

# Meeting of the NOAA Science Advisory Board

November 15-16, 2023

Location: DoubleTree Silver Spring  
8777 Georgia Avenue  
Silver Spring, Maryland

Presentations for this meeting have been posted on the Science Advisory Board (SAB) website:

<https://sab.noaa.gov/past-meetings/past-meeting-documents/#Nov2023>

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**SAB members in attendance:**

Mr. John Kreider, President, Kreider Consulting LLC (Chair); Mr. Jon Allan, Senior Advisor, Senior Academic and Research Program Officer, School for Environment and Sustainability, University of Michigan; Mr. Jesse Ausubel, Director, Program for the Human Environment, The Rockefeller University; Dr. Ilene Carpenter, Earth Sciences Segment Manager, Hewlett Packard Enterprise; Mr. David Grimes, President and CEO, Grimes Consulting; Mr. W. Christopher Lenhardt, Domain Scientist, Renaissance Computing Institute, University of North Carolina at Chapel Hill; Dr. Brooke Fisher Liu, Professor of Communication, The Graduate School, University of Maryland; Dr. Bonnie McCay, Distinguished Professor Emerita, Department of Human Ecology School of Environmental & Biological Sciences, Rutgers University; Dr. Zhaoxia Pu, Professor, Department of Atmospheric Sciences, University of Utah; Dr. Martin Storksdieck, Director, STEM Research Center and Professor, College of Education and School of Public Policy, Oregon State University; Dr. Steve Weisberg, Executive Director, Southern California Coastal Water Research Project; and Dr. Anthony Wu, Executive Director, AeroMarine LLC.

**SAB working group chairs in attendance:**

Dr. Kirstin Dow, Climate Working Group (CWG); Dr. Joellen Russell, Climate Working Group (CWG); Ms. Molly McCammon, Ecosystem Sciences and Management Working Group (ESMWG); Dr. Brad Colman, Environmental Information Services Working Group (EISWG); Dr. Scott Glenn, Environmental Information Services Working Group (EISWG); Dr. Rocky Lopes, Tsunami Science and Technology Advisory Panel (TSTAP); and Ms. Corina Allen, Tsunami Science and Technology Advisory Panel (TSTAP).

**NOAA senior management and Line Office representatives in attendance:**

Dr. Rick Spinrad, Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator; Ms. Rachael A. Dempsey, Deputy Assistant Administrator for Navigation, Observations, and Positioning, NOAA's National Ocean Service; RADM Nancy Hann, Director, NOAA Office of Marine and Aviation Operations, and Director, NOAA Commissioned Officer Corps; Dr. Sarah Kapnick, NOAA Chief Scientist; Dr. Steve Thur, Assistant Administrator, Oceanic and Atmospheric Research; Dr. Francisco Werner, Director of Scientific Programs and Chief Science Advisor, NOAA Fisheries; and Mr. Tony LaVoi, Chief Data Officer, Office of the Chief Information Officer.

## **Staff for the Science Advisory Board in attendance:**

Ms. Casey Stewart, Executive Director and Designated Federal Officer (DFO); Mr. Joseph Fillingham, Alternate DFO; Ms. Karin Bucht; and Ms. Katherine Longmire.

## **Opening Statement of the Chair**

John Kreider, Kreider Consulting and Chair, NOAA SAB

John Kreider welcomed the attendees to the meeting and noted that a change in plans forced him to participate remotely. He asked the speakers to adhere to the time limitations for their presentations.

## **SAB Consent Calendar**

John Kreider, Kreider Consulting and Chair, NOAA SAB

- July 2023 SAB meeting minutes
- September 2023 SAB meeting minutes
- Working Group status reports
- EISWG membership renewals

Chris Lenhardt made a motion to accept the consent calendar. The motion was seconded by Martin Storksdieck and passed unanimously.

## **Review of Action Items from July 2023 SAB Meeting**

Casey Stewart, Executive Director, NOAA SAB and Designated Federal Officer

After the July meeting the following products were accepted and transmitted to NOAA:

- 2023 Environmental Information Services Working Group (EISWG) Report to Congress
- SAB Tsunami Science and Technology Advisory Panel (TSTAP) Statement on National Risk Assessment
- Report on the Review of the Cooperative Institute for the North Atlantic Region (CINAR)
- SAB Climate Working Group (CWG) Review of the Climate Program Office Strategic Plan
- Report on the Review of the Cooperative Institute for Research in the Atmosphere (CIRA)

Other Action Items:

- The SAB decided to send the Report on the Review of OECI back for further review
- The SAB agreed to engage with NOAA's Chief Scientist on the FY26 budget and process
- John Kreider will follow up with Dr. Spinrad on the SAB's input on NOAA's budget
- The SAB working group co-chairs met with the liaisons

## **Discussion on NOAA Update**

Richard Spinrad, Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator

Dr. Spinrad provided an update on NOAA activities since the previous SAB meeting. He began by recognizing two extraordinary individuals who had recently passed away: Dick Hallgren, former head of the National Weather Service who also served as Executive Director for the American Meteorological Society; and Captain Don Walsh, most notably one of the first two people to descend to the deepest part

of the ocean, the Mariana Trench. Dr. Spinrad then discussed the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA). NOAA has issued over \$1 billion worth of grants, contracts, and acquisitions resulting from these two pieces of legislation, on a broad array of activities including improved high-performance computing and investments in coastal and habitat restoration and coastal resilience. There are many funding opportunities under the now two-year old BIL; a list is included in the presentation slide. Much time has been devoted to developing spending plans, getting them approved by the Department of Commerce (DOC), Office of Management and Budget (OMB), and Congress, and issuing Notices of Funding Opportunities (NOFOs).

Dr. Spinrad then spoke about the three pillars he identified when he became Administrator - climate, economic development, and equity, and how these are represented in the investments NOAA is making. On climate, investments are mostly on adaptation and resilience; on economic development, there are elements like industry proving grounds and accelerator investments; and on equity, investments are in harmony with the Administration's emphasis on environmental justice and Justice40, where 40% of new investments go to underserved or unserved communities. There are also a number of dedicated carve-outs for Tribal investments in a number of areas, notably fish passage and habitat restoration, hatchery in the Pacific Northwest and Alaska, and infrastructure. NOAA is investing in capital in an unprecedented way.

Dr. Spinrad then discussed technological advancements. On space technology, NOAA is building satellites. The last geostationary satellite was launched a year and a half ago; the next one, GOES-U, will be launched in April 2024. The next round of polar orbiters will also be launched. Additionally, NOAA is building four new ships, has plans for two more, and expects to acquire six aircraft, including replacement for the aging P-3s. The state-of-the-art port facility in Ketchikan, Alaska was also recently opened and NOAA will open another facility in Newport as the agency relocates its Atlantic operations to Rhode Island. NOAA is also rebuilding the facilities in Charleston, South Carolina.

Dr. Spinrad then noted that NOAA has hired more people in the last year than ever before. He also noted some anniversaries for the Atlantic Oceanographic and Meteorological Laboratory, Pacific Marine Environmental Lab, Great Lakes Environmental Lab, and the Air Resources Lab. Additionally, there are interesting developments in NOAA's relationships with other DOC partners, including the National Institute of Standards and Technology (NIST), Economic Development Administration (EDA), and the Patent and Trademark Office (PTO). PTO has received many requests for intellectual property (IP) protection in the area of climate products and services that the patent examiners are not very knowledgeable about; conversely, NOAA has climate scientists who are not fluent in IP issues. As a result, there have been personnel exchanges and formal relationships have been established.

In the area of youth engagement, Dr. Spinrad discussed the Youth Changemakers Fellowship, the intent being to have youth voices at the table where strategy and policy are being developed. Upcoming activities include the largest ever NOAA delegation to COP28 in Dubai, including Dr. Lauren Gibson, Special Advisor on youth engagement to the NOAA Administrator. Moreover, NOAA is working to integrate equity into its core operations. Leadership took part in a 2.5-day workshop on Undoing Racism, and NOAA hosted an agency-wide environmental justice training activity.

