report to Congress noted a planned key enhancement to NWSChat. The legacy NWSChat was unreliable and outdated, increasing the risk of outages during critical situations. NWSChat 2.0, delivered on the Slack platform, was declared fully operational in August 2023 - within one year from the initial procurement and with one of the fastest deployments Slack has ever seen among its 40M+ users. The new system is user-friendly, reliable, mobile-friendly, and enables forecasters and their partners to share forecasts, audio, and video in real-time, greatly enhancing Impact-Based Decision Support Services (IDSS) for NWS core partners. This is a tremendous win for the NWS.

The EISWG is generally encouraged by NOAA's prioritization of enhancing IDSS, such as through GSL's IDSS Engine project. These efforts link strongly to PWR recommendation ID-4.1., "*to examine for whom, in what hazard scenarios, when, and how forecast uncertainty (probabilistic) information is advantageous versus when it is not, including whether and when it's potentially detrimental.*"

Another encouraging area of planned enhancements in data dissemination is AWIPS in the Cloud. Upon full implementation, the NWS will enhance its operations in two ways: (1) by allowing for distributed staff, which can expand mutual aid opportunities and recruitment and retention efforts; and (2) strengthen IDSS support to core partners by ensuring full access to the suite of data necessary to perform the role of an incident meteorologist. This effort warrants continued prioritization by the NWS and the Congress.

A third area of progress that was highly encouraged by EISWG was greater use of commercial cloud services. The NOAA Open Data Dissemination (NODD) program was implemented to share environmental data with the public using Amazon Web Services, Microsoft Azure, and Google Cloud Platform. This has been especially useful for sharing operational model forecast results that were previously sequestered behind the NOAA firewall and inaccessible to the public. The result is more reliable access to a broader array of forecasts, including the first public access to the operational hurricane forecast model runs. This has also broadened the community that can use the operational forecasts for scientific research, resulting in new pathways for feedback to NOAA on model performance and potential improvements.

5.C Hurricane Forecast Improvement Program (HFIP)

Hurricanes have caused more economic damage than all other Billion Dollar Weather and Climate Disasters combined (51.8% since 1980) (NCEI). The Weather Act requires NOAA to maintain a project to improve hurricane forecasting, namely, NOAA's Hurricane Forecast Improvement Program (HFIP). HFIP's strategic plan includes sections on improving hurricane track and intensity forecasts, storm surge forecasts, and research on the communication of forecasts and warnings. In response to NOAA's HFIP strategic plan, EISWG developed 5 summary and 21 individual recommendations in 2020, and has tracked NOAA progress in our annual Reports to Congress since 2021.

In the most significant advancement in NOAA hurricane forecasting since the introduction of the Hurricane Weather Research and Forecast (HWRF) model in 2007, NOAA's HFIP successfully transitioned to operations the new Hurricane Analysis and Forecast System (HAFS) during the 2023 Hurricane Season. HAFS is a regional-scale coupled atmosphere-ocean model with advanced physics that continues to be evaluated and enhanced for improved skill in forecasting hurricane track, intensity and size. This achievement in the HFIP strategic plan was only possible through disaster supplemental investments by Congress, and dedicated efforts of NOAA hurricane researchers working together with their external science and technology partners. In parallel, significant improvements to NOAA's data-assimilative global Real Time Ocean Forecast System (RTOFS), the single source of the ocean initial conditions used in every NOAA operational hurricane forecast since 2019, continue to be made. The ongoing RTOFS improvements are also accelerated through disaster supplemental support from Congress to activities that include the NOAA-led Integrated Ocean Observing System (IOOS) Hurricane Glider partnership between NOAA (NOS, OAR & NWS), Navy (as envisioned in the CENOTE Act), and numerous academic partners (engaged through IOOS). Similarly, four NOAA OAR social science pilot studies, also supported through Congressional disaster supplementals, collected unique human behavioral data on increasingly effective methods of communicating hurricane warnings to threatened populations. The above examples demonstrate the value of Congressional supplemental funding in accelerating hurricane research and its transition to operations.

Despite these significant advances with measurable positive impacts, challenges remain. Limited-duration supplemental investments do accelerate ongoing research and transitions to operations, but successful transitions must be supported by sustained operational funds that are already stretched to the breaking point. In addition, the HFIP strategic plan has only been funded at the 66% level for years, with a significant unfunded gap being research and transitions to extend hurricane storm surge forecasts beyond the original two-days-before-landfall lead time. Short lead times are often insufficient to provide actual storm surge forecast input to local evacuation decisions from an approaching storm. The NOS

Storm Surge program has filled a critical research gap, but the process to transition this research for operational hurricane forecasting requires computing infrastructure not available to National Hurricane Center (NHC) forecasters. Similarly, during the 2023 hurricane season, for the sixth year running, the IOOS Hurricane Glider partnership provided over 100,000 profiles of subsurface ocean temperature and salinity for assimilation in RTOFS to improve the representation of essential ocean features impacting hurricane intensity in the HAFS initial conditions. Despite this proven observational efficiency and impact through supplemental funding, sustained operational support for NOAA's Uncrewed Systems hurricane fleet, both surface and subsurface, is lacking.

