

**Meeting of the NOAA Science Advisory Board  
December 7-8, 2021**

Location:      Webinar

Presentations for this meeting have been posted on the Science Advisory Board (SAB) website:  
<https://sab.noaa.gov/past-meetings/past-meeting-documents/>

**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; Dr. Chelle Gentemann, Senior Scientist, Farallon Institute; Mr. David Grimes, President and CEO, Grimes Consulting; Dr. Robert Grossman, Frederick H. Rawson Distinguished Service Professor in Medicine and Computer Science and Jim and Karen Frank Director, Center for Translational Data Science, University of Chicago; Dr. Jason Hickey, Technical Staff, Google Research; Dr. Everette Joseph, Director, National Center for Atmospheric Research; Mr. W. Chris Lenhardt, Domain Scientist, Renaissance Computing Institute, University of North Carolina at Chapel Hill; Dr. Brooke Fisher Liu, Professor of Communication and Associate Dean for Academic Standards and Policies, The Graduate School, University of Maryland; Dr. Bonnie McCay, Distinguished Professor Emerita, Department of Human Ecology School of Environmental and Biological Sciences, Rutgers University; Dr. Zhaoxia Pu, Professor, Department of Atmospheric Sciences, University of Utah; Dr. Denise Reed, Professor Gratis, Pontchartrain Institute for Environmental Sciences, University of New Orleans; Dr. Martin Storksdieck, Director, STEM Research Center and Professor, College of Education and School of Public Policy, Oregon State University; Dr. Elizabeth Weatherhead, Senior Scientist, U.S. Geological Survey; Dr. Steve Weisberg, Executive Director, Southern California Coastal Water Research Project; Dr. Anthony Wu, Executive Director, AeroMarine LLC; Dr. Donald Wuebbles, The Harry E. Preble Professor of Atmospheric Sciences, University of Illinois.

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

Dr. Rick Spinrad, Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator; Dr. Karen Hyun, NOAA Chief of Staff; Mr. Craig McLean, Acting Chief Scientist and Assistant Administrator for Oceanic and Atmospheric Research; Ms. Janet Coit, Assistant Administrator, National Marine Fisheries Service and Acting Deputy NOAA Administrator; Dr. Louis Uccellini, Assistant Administrator, National Weather Service; Ms. Nicole LeBoeuf, Assistant Administrator, National Ocean Service; Dr. Steve Volz, Assistant Administrator, National Environmental Satellite Data and Information Service; Dr. Gary Matlock, Deputy Assistant Administrator for Science, Oceanic and Atmospheric Research; Dr. Cisco Werner, Director of Scientific Programs and Chief Science Advisor, National Marine Fisheries Service; Ms. Margo Schulze-Haugen, Deputy Director, National Centers for Coastal Ocean Science; Dr. Steve Smith, Director, Office of Science and Technology Integration, National Weather Service.

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

Dr. Cynthia Decker, Executive Director and Designated Federal Officer; Ms. Courtney Edwards.

**December 7, 2021**

**Opening Statement of the Chair**

John Kreider, Kreider Consulting and Chair, NOAA SAB

John Kreider welcomed the attendees to the meeting and reviewed the agenda.

**SAB Consent Calendar**

John Kreider, Kreider Consulting and Chair, NOAA SAB

- July 2021 SAB Meeting Minutes
- August 2021 SAB Meeting Minutes
- Working Group status reports
- EISWG Membership Extensions

Chelle Gentemann made a motion to accept the consent calendar. The motion was seconded by David Grimes and was passed unanimously.

**NOAA Update**

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

Summary

NOAA plays a strong role in delivering world class science, data, and services, including innovative solutions to help the nation and the world to adapt to climate change. As demand for their products and services has increased, NOAA has been looking at how to prioritize its investments in climate research, data tools, and decision support. NOAA has been involved in half a dozen geographically- specific climate and equity roundtables. NOAA has established the Climate Council to help identify the prioritization scheme the agency will use to support development of the authoritative climate products and services, and the concept of impact-based decision support will guide their investments. Interagency and cross-agency dialogue is essential and a new set of interagency working groups have been formed to focus on investment priorities and agency roles and responsibilities for issues such as flood, extreme heat, drought, coastal resilience, and fires. Dr. Spinrad discussed his vision for the New Blue Economy, which refers to a knowledge-based ocean economy that looks to the ocean for data, information, products, and services that will support many new and traditional ocean-based sectors. NOAA's capacity for developing data and knowledge has grown tremendously due to technological innovations, such as the expansion of the Integrated Ocean Observing System (IOOS). Entrepreneurial developers and investors are building data-based businesses in which the private sector provides value-added products tuned to very specific markets. NOAA seeks to learn from these developments and take advantage of the public-private sector that by some estimates could soon be a \$100 billion dollar industry. Equity is a major area of emphasis for NOAA, both in diversification of its workforce and serving the needs of vulnerable communities. The agency acknowledges that it

is not currently serving the needs of the most vulnerable communities as effectively as they could be.

At the COP26 Conference in Glasgow, the posture of the U.S. and that of NOAA was significantly elevated from recent years. The conference stressed the need for greater action and support, especially for the adaptation agenda. NOAA plays a key role with respect to many of the deliverables identified at COP26, including the President's Emergency Plan for Adaptation and Resilience and the Blue Carbon Inventory. NOAA is taking an active role with the White House Office of Science and Technology Policy (OSTP) and other federal partners on domestic issues. The President cited NOAA's Lightning Mapper tool as an example of the U.S. developing capabilities for predicting and responding to wildfires. Arctic issues will be a high priority for this Administration, and the NOAA Arctic Council will be reinvigorated to ensure resources are being put towards addressing Arctic challenges. NOAA is also involved in the setup of the new Interagency Council for Advancing Meteorological Services (ICAMS), which covers both meteorology and climate. NOAA is working hard to fill out the political team and hopes to report on new appointees by the next SAB meeting. In the coming years, the SAB can expect to hear more about space commerce, a topic under NESDIS's responsibility and that Congress and the Department of Commerce are keenly interested in. The Infrastructure Investment and Jobs Act, which will provide about \$3 billion of additional investment to NOAA over 5 years into observational capabilities, high performance computing, and building out coastal resilience. NOAA wants to ensure they are making these investments in a climate-smart/climate-ready manner. NOAA also has received a significant increase in the President's budget and currently the House and Senate marks look favorable to their requests.

Dr. Spinrad recognized the upcoming retirement of Dr. Louis Uccellini and thanked him for his work with the National Weather Service (NWS) over the years. Additionally, he expressed his condolences and appreciation for the work of Dr. James Cowan, who passed away in August.

### Discussion

Elizabeth Weatherhead asked for Dr. Uccellini's thoughts on where the SAB has been useful and where it should be headed. Dr. Uccellini said it is clear that the SAB is in a different place than it was a year ago, which is largely thanks to the new leadership. He has never seen anyone hit the ground running as fast as Dr. Spinrad has in his position as Administrator. NOAA has a greater team approach now across Line Offices, and the collaboration he has been seeing gives his confidence that the agency will take advantage of the opportunities the recently signed infrastructure bill presents. NWS is on a firm foundation and has recognized that the impact-based decision support services are critical to realizing their mission. NWS' role does not end with forecasts and warnings; the information they provide has to be connected to decisionmakers at every governmental level.

Joellen Russell