Finally, Dr. Spinrad shared the list of topics that concern him, including how to sustain the momentum from the injection of additional resources from BIL and IRA; the budget cycle, including a continuing resolution for FY24 as well as the development of the FY25 budget given the new constraints of the Fiscal Responsibility Act; and new climate change-related threats to infrastructure, health, and water accessibility. These threats are being addressed with a partnership with the American Society of Civil Engineers to advise on building codes, by expanding the National Integrated Heat Health Information System to a global system, and with a similar effort on hydrology with respect to the National Water Model to expand into the continent of Africa. Along with other new opportunities, including the National

Climate Assessment (NCA) 5, the interagency Fast Track Action Committee (FTAC) on Climate Services, new investments in areas such as marine carbon dioxide removal (mCDR) and artificial intelligence (AI), Dr. Spinrad continues to advocate climate optimism, which is at the heart of NOAA's concept of a climate-ready nation.

### *Discussion*

Chris Lenhardt asked about the FTAC and what had been discussed in terms of data infrastructure, given the need to share information across agencies, and wondered if NOAA's climate data were somewhat similar to the Svalbard seed bank. Dr. Spinrad responded that NOAA's climate data is more like a data bank in the cloud and referenced the Findable, Accessible, Interoperable, Reusable (FAIR) principles. He thought the more important issue will be increasing global coordination rather than improving coordination among U.S. federal agencies.

Jesse Ausubel noted that many organizations involved in research and education have not fully recovered from the effects of the COVID pandemic in areas such as morale, hiring, productivity, and mismatch of capital and space, and asked what NOAA's experience has been, particularly with regard to its labs and research facilities. Dr. Spinrad noted the ongoing and contentious issue of returning to the workplace. He said during the pandemic NOAA undertook a first-time effort to prioritize the facilities' needs using a rigorous process looking at mission need, capabilities, and demand for facilities, including square footage requirements in light of new workforce dynamics. The resulting prioritized facilities list is being used to inform Congress of agency needs. In discussions with Commerce Secretary Gina Raimondo, Dr. Spinrad said he emphasized that meeting the mission is more important than the physical location of staff.

Martin Storksdieck asked about the One NOAA concept that had been discussed previously. Dr. Spinrad said he considers it a given in all of the discussions that the priorities, including climate, economic development, and equity, are predicated on the concept that NOAA is operating as the nation's environmental intelligence agency. Following up, Dr. Storksdieck asked about the possibility of NOAA becoming its own agency. Dr. Spinrad said ultimately, it is about NOAA's mission, and there are pluses and minuses to this approach; his main concern is that Congress is well-informed about any decision it makes.

John Kreider asked what would be considered a success for NOAA given the large contingent going to COP28. Dr. Spinrad pointed to being able to move the needle on international collaboration in areas such as heat health, global hydrology, ocean acidification, marine pollution, illegal, unreported, and unregulated (IUU) fishing, as well as NOAA gaining recognition as a global leader in science-based climate products and services.

## **Discussion on NOAA Science Update**

Sarah Kapnick, NOAA Chief Scientist

Dr. Kapnick began by discussing NOAA's marine carbon dioxide removal (mCDR) and solar radiation modification (SRM) efforts. Since publication of the Strategy for NOAA mCDR in June 2023, \$24 million in mCDR awards have been made, using a collaboration with the U.S. Navy, the Department of Energy (DOE), and a nonprofit, run through the National Oceanographic Partnership Program (NOPP) and the Ocean Acidification Program. An FTAC on mCDR was established in September and will issue a report by next September on pathways towards mCDR research, implementation, and regulatory issues. On SRM, the NOAA Earth Radiation Budget (ERB) research initiative recently had its first public science meeting. Based on feedback, NOAA is working on a draft SRM research agenda as requested by Congress, which will be circulated to agency partners for review. Moving to AI, DOC released its Interim Generative AI Policy in July, and President Biden signed an Executive Order to build capacity to

evaluate and mitigate the risks of AI. This will ensure safety, security, and trust while promoting an innovative, competitive AI ecosystem that supports workers and protects consumers.

Dr. Kapnick then discussed NOAA's research and development vision areas. Under Vision Area 1, reducing societal impacts from hazardous weather and other environmental phenomena, the Weather Program Office's (WPO) Joint Technology Transfer Initiative (JTTI) and the Social Science Program (SSP) have been working to integrate social science data into hazardous weather communications. JTTI has now transitioned its first ever social and behavioral science product from the nonprofit sector to NWS operations. This will improve the usability of the Winter Storm Severity Index (WSSI) by adding updated risk categories and providing impact maps on various components including things like snow amount and ice accumulation. The project will serve as a case study of how NOAA can integrate social science moving forward. Supplemental appropriations also provided a unique opportunity to integrate social science into tropical products. Moreover, NWS, WPO, and SSP synthesized and translated findings across various projects to develop recommendations for NOAA research, development, and operations in general based on the FY18 SBES hurricane supplementals. The main findings were to produce short explanations that describe how to interpret probabilities, provide tropical products with more localized and personalized information, and that partners need more summary products in a centralized and transparent location. Partners also stated that different types of timing information are critical for their decision-making, asked for more information about tropical cyclone tracks, scenarios, and forecast models, and suggested changes to optimize the extraction of key information from graphics and text. Finally, the Chemical Science Laboratory (CSL) developed a country-wide field campaign, the Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA), to use advanced tools to study air quality and pollutants in urban areas using NOAA and NASA aircraft as well as on-the-ground backpack monitoring. The project provided an opportunity for ground and aircraft-based confirmation of NASA's new TEMPO geostationary atmospheric composition satellite.

Under Vision Area 2, sustainable use and stewardship of ocean and coastal resources, Dr. Kapnick highlighted a multi-agency effort to monitor, detect, and mitigate negative impacts of thiamine deficiency on California salmon and steelhead. She also noted that STOF3D-Atlantic, the Surge and Tide Operational Forecast System for the Atlantic Basin, is now operational, which will aid disaster mitigation, enhance coastal resilience, and ensure safe marine navigation while also providing current salinity and temperature forecast guidance.

Under Vision Area 3, a robust and effective research, development, and transition enterprise, Dr. Kapnick highlighted implementation of NWSChat 2.0 via Slack, which will improve communications both within NWS and with public safety partners. The Rapid Intensification Deterministic Ensemble (RIDE) has also been implemented and has improved real-time tropical cyclone rapid intensification prediction for the National Hurricane Center and the Department of Defense's (DoD) Joint Typhoon Warning Center. In the area of building a climate-ready nation within the vision areas, she highlighted that NOAA now has the world's first kilometer-scale global climate simulations, with more than two years of present and perturbed climates using the X-SHIELD model. This high-resolution modeling will also be critical to fill in gaps in the historical data used to train AI-based forecast models. Additionally, the STAR land product development team has built a monitoring system to look at global land surface temperature anomalies and their impacts. Dr. Kapnick concluded by noting she is working with the Science Council around trust in NOAA science and managing reputation beyond just scientific integrity.

### *Discussion*

Jesse Ausubel mentioned that Dr. Michael Markels, a chemical engineer who worked on CDR in the 90s and early 2000s, was granted many patents in the area of CDR and suggested someone ought to look into

those. Dr. Kapnick noted that PTO has an expedited 12-month process called Patents for Humanity that can be used for CDR technologies.

## **SAB Report on Public-Private Partnerships Update**

Steve Weisberg, Southern California Coastal Water Research Project and SAB Member

Steve Weisberg noted that the Public-Private Partnership Committee provided a draft report in April. The feedback from Dr. Spinrad was that the recommendations were good but did not take advantage of NOAA's position within the DOC. In response, the group has been holding interviews with personnel from DOC, including EDA, the Small Business Administration (SBA), and NIST. In the process they learned about NIST's Manufacturing Extension Partnership which can bolster initial research and get it through the "valley of death"; EDA and SBA also have similar programs. The group has also interacted with PTO to try to address the lack of awareness early developers have about IP protection. Two additional interviews are planned, then the group will present a revised report. Dr. Weisberg thanked Dr. Spinrad for his feedback.