5.D Observing System Simulation Experiments (OSSEs)

The original EISWG report on the Use of Observing System Simulation Experiments (OSSEs) at NOAA was approved by the SAB in April of 2019. The EISWG 2023 Report to Congress (RtC) reiterated the motivation behind OSSEs as one pathway to assess the value of new observing systems on model generated forecast guidance, especially as models increasingly adopt a coupled Earth system approach. The 2023 RtC further provided an update on progress, and a reassessment of challenges, such as the importance of elevating the visibility of the current Quantitative Observing System Assessment Program (QOSAP) in NOAA OAR, and continuing to expand QOSAP's application areas beyond its successful satellite data assessments to a broader array of Earth system observations.

In 2023, the NOAA Modeling Team (NMT), part of NOAA's Earth System Integration Board (ESIB), developed the NOAA Modeling Strategy Strategic Plan 2024-2033 (https://repository.library.noaa.gov/view/noaa/56332). The strategy is designed to unify, align and leverage NOAA research, operations and applications to deliver a world-class, widely-accessible, fully-coupled Earth Modeling System supported by a robust portfolio of observing systems. The increasing need for both OSSEs with simulated datasets, and for data-denial Observing System Experiments (OSEs) with actual datasets, is now specifically called out in Objective 2.2 of this Strategic Plan.

Section 6. EISWG TOPICS IN DEVELOPMENT

EISWG currently has three topics in development: (a) Water and Drought, (b) Heat and Human Health, and (c) Deep Learning in Numerical Weather Prediction.

(a) Water and Drought: Water extremes and their cascading impacts, from drought to flood, are national issues that are especially acute in the western states. More accurate Quantitative Precipitation Forecasts (QPFs) with longer lead times and probabilistic information are required for water management. Accurate QPFs can enable more flexible

water management through use of Forecast-Informed Reservoir Operations. Better QPFs require better forecasts of the storms that produce extreme precipitation, which is primarily driven in the western U.S. by atmospheric rivers (ARs). Aircraft and buoy observations of essential atmospheric structures, particularly ARs, when combined with extensive forecast ensembles, offer valuable insights for probabilistic QPF several days in advance. Operationalizing these methods is crucial. Climate projections indicate a rising occurrence of both droughts and intense rainfall events.

(b) Heat and Human Health: Extreme heat is the leading cause of weather-related fatalities in the U.S. (https://www.weather.gov/hazstat/). Based on the most recent NWS statistics, there were over twice as many heat-related deaths in 2022 than documented in the 30-year average. The Fifth National Climate Assessment (https://nca2023.globalchange.gov/) indicates that heat waves are occurring more often, longer-lasting, and more intense, affecting the entire nation, especially those most vulnerable. The NOAA, along with other Federal agencies, has prioritized extreme heat education, preparedness, and response efforts.

(c) Deep Learning in Numerical Weather Prediction: Artificial Intelligence (AI) and Machine Learning (ML) are topics of general interest across the NOAA SAB. EISWG is delving into the use of deep learning for numerical weather prediction. The rapidly rising interest in this area stems from its early promising outcomes. Our aim is to provide recommendations on how to enhance weather forecasts by integrating deep learning alongside ongoing advancements in numerical weather prediction models. The EISWG also recognizes the potential important role that NOAA could play in setting values and guiding principles, supporting infrastructure, data quality and access, licensing, etc.

Section 7. SUMMARY

This seventh annual Report to Congress highlights numerous examples of how NOAA, through annual budget and supplemental funding prioritization, have taken steps to implement recommendations identified within the PWR report and by the EISWG. This progress is positive and promising in response to the changing threat landscape. However, despite these accomplishments, there are urgent needs and increasing threats that must be addressed including aging infrastructure, increasing demands, and threat of burn-out on dedicated staff.

Our Nation's investment in the provision of weather services falls short of what is needed and directly prevents the full benefit of what is technologically and scientifically possible in

this area. This is contributing to unnecessary loss of life and significant economic losses. As such, the EISWG prioritizes the following actions for NOAA consideration or next steps:

- Implement the series of guidelines and five recommendations regarding the NESDIS Observing System Backbone Framework.
- Move forward with gap-filling radars, which provide coverage for gaps or otherwise poor radar coverage, especially in traditionally underserved communities.
- Aggressively complete the development of dependent technology and move toward deployment of the next generation of surveillance radars.
- Prioritize recommendations presented within the EISWG Subseasonal and Seasonal (S2S) Report.
- Support the broader HFIP strategic plan (including storm surge and social sciences), and the sustained operations of Earth system observation networks for improved hurricane forecasts.
- Continue to work with NSF and other Federal space weather partners during the ngGONG design phase, and, consistent with current practices, continue the operational support of GONG and its successor ngGONG.
- Continue to prioritize future funding toward recommendations within the PWR report, including NOAA's increased emphasis on Social, Behavioral and Economic Sciences.

To accomplish the above bullets and support the NOAA mission, Congress must appropriately fund the NWS and move away from the zero-sum game. This is necessary to reduce or eliminate interruptions in operations, provide for replacements for aging infrastructure, fully implement projects supported through supplemental funding that have demonstrated value, and expand NOAA's significant societal and economic value.

The EISWG welcomes NOAA and Congress to leverage the collective expertise of this group to facilitate the advancement of these plans, as appropriate, to aid NOAA's mission of supporting science, service and stewardship. We respectfully request that Congress consider explicit language in the pending Weather Act Reauthorization to reiterate the vital role of EISWG. The EISWG is committed to collaborating effectively and contributing to the success of the recommendations noted above. Please let us know if you have any questions, comments, or concerns, or if the EISWG can be of further assistance.