### *Discussion*

John Kreider noted that although the report wasn't ready, he wanted to leave this item on the agenda as an opportunity for discussion. Several SAB members have commented in the past about the importance of NOAA engaging partnerships to enable science. Partnerships provide opportunities for technical exchange and also strengthen relationships between NOAA and users of NOAA information and products. Dr. Spinrad noted that any advice on particular trade groups or organizations to partner with would be helpful.

Jesse Ausubel asked if there are particular areas with opportunities for partnering. Dr. Weisberg responded that there isn't one particular area and that it is more about the culture of NOAA and its role as a facilitator. Dr. Kreider asked if NOAA agrees that it is a culture issue. Steve Thur said he did agree in a number of ways and mentioned the sometimes push-pull dynamic of collaboration versus competition, the need to find better ways to reward staff for using their time to pursue partnerships as opposed to other job responsibilities, and to more fully highlight the successes of partnerships.

Martin Storksdieck noted that there are also structural components and issues around the tools accessible to NOAA employees, creating an interplay of culture, incentives, and tools. Jon Allan noted that the group's interviews have revealed many tools with NOAA and DOC, but sometimes a lack of capacity in handoffs and facilitation of a nurturing environment. Dr. Kapnick said there will be training around IP and they will be looking at how to enable necessary cultural changes. Hendrik Tolman noted that NWS has open-source tools, but robust open-source science is still hard to accomplish. Culture change is difficult and takes time, but the tools and the commitment are there.

David Grimes shared the concerns about culture and said it is a question of making relationships work and seeing value in bringing groups together. He asked if there is a particular area of focus that would be valuable to NOAA for the group to examine. Dr. Spinrad noted that different line offices have their own culture and their own challenges in dealing with public-private partnerships. He asked the SAB for their perspectives on what may be low-hanging fruit as well as what areas may be particularly challenging. John Kreider proposed an action item around what area would be valuable to do a deep dive on this subject.

Anthony Wu noted that the DoD had realized recently that they cannot achieve mission objectives without much greater involvement with and investment from the private sector, and he wondered if NOAA is able to accomplish all of its missions with only internal funding. Responding to Dr. Spinrad,

David Grimes proposed climate services and AI as areas where private sector, academic, and public sector engagement are essential for success.

Dr. Weisberg asked Dr. Spinrad if adding a couple case studies to the report would be helpful. Dr. Spinrad agreed that it would and suggested they need to identify the right granularity for those case studies and to think outside the box in terms of other areas where partnerships have not previously been considered.

## **Discussion on Operational Climate Services**

Richard Spinrad, Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator  
Kevin Mahoney, Chief Scientist, OPNAV N2N6E, Oceanographer and Navigator of the Navy

Dr. Spinrad began by noting that within FTAC there has been discussion about research versus services, but often research is itself a service. NOAA conducts mission-oriented research and has developed a definition of operational climate services: sustained, systematic, reliable and robust climate service activities, with an institutional commitment to deliver specified products and services to various stakeholders such as policymakers, planners, businesses and the general public. Operational Services is a framework under which NOAA can define its priorities.

Dr. Spinrad identified three questions for the SAB to frame the discussion:

- What are your thoughts on requirements for operational climate services?
- What are your thoughts on respective roles and responsibilities of NOAA and other shared operational stakeholders?
- What do you see as the dynamic in terms of the roles for research and operations?

Dr. Mahoney discussed the annual requirements process in the Navy, which examines the fleet's needs to perform tasks and where there are gaps. The Navy then tries to leverage efforts from other agencies, such as NOAA environmental forecasting, to fill gaps before applying funds to recreate work that has already been done. Requirements and capability gaps need to be traced back to DoD needs, however, and efforts like the National Defense Strategy and the Naval Implementation Framework team help to inform the priorities, given the difficulty to fund every requirement. These requirements often relate to meteorology and oceanography, including climatological planning for a specific area in which the Navy will conduct operations and forecasting to assist tactical forces. OPNAV also focuses on precision time and time interval, looking at everything from the seafloor to space-based environmental monitoring.

Dr. Spinrad asked how to best structure the dynamic of Navy operators to receive the products they need from other federal agencies. Dr. Mahoney discussed the Navy's focus on low-bandwidth, low-computational effort products that can be used in a perceived environment with no connectivity. Dr. Spinrad then asked how agencies with operational climate services needs ensure there is no duplication of effort and address gap areas where no one is working. Dr. Mahoney noted that NOAA has a different scope and area of responsibility. The Navy is generally more concerned with operational missions overseas and homeland defense of Navy and other maritime facilities. For instance, in the area of sea-level rise, the Navy is concerned with resilience and how to respond to sea-level rise, and it often relies on products from NOAA and others.

David Grimes asked about the dynamic for collaboration on fundamental, longer-term issues that extend beyond the budget cycle. He also noted that although the oceans are deeply linked to climate, there are typically fewer observations of the oceans than the atmosphere, and he wondered about opportunities for the Navy to provide insights into ocean processes. Dr. Mahoney noted that the Climate Services Working Group will help increase collaboration between NOAA and the Navy. He discussed not only the



challenges of classified Navy data but also that the Navy simply does not measure certain ancillary data important to NOAA, such as CO2 levels or plankton concentrations. Dr. Spinrad highlighted the need to discriminate between operational activities and marine scientific research and the potential problems if the Navy were to start collecting data in foreign exclusive economic zones (EEZs). Rear Admiral Nancy Hann said one way the agency is trying to integrate with the Navy, and more broadly with DoD, is through the use of NOAA liaison officers. The aim is to bring awareness to NOAA data, products, and services. Dr. Spinrad noted that collaborating with the Navy has been successful; the problem is working with the rest of the U.S. government to establish agreements on priorities for observations. Dr. Mahoney talked about the challenge of moving from research and development to operations, given the need to ruggedize and ensure rigorous cybersecurity.

Jesse Ausubel asked about areas such as marine debris, oil spills, and marine mammals. Dr. Mahoney responded there is some historical precedent for the Navy to support NOAA in areas not directly relevant to the Navy, including the Navy's progress towards more extended forecasts. Rachael Dempsey discussed collaboration with the Navy in the areas of hydrographic services, the transition to electronic charts, and the Integrated Ocean Observing System (IOOS) program.

Martin Storksdieck asked how research is translated into operations. Dr. Mahoney noted that the Navy has warfighters who are not scientifically-minded and scientists who do not know how to translate and distribute their research to the warfighters. Dr. Mahoney often needs to act as an interpreter between the two groups.

Dr. Spinrad asked if there have been discussions around reestablishing Task Force Climate Change or Navy involvement in the National Climate Task Force. Dr. Mahoney responded he has not seen anything regarding either. He said the Navy understands that climate change will have an impact, but they must work within their role and apply the resources they have to meet their own unique challenges, such as understanding how the underwater acoustic environment will change.

Scott Glenn, Co-Chair, EISWG, suggested collaborations between NOAA and Navy on weather, particularly around hurricanes and ocean observing, and how it contributes to Navy's humanitarian missions. Joellen Russell, Co-Chair, CWG, expressed concern about the state of civilian operational oceanography and who will perform tasks such as deploying floats to the Arctic and maintaining the Argo array from decaying. Dr. Spinrad noted the importance of Navy and NOAA being coordinated in their messaging around the need for operational climate services.

## **NOAA Response to SAB Environmental Information Services Working Group (EISWG) Subseasonal and Seasonal (S2S) Report**

Kevin Garrett, Director, NWS/OSTI Modeling Program

Kevin Garret began by providing background on the EISWG report, which was approved by the SAB in August 2022. The report was itself a review of a NOAA report to Congress on utilization of NOAA's S2S information. Responding to the EISWG report's summary recommendations, he said that NOAA concurred with the recommendations to publish the S2S report in the public domain and standardize definitions and terms related to S2S prediction. NOAA also concurred with highlighting S2S as a true earth system approach with increased cross-line office coordination and increased international engagement through ICAMS. NOAA partially concurred with the recommendation to emphasize S2S in projects funded by the Earth Prediction Innovation Center (EPIC) and with the idea to adapt the National Academy of the Sciences (NAS) vision equating the broad use of S2S in weather predictions. The current scope of EPIC does not extend to funding scientific research for environmental modeling, but it is essential for programs across NOAA to align S2S priorities, research, and operations. This includes

coordinating with and leveraging EPIC to ensure researchers and developers have access to tools and processes to support NOAA S2S developments. NOAA largely concurred with recommendations to increase accessibility of current S2S products and services, including listing with description the available products, tools, and methods for verification as well as verification statistics, impacts, and value of those products to stakeholders. Although transitioning CPC products' web presence to an expanded internet clearinghouse will require additional planning and resources, NOAA did see value in streamlining products that enhance decision-making, and identifying and reducing duplication of effort. There are many challenges in developing comparative skill metrics, such as requiring consistent attributes, knowledge of forecast of forecast methodologies, and compatible/standard data formats. NOAA also concurred with recommendations to develop more specific plans, priorities, and roadmaps, including goals that are specific, measurable, achievable, relevant, and time-based (SMART) and broaden stakeholder engagement and interagency coordination to include social, behavioral and economic science (SBES) to create more impactful and actionable products and services. Finally, NOAA concurred with recommendations to periodically review S2S long-term priorities in supporting research, improving collaborations, and prioritizing S2S pilot projects.

### *Discussion*

John Kreider, noting the degree to which NOAA concurred with the recommendations, asked if there was any one important aspect that changed as a result of the report. Mr. Garrett noted they are focusing much more on stakeholder engagement and ensuring coordination through interagency partnerships.

Brad Colman, Co-Chair, EISWG, said he would have liked to have seen more specific actions called out, as well as timelines, rather than simply agreement with the recommendations in the report. Mr. Garrett noted the resource challenges around meeting a few of the objectives. For example, although there were resources appropriated in FY23 for the seasonal forecast system development plan, future resources are unknown.

Scott Glenn, Co-Chair, EISWG, discussed a few specific recommendations from the EISWG report: the SBES activities under Recommendation 15 around inundation and the possibility to take some immediate actions; Recommendation 17 on the need for funding to prioritize S2S research based on operational requirements as well as investments to successfully operationalize it, and the example of Hurricane Forecast Improvement Project (HFIP); and Recommendation 20 on collaborations to fill ocean observing gaps. Addressing HFIP, Mr. Garrett noted it wouldn't have been so successful without supplemental funding; without continued support, NOAA will struggle to implement the new seasonal forecast system. Regarding observation gaps, he noted there is a working group focused on addressing gaps in all of NOAA's modeling applications.

John Kreider expressed concern about the comments around future funding and the resulting inability to have timelines, particularly given all the additional recent funding. Mr. Garrett clarified that committing to a timeline, rather than simply producing one, is difficult given the uncertainty around future funding. Hendrik Tolman noted that the draft plan has much detail about what NOAA wants to accomplish and where it wants to focus, and he also mentioned a summit with the National Science Foundation (NSF) and a subsequent call for proposals by NSF to work on software related to S2S and the Unified Forecast System (UFS).

Brad Colman talked about the importance of verification to stakeholders and his hope that METplus would provide open access to verification scores.

## **SAB Environmental Information Services Working Group (EISWG) Report on NESDIS Observing System Backbone**

Ilse Gayl, Advanced Environmental Monitoring and EISWG member

Ilse Gayl began by explaining that the report provides recommendations on NOAA's approach to structuring its NESDIS-based and alternative source data to comprise a robust, reliable system optimized for performance, cost, and risk. A 2020 report to Congress described NOAA's long-term plan to maintain a radio occultation (RO) constellation comprising a backbone of observations to be augmented by external data from other agencies, the private sector, and international partners. The EISWG study team interviewed experts from NOAA and external partners and the team believes the recommendations could be used for observational needs across NOAA, not just in the context of RO. Driven by the emergence of commercial satellite data, NOAA has an opportunity and growing interest in utilizing alternative-source spaceborne observations. This opportunity may not eliminate the need for NOAA to make similar observations, however; NOAA observations comprise the backbone and may serve one or more functions. The first recommendation, therefore, is that NOAA should employ a backbone approach to integrating alternative-source observations, and the nature of that backbone should be determined using a formal decision and implementation framework. The first framework guideline is to employ a data- and use-oriented systems approach by treating multiple data sources as part of a system, then defining performance metrics to optimize the use of each source. Defining performance metrics would be accomplished by measuring end use performance and effectiveness, cost, and risk, and recognizing the importance of stability and continuity of data sets. The second recommendation is to apply a data and use-centric process for defining and implementing a backbone, with the data managed as a system to optimize performance, cost, and risk. A second framework guideline is that the backbone design should enable all related data elements, maximizing the value of alternative data, and data stability, including funding stability, is very important. The third recommendation is that, when employed, a backbone should be designed as an enabler for the overall observational data element (ODE) system. The third framework guideline is the importance of continuous assessment and risk mitigation with regard to alternative data sources. For example, currently few or no alternative sources of spaceborne ODE have robust markets. There are also issues around alignment of NOAA and commercial interests, including data sharing and the risk that government budgets for alternative data are more volatile than those for government owned and operated systems. This leads to the fourth recommendation, that NOAA should define and use a continuous process to assess and mitigate risks associated with ongoing alternative source data availability and access. The team created a backbone framework decision matrix to cover each need and purpose of the backbone. The fifth recommendation is that the backbone approach works for RO, with important roles as yet unfulfilled by commercial or other partner providers, and NOAA should plan the RO ODE to include a NESDIS backbone component.

### *Discussion*

Paul DiGiacomo said the report is consistent with the enterprise approach NESDIS has been pursuing, which is source-agnostic and user-centric to better support users and the mission. He highlighted the criticality of a foundational calibration solution.

David Grimes made a motion to accept the report. He also looked forward to hearing from NOAA how the approach could be applied to a different sector such as climate.

John Kreider asked about technology readiness levels (TRL) and whether there is a common standard for discussing levels of maturity or robustness of technology. Ms. Gayl said that would be a better question for Bill Gail, who was not able to participate in the presentation.

A motion having been previously made by David Grimes, Jesse Ausubel seconded the motion to accept the report, and it passed unanimously.

## **SAB Tsunami Science and Technology Advisory Panel (TSTAP) Terms of Reference Update**

Corina Allen, Washington Geological Survey and Co-Chair, TSTAP

Rocky Lopes, Emergency Manager and Co-Chair, TSTAP

Rocky Lopes began by providing some background on the Tsunami Science and Technology Advisory Panel (TSTAP). Its terms of reference were created in 2020 by John Gaffney, who chaired the SAB at the time. TSTAP is proposing three changes to its terms of reference: codifying the co-chair rotation scheme with overlapping two-year terms, defining member terms of service and the method to fill vacancies to be consistent with SAB procedures, and decoupling TSTAP from EISWG administratively while retaining an EISWG liaison. TSTAP requests the SAB recommend that NOAA establish TSTAP as a freestanding working group with these updated terms of reference.

### *Discussion*

Martin Storksdieck asked if there might be any downsides. Dr. Lopes said they don't see any, particularly since they will retain the EISWG liaison. TSTAP is seeking to remove an administrative step that has sometimes caused delays. He said they have the support of their EISWG liaisons and the EISWG Co-Chairs. Scott Glenn said that EISWG discussed the matter and agreed there is value in maintaining the liaison relationship.

John Kreider asked if there had been any response to the TSTAP comments on the Federal Emergency Management Agency's (FEMA) National Risk Index for tsunamis, and if there were other natural risks not appropriately recognized by FEMA. Corina Allen, TSTAP Co-Chair, said they had received neither confirmation that NOAA had transmitted the comments to FEMA nor any response from FEMA.

Jesse Ausubel inquired about the potential impact to tsunami prediction of Russia's withdrawal from the Comprehensive Test Ban Treaty and decreased willingness to collaborate internationally. Dr. Lopes noted that Russia was never very forthcoming in sharing their data, but he acknowledged TSTAP had not been briefed on the issue.

Jesse Ausubel made a motion to accept the TSTAP recommendations, Martin Storksdieck seconded, and the recommendation was approved unanimously.

## **SAB Data Archive and Access Requirements Working Group (DAARWG) Workplan Update**

Christopher Lenhardt, University of North Carolina at Chapel Hill and Co-Chair, DAARWG

Chris Lenhardt began by noting that the chair of DAARWG had resigned in early 2023 due to health reasons, so he and Ilene Carpenter had stepped in to maintain the group in their role as SAB liaisons to DAARWG. Mr. Lenhardt thought of it as a reboot for the group to address newer issues such as cloud, open science and data, community engagement, and diversity. He acknowledged the strong support from NOAA staff. Proposed topics for 2024 include generative AI (GenAI), which may be a cross-working group discussion; open data dissemination; the NESDIS cloud framework; and the next version of Public Access to Research Results (PARR2). The plan is to convene shorter virtual meetings with briefings on key topics leading up to the next in-person meeting, to follow up with the Ecosystem Sciences and

Management Working Group (ESMWG) and other working groups on collaborative topics, and to continue work on recruiting co-chairs to lead DAARWG.

### *Discussion*

Jesse Ausubel asked for an update on cybersecurity issues. Mr. Lenhardt identified security issues including trust in data in the context of AI and nefarious actors representing themselves as presenting NOAA data. He noted that the cloud has the potential to offer security due to the rules required for government cloud services, but it is not a guarantee. Tony LaVoi added that cybersecurity is a paramount concern. NOAA conducts annual reviews of all of its independent IT systems as well as around-the-clock security monitoring. He also discussed secure ingest of data, regardless of the source. All NOAA staff undergo annual IT security training; supplemental training is provided any time there is an incident. Mr. Lenhardt acknowledged that it might be good to explicitly add cybersecurity as a focus.

Ilene Carpenter highlighted the fast pace of change in AI and noted that its broad implications make it potentially a very useful topic for cross-working group collaboration. Cisco Werner talked about data modernization and the need to make data AI-ready and include ontologies. He expressed concern about the backlog of data sets that may not be ready for AI and data modernization. Mr. Lenhardt added cloud-ready to the mix and suggested DAARWG could make suggestions on how NOAA should approach these issues. He also referred to the FAIR data principles and the possible need to focus on certain aspects of FAIR to get the most bang for the buck, given limited resources.

John Kreider referenced the AI panel at the July meeting, where panel members emphasized that data be available for AI testing and use. Dr. Spinrad noted another aspect of AI is its potential to help with NOAA's labor-intensive regulatory work, which may lend itself well to GenAI for efforts like literature reviews. David Grimes expressed support for the idea of cross-working group collaboration but suggested the group try to be more specific given the open-ended nature of the topic of AI.

Dr. Tolman noted that DOC rules on GenAI are starting to be enforced, but they are very much in flux, particularly around IP and data disclosure. In addition to GenAI, the idea of AI replacing or supplementing modeling is also being discussed; NOAA will be holding an internal workshop on that issues.

John Kreider asked if it would be more valuable to examine AI in a shorter-term, more focused way or in a broader, comprehensive way. David Grimes thought a more focused approach would be wiser, given the broad scope, and would allow the group to learn something rather than getting lost in broad discussion. Chris Lenhardt supported the focused-use case idea and cited the need to contextualize the various issues. He also suggested the NOAA liaisons to the working groups could assist in the collaboration. David Grimes proposed that the working group chairs could work to come up with a topic that would fit the criteria described. John Kreider agreed. Tony LaVoi pointed to a potential opportunity around the requirement for NOAA to update the PARR plan.

## Updates from SAB Working Groups

### *Climate Working Group (CWG)*

Joellen Russell said the next two potential co-chairs are being considered, and the group is in a rebuilding phase. She noted that the CWG would present a white paper on operational civilian ocean forecasting on the second day of the meeting. Additionally, there are a few NOAA requests for reviews that the group is anticipating, but none have been officially tasked to the CWG yet. Kirstin Dow noted they had completed a review of the draft Program Office Strategic Plan, and reiterated that she and Dr. Russell's terms would end on December 31<sup>st</sup>, 2023. The CWG is in discussion with ESMWG on the mCDR topic.

### *Data Archiving and Access Requirement Working Group (DAARWG)*

Chris Lenhardt highlighted that the SAB has seen the slate of new member candidates and there are one or possibly two co-chairs in the works. He looked forward to being able to step back to his role as liaison rather than serving as both co-chair and liaison.

### *Ecosystem and Sciences Management Working Group (ESMWG)*

Molly McCammon said they have formally recruited two new members, bringing the total to seven, with three more ready for Dr. Spinrad's review. An in-person meeting will be held December 7-8 in Silver Spring, MD, with panels on mCDR, coastal resilience, and harmful algal blooms (HABs) research needs and emerging data tools, and updates from NOAA line office liaisons. All panels will include an examination of AI. The panel on mCDR will examine strategies and technologies, NOAA's Fast-Track Action Plan, economic and social justice, and community engagement. There will also be a panelist to talk about science needs for monitoring, reporting, and verification of CDR. The CWG has been invited to attend. Questions being considered include the potential role of AI, the transition from research needs to operational systems, and how to go from larger-scale needs down to state and local response. The panel on coastal resilience will include an overview of current activities, the role of AI, particularly in making ecological predictions, and current science needs and gaps. Finally, the ESMWG will examine a case study on HABs research needs and emerging data tools. The panel will include Don Anderson from Woods Hole, discussing emerging issues and science needs; Clarissa Anderson from Scripps on challenges of using data for modeling and forecasting; Chris Whitehead from Ocean & Earth Environmental on integrating HAB monitoring into tribal environmental programs; and Rob Redmon, Director of the NOAA Center for AI, on the potential to use AI in mitigating impacts of HABs and other ocean stressors. DAARWG has been invited to attend and participate in the discussions.

### *Environmental Information Systems Working Group (EISWG)*

Brad Colman provided an update on the next generation Global Oscillation Network Group (ngGONG). GONG is a global network of six surface-based stations monitoring the surface of the sun, with a life expectancy of around 2030. There was a proposal to develop the next generation of the system, but it was rejected by NSF due to the lack of an operational -- rather than simply research -- requirement. A second proposal cited the system's importance to NOAA's operational system. This proposal was not funded in the current cycle, but, depending on resource availability, it may be funded in 2024. GONG will require about 3 years to design and 5 years to install, however, which would delay implementation until 2032. Additionally, there is no backup solution, and the impact of not investing in GONG will set space weather services back 10 years. Meanwhile, EISWG appreciated that the SAB Office and NOAA leadership found resources to allow the group to meet this fiscal year. EISWG recognized that the line offices which fund the working groups must make tough budget decisions. SAB funding is more stable, and EISWG would appreciate if the same sort of stability could be provided for working group funding. Scott Glenn then discussed the ongoing reauthorization process for the Weather Act. EISWG, including its report to Congress, was codified in the Weather Act of 2017. EISWG's understanding, confirmed by NOAA federal relations, is that if the group is not addressed in the reauthorization, then the 2017 charge and report to Congress will stand. Finally, EISWG acknowledged its SAB liaisons as well as Karin Bucht's service and congratulates her as she moves on to new and greater things at NOAA.

### *Tsunami Science & Technology Advisory Panel (TSTAP)*

Rocky Lopes began by saying that TSTAP also appreciated the support from Karin Bucht. Additionally, TSTAP appreciated that NWS was able to find funding for its first in-person meeting of the year at the Pacific Marine Environmental Lab, at which they received NOAA's response to their first quadrennial report. TSTAP meets on a monthly basis and has discussed many follow-ups to that response. For

example, TSTAP has concerns about the resourcing to implement recommendations in the report. There has been some forward movement, notably on consolidating the AWIPS-based Tsunami Operations Messaging System (ATOMS), hopefully with implementation by 2025. Meanwhile, TSTAP has had member turnover and looks to recruit broad geographic representation, in addition to experience and capabilities. Recommendations for a replacement member and renewals of four existing members are pending approval. Then Dr. Lopes discussed the issues of tsunami vulnerability and the National Risk Index. TSTAP would like to ensure that warnings and alerts are appropriate, precise, and social-science based. Next, Corina Allen discussed the group's annual report, which will be delivered at the March 2024 SAB Meeting. She noted conversations the group had with NWS, their NOAA liaison, and the National Tsunami Hazard Mitigation Program around the recommendations in TSTAP's report to Congress. There has been some progress on the main recommendation to unify the two tsunami warning centers under one direct line of command, but the resources necessary to move forward on several other recommendations and issues are lacking. TSTAP will also present a white paper on the nuances of tsunami alerting for complicated waterways at the March 2024 SAB Meeting. Finally, TSTAP is planning their next in-person meeting for 2024, hopefully at the Pacific Tsunami Warning Center.

### **Public Comment**

There were no public comments.

### **Opening Statement of the Chair – Day 2**

John Kreider, Kreider Consulting and Chair, NOAA SAB

John Kreider welcomed the group back for day two of the meeting. He then introduced the first topic of the day, an update on NOAA Cooperative Institute (CI) Reviews from Shannon Louie Director of the NOAA Cooperative Institute and Administration Office (CIAO). Mr. Kreider highlighted that it is the responsibility of SAB members to chair a CI review during their membership tenure.

### **Update on NOAA Cooperative Institute (CI) Reviews**

Shannon Louie, Director, Cooperative Institute Administrative Office, NOAA Oceanic and Atmospheric Research (OAR)

Shannon Louie began by providing an overview of the NOAA Cooperative Institute (CI) program. CIs differ from other extramural relationships because the statutory authority allows NOAA to use the personnel, facilities, and services of CIs for NOAA mission research, education, training, and outreach without the need for additional agreements. NOAA manages the CI program at three levels: at the project level between the NOAA sponsor and the CI principal investigator; at the award level by the technical program manager (TPM) and federal program officer who partner with the CI director and administrator; and at the enterprise or corporate level by the Cooperative Institutes Administration Office (CIAO) and the CI Collective (CIC). The CIC, new as of 2023, is an advisory body composed of NOAA CI TPMs and the CIAO to build consensus and communicate policies and procedures to deliver consistent messaging and services throughout the CI program portfolio and stakeholder community.

CIs are funded by cooperative agreement, with one competitive five-year award and one non-competitive five-year award. The renewal review is conducted with the support of the SAB

beginning in the fourth year with a SAB member named as chair for each review. The chair collaborates with the CI director and the TPM, who serves as the principle point of contact for scientific and technical issues for each CI. Reviews are conducted by a four- or five-person merit review panel based on CI-provided written materials during a two-day hybrid review event. Following the review, the chair presents a report to the full SAB for adoption or further review. Once adopted, the science review report and the administrative review report serve as the basis for the CI proposal submission and the justification from the program office to the grants officer.

### *Discussion*

John Kreider stated that the SAB has been trying to do a better job of looking ahead to upcoming reviews in order to prepare and establish review teams earlier. Jesse Ausubel remarked that management issues seem to be more prominent than science issues and suggested that management and organizational expertise may therefore be more important. Ms. Louie noted the administrative review of the CI as an important part of the renewal process. She stressed the importance of ensuring top-notch, innovative science and the important role of the SAB chairing the science reviews. The administrative review is done by a separate panel of NOAA experts including the TPM, federal program officer, and grants management.

Chris Lenhardt asked if Ms. Louie had any takeaways from recent conversations with SAB members. Ms. Louie highlighted the importance of communication and providing a technical point of contact who can help the TPM, SAB member, and CI director move forward. John Kreider proposed compiling a list of comments and lessons learned.

Steve Weisberg asked what happens to recommendations made by the review panels and suggested a one-year follow-up after the science review to better understand steps taken to address review recommendations. Ms. Louie said that when possible, her office will incorporate comments into the proposal or through the renewal negotiation process. Comments at the corporate or enterprise level may inform improvements to future notices of funding opportunity (NOFOs) or be incorporated into the CI Handbook.

Martin Storksdieck, referring to his experience with a similar process at NSF, asked if NOAA had considered an earlier initial review during the first year or two of the CI's award period to ensure CIs are set up for success before the year four review. Ms. Louie said they would consider that. She noted that research performance progress reports are done yearly and the first one is due after only nine months. She also emphasized the substantial federal involvement in the cooperative agreement process and that issues can be addressed as they arise.

John Kreider noted there are four CI reviews coming up in 2024, and chairs have been identified for three of them.

### **SAB Environmental Information Services Working Group (EISWG) Report on Gap-Filling Radars**

Marty Ralph, Center for Western Weather and Water Extremes, EISWG member



Marty Ralph began by noting that the Priorities for Weather Research (PWR) had made an important recommendation to begin filling gaps in radar coverage, and although some improvements have been made since, the vast majority have not been filled. The problem is urgent, and areas that have not had effective coverage are more vulnerable to severe weather. The Next Generation Weather Radar, NEXRAD, is a phenomenal resource, but there are relatively few of them and they are limited by the curvature of the Earth and things like mountains and valleys. Smaller, less-expensive radars are commercially available and well-demonstrated; many smaller radars can fill in the gaps left by the larger ones. A key finding on equity is that the gaps often correspond with populations that are underprivileged, including African-American communities and tribal lands. There is also correlation between radar gaps and areas where the CDC's Social Vulnerability Index is high. Moreover, there are areas outside the continental U.S. with poor coverage and high vulnerability. EISWG received input from NOAA, public-academic research consortia, experts in remote and American Indian tribal weather risk management, and commercial radar data providers. The findings include the urgency of the issue, the challenges of NEXRAD versus gap-filling radar, and the opportunities around integration of data from commercial radars. A key finding is that NOAA can work with the private and academic sectors on the backbone. The recommendations are that NOAA should establish a gap-filling radar data strategy using the NESDIS Observing System Backbone Framework report to define backbone architecture; NOAA should act immediately to use already-available commercial data; and that NOAA should act immediately to implement the gap-filling radar data strategy, using X-band and C-band radars to prioritize coverage of and engagement with underserved populations.

### *Discussion*

Dr. Spinrad, referring to a statement in the report around contracting with willing companies to deploy in areas otherwise undesirable commercially, asked whether there had been any discussions with commercial entities and any possible corporate social responsibility aspect. Ilse Gayle responded that companies feel strongly about the corporate social responsibility and are open to negotiating. She emphasized that it is still early in the process, and there are potential benefits of NOAA simply buying radars and training underserved local populations such as tribes. Brad Colman suggested starting with existing commercial providers then moving forward to determine the best strategy to get full coverage. Dr. Thur explained that the Weather Program Office plans to use FY24 and FY25 funds to do an options analysis for gap-filling radar.

John Kreider, noting that the PWR report two years ago identified the urgency, asked whether there is disagreement between EISWG and NOAA about whether NOAA is doing enough. Brad Colman said EISWG believes not enough progress is being made and wanted to call attention to immediate, low-hanging fruit. Dr. Spinrad added that the strong emphasis on environmental justice in this report is a fundamentally different element that would not have been a focus two years ago.

David Grimes discussed procedural issues around receptivity and timing and the need to do some validation around those issues from the beginning. Scott Glenn discussed the triage process EISWG uses to choose their work based on the benefits and the urgency. Dr. Tolman acknowledged there are short-term issues while they look ahead to Radar Next, but they have

established a funding procedure through Mesonet to move quickly to fill some gaps through cooperative research and development agreements (CRADA) research.

Anthony Wu asked if the smaller radars have increased accuracy for tracking severe weather events. Marty Ralph responded there is a fundamental measurement gap for various phenomena if you look too high in the atmosphere. Dr. Thur noted the agency had entered into a CRADA with Climavision about as fast as they could, bureaucratically, after receiving the PWR report, with a goal to determine if Climavision's data improved accuracy of weather forecasting and precipitation.

David Grimes made a motion to accept the report, Chris Lenhardt seconded, and the motion passed unanimously.

### **NOAA Response to SAB Report on Open Data/Open Science**

Jason Cooper, Senior Policy Advisor, NOAA Office of the Chief Data Officer  
Archivist, National Centers for Environmental Information

Jason Cooper presented NOAA's response to the SAB report submitted November 2022. The report's three key findings were: (1) NOAA was succeeding in making data fair through its data strategy and accompanying action plan; (2) it was also succeeding in making publications open and available through its Institutional Repository; and (3) it should embrace open science agency-wide. In its response, NOAA concentrated on four focus areas: open data, open-source software, open science, and consistent guidance across the agency. Its approach involved accepting challenges and implementing FAIR (findable, accessible, interoperable, and reasonable) data principles. NOAA first assigned the task to the Chief Data Officer, Tony LaVoi, who then tasked Mr. Cooper to lead and coordinate the response. NOAA already had several initiatives underway, including its Data Governance Committee (DGC) and NAO 212-15B, which established a data management policy. Moreover, the Commercial Data Buys Task Team is tasked with providing guidance on the acquisition and use of commercial data. The DGC chartered a task team that produced a report identifying six gaps in digital object identifier (DOI) issuance needs. Another NAO in development is 201-118, which addresses open-source software recommendations, emphasizing support for community development of software and compliance with laws and best practices. NOAA has two open source initiatives, Openscapes and the Earth Prediction Innovation Center (EPIC). It seeks to leverage early adopters to extend open science across the agency.

#### *Discussion*

Jason Ausubel criticized the presentation for not considering the conflict in society between community and commercialization. Mr. Cooper recognized the need for clear expectations and negotiations in the early stages of engaging with communities. Dr. Tolman acknowledged there was a difference between doing open source and doing open science.

Chris Lenhardt expressed optimism that NOAA's efforts at consistency and centralization would pay off. He suggested considering levels of service related to data, data access, and provision of data because not all data is created equal. Mr. Cooper assured him that NOAA is working on requirements for data citation and metadata.

Dr. Spinrad emphasized the need for an all-of-government approach, especially in the context of climate services. He discussed alignment issues in policy across government agencies.

John Kreider noted a tendency in the NOAA presentations to talk about successes and recommendations they agreed with. He invited presenters to discuss what they disagreed with and the challenges NOAA faces. Mr. Cooper acknowledged there was some hesitation in NOAA on adopting open science policies agency-wide.

## **SAB Climate Working Group (CWG) Report on Organizing US Civilian Operational Oceanography Forecasting Services**

Joellen Russell, University of Arizona and Co-Chair, CWG

Susan Wijffels, Woods Hole Oceanographic Institute and CWG Member

Joellen Russell presented a report proposing the establishment of a global ocean forecast system organized by NOAA. She highlighted the current limitations of the National Digital Forecast Database Display, emphasizing a significant gap in coverage, particularly along the coast of Canada and most of the Atlantic. The ocean is undergoing substantial and continuous changes, including increased temperatures, altering oxygen levels, changing pH, and accelerated currents worldwide. The impacts are observed in higher wave heights, variations in mixed layer depths, and the transformation of oceanic systems. These changes have real consequences for human activities, especially in ocean commerce and transit. Dr. Russell illustrated the importance of ocean forecasting for global shipping, emphasizing the need for a comprehensive system analogous to a traffic and weather report for ocean routes. She also discussed the strategic implications of melting sea ice in the Arctic, emphasizing the lack of a dynamic sea ice prediction model. The report presented by Dr. Russell and her group focused on the necessity of operational oceanography in developing a global environmental intelligence network. It called for a clear delineation of goals, objectives, and products for a civilian operational oceanographic and prediction service, framed within the context of global environmental intelligence. The report underscored the challenges posed by the lack of a dynamic sea ice prediction model, increasing global competition, and the need for improved forecasting for ocean commerce and transits. Recommendations included organizing a multi-office work team, developing a cost-effective list of ocean products and services, and reconfiguring model and prediction development plans to ensure timely deployment. Dr. Russell urged enhanced integration of research-to-operations (R-to-O) within NOAA, expressing concerns about the current state of R-to-O integration. The report also emphasized the importance of a centralized ocean product portal for easy access to information, including observations and model-related products. The overarching goal is to provide timely and accurate information to support decision-making in the face of a changing climate and oceanic conditions.

### *Discussion*

Dr. Spinrad commented on the absence of discussion on the Global Ocean Observing System (GOOS). Dr. Russell acknowledged concerns about the decay of the Argo array and the limitations in maintaining and expanding it. She argued for the necessity of an operational

global system, criticizing the decrease in civilian ocean funding and highlighting the impact of inflation on ongoing efforts.

Dr. Spinrad also addressed potential international collaboration and the role of the International Oceanographic Commission (IOC). Dr. Russell argued that operational data must be assimilated and are necessary for forecasting, and that research-oriented data may not align with operational needs. She reiterated the challenges of aligning research and operational arms within oceanography.

David Grimes asked about the potential development of a global ocean portal and the inclusion of environmentally related products. Dr. Russell stressed the importance of building ecosystem prediction in such a portal, mentioning the approval of sensors by the IOC.

David Grimes made a motion to accept the report with the suggestion of including nuanced statements in the transmittal letter to address concerns about the perceived absence of NOAA leadership and to provide a more balanced perspective on its contributions to oceanography. Martin Storksdieck seconded, and the motion passed unanimously. The report was approved with the intention to enhance clarity in the transmittal letter.

### **SAB Open Discussion**

John Kreider, Kreider Consulting LLC and Chair, NOAA SAB

During the open session, participants addressed the previous day's session on operational climate services. Concerns were raised about the lack of consensus or conclusions reached during the discussion. Dr. Spinrad emphasized the need for clarity and separation between research and development (R&D) and operational activities within climate services. He highlighted the challenge of identifying priorities for climate services and proposed a paradigm similar to the one used in the Department of Defense for distinguishing between R&D and operations. Two key questions were posed to the group: whether the paradigm of separate but interactive operations and R&D works for climate services, and whether pursuing a joint-forces approach with other agencies, particularly those with strong operational activities, would be valuable.

David Grimes provided an international perspective, referencing the global framework for climate services adopted by the U.N. and the challenge of translating key messages from climate assessments effectively. He expressed skepticism about the strict separation of research and operations, emphasizing the need for ongoing learning and adaptation due to the uncertainties in climate science. A significant portion of the discussion revolved around the complexity of climate communication and the role of governance. Mr. Grimes highlighted the importance of early warning services and the challenge of effectively conveying the severity of climate threats. Dr. Spinrad emphasized the need for clarity in responsibilities, including training, capacity building, and evaluation within the full spectrum of climate services.

The discussion then expanded to cover issues of governance, decision-making processes involving multiple stakeholders, and the need for better coordination and communication among agencies. John Kreider expressed his belief in the feedback loop between operational services

and research and suggested that NOAA might need to take the lead in defining critical priorities for operational climate services.

Martin Storksdieck brought attention to the translational challenge in applying research findings to operational practices, particularly in the realm of climate-based education and communication. He highlighted the need to build trust in climate predictions considering the unique nature of climate compared to weather predictions.

Jon Allan emphasized the importance of convening conversations across different domains and breaking organizational silos to address climate service challenges effectively. He suggested that NOAA, given its convening power, initiate cross-lateral conversations to explore intersectionalities and enterprise-level solutions.

John Kreider emphasized the need for discussions on undefined or less accepted issues, highlighting the emotional and conflicting nature of these conversations. David Grimes expressed concerns about public engagement and suggested targeting the financial sector as a catalyst for change. Dr. Spinrad emphasized the ongoing efforts to build trust while acknowledging the evolving public interest in climate-related issues.

The discussion then shifted to the consideration of critical emerging technologies. John Kreider raised the question of whether to identify and address these technologies. David Grimes suggested looking at disruptive signals that impact NOAA's mission, considering both technological and process-related disruptions. Chris Lenhardt mentioned the idea of non-stationarity in social systems and potential destabilization.

There was agreement on the importance of addressing disruptive signals and emerging technologies. The conversation concluded with John Kreider seeking volunteers to work on framing specific topics for future meetings. Jon Allan and Martin Storksdieck offered to serve in this capacity.

## **Review of Actions**

Casey Stewart, Executive Director, NOAA SAB and Designated Federal Officer

Casey Stewart reviewed the five action items from the meeting:

1. The SAB will transmit the EISWG observing system backbone report to NOAA.
2. The SAB will transmit the recommendation to NOAA that TSTAP be a freestanding working group of the SAB, and to include its updated terms of reference for NOAA's consideration and decision.
3. The CIAO and the SAB office will provide a list of the summary of comments by SAB members on their experience with CI reviews.
4. The SAB will transmit the EISWG report on gap-filling radars to NOAA.
5. The SAB will transmit the CWG operational oceanography report to NOAA with a transmittal letter addressing the concerns raised about the nuances of NOAA's role and the operational oceanography.

John Kreider added a final item calling on SAB members and NOAA to provide input to specific topics. He, Jon Allan, and Martin Storksdieck will scope out a topic and approach for the next meeting.

### **Plans for Next Meeting**

John Kreider, Kreider Consulting LLC and Chair, NOAA SAB

The next SAB meeting is scheduled for March 19-20 in the Washington, D.C. metropolitan area.

### **Adjourn**

The meeting adjourned at 11:55 a.m.

### **Minutes Certification**

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**John R. Kreider, NOAA SAB Chair**

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**Date**

## Acronyms/Glossary

<i>AEROMMA</i>	Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas
<i>AI</i>	Artificial Intelligence
<i>ATOMS</i>	AWIPS [Automated Weather Information Processing System] Tsunami Operating Messaging System
<i>AWIPS</i>	Advanced Weather Interactive Processing System
<i>BIL</i>	Bipartisan Infrastructure Law
<i>CDC</i>	Centers for Disease Control and Prevention
<i>CDR</i>	Carbon Dioxide Removal (also mCDR for Marine CDR)
<i>CEO</i>	Chief executive officer
<i>CI</i>	Cooperative Institute
<i>CIAO</i>	Cooperative Institute Administration Office
<i>CIC</i>	Cooperative Institute Collective
<i>CINAR</i>	Cooperative Institute for the North Atlantic Region
<i>CIRA</i>	Cooperative Institute for Research in the Atmosphere
<i>CO2</i>	Carbon Dioxide
<i>CPC</i>	Commissioned Personnel Center
<i>CRADA</i>	Cooperative Research and Development Agreements
<i>CSL</i>	NOAA Chemical Sciences Laboratory
<i>CWG</i>	Climate Working Group
<i>DAARWG</i>	Data Archive and Access Requirements Working Group
<i>DFO</i>	Designated Federal Officer
<i>DGC</i>	Data Governance Committee
<i>DOC</i>	Department of Commerce
<i>DOE</i>	Department of Energy
<i>DOI</i>	Department of the Interior
<i>EDA</i>	Economic Development Administration
<i>EEZ</i>	Exclusive Economic Zone
<i>EISWG</i>	Environmental Information Systems Working Group
<i>EPIC</i>	Earth Prediction Innovation Center
<i>ERB</i>	Earth Radiation Budget
<i>ESMWG</i>	Ecosystem and Sciences Management Working Group
<i>FAIR</i>	findable, accessible, interoperable, and reusable (pertaining to data)
<i>FEMA</i>	Federal Emergency Management Agency
<i>FTAC</i>	Fast Track Action Committee
<i>GOES</i>	Geostationary Operational Environmental Satellite
<i>GONG</i>	Global Oscillations Network Group
<i>GOOS</i>	Global Ocean Observing System <a href="http://www.ioc-goos.org/">http://www.ioc-goos.org/</a>
<i>HAB</i>	Harmful Algal Bloom
<i>HFIP</i>	Hurricane Forecast Improvement Program
<i>ICAMS</i>	Interagency Council for Advancing Meteorological Services
<i>IOC</i>	Intergovernmental Oceanographic Commission <a href="http://www.ioc-unesco.org/">http://www.ioc-unesco.org/</a>
<i>IOOS</i>	U.S. Integrated Ocean Observing System (IOOS®)
<i>IP</i>	Intellectual property
<i>IRA</i>	Inflation Reduction Act

<i>IUU</i>	Illegal, Unreported and Unregulated (fishing)
<i>JTTI</i>	Weather Program Office's Joint Technology Transfer Initiative
<i>NAO</i>	NOAA Administrative Order
<i>NAS</i>	National Academies of Sciences
<i>NASA</i>	National Aeronautics and Space Administration
<i>NCA</i>	National Climate Assessment
<i>NESDIS</i>	National Environmental Satellite, Data, and Information Service <a href="http://www.nesdis.noaa.gov/">http://www.nesdis.noaa.gov/</a>
<i>NEXRAD</i>	Next Generation Weather Radar
<i>NIST</i>	National Institute of Standards and Technology <a href="http://www.nist.gov/index.html">http://www.nist.gov/index.html</a>
<i>NOAA</i>	National Oceanic and Atmospheric Administration
<i>NOFO</i>	Notice of Funding Opportunity
<i>NOPP</i>	National Oceanographic Partnership Program
<i>NSF</i>	National Science Foundation <a href="http://www.nsf.gov/">http://www.nsf.gov/</a>
<i>NWS</i>	National Weather Service
<i>OAR</i>	(Office of) Oceanic and Atmospheric Research
<i>ODE</i>	Observational data element
<i>OECI</i>	Cooperative Institute for Ocean Exploration
<i>OMB</i>	Office of Management and Budget <a href="http://www.whitehouse.gov/omb">http://www.whitehouse.gov/omb</a>
<i>OSTI</i>	Office of Science Technology and Integration
<i>PARR2</i>	Public Access to Research Results
<i>PTO</i>	Patent and Trademark Office
<i>PWR</i>	Priorities for Weather Research
<i>RIDE</i>	Rapid Intensification Deterministic Ensemble
<i>RO</i>	Radio Occultation
<i>S2S</i>	Subseasonal to Seasonal
<i>SAB</i>	Science Advisory Board
<i>SBA</i>	Small Business Administration
<i>SBES</i>	Social Behavioral and Economic Science
<i>SMART</i>	Specific, Measurable, Achievable, Relevant, Time-based
<i>SRM</i>	Solar radiation modification
<i>SSP</i>	Social Science Program
<i>STAR</i>	Stenella Abundance Research project
<i>STEM</i>	Science, Technology, Engineering, Mathematics
<i>STOFS</i>	Surge and Tides Operational Forecast System
<i>TPM</i>	technical program manager
<i>TRL</i>	Technology Readiness Levels
<i>TSTAP</i>	Tsunami Science & Technology Advisory Panel
<i>UFS</i>	Unified Forecast System
<i>WPO</i>	Weather Program Office
<i>WSSI</i>	Winter Storm Severity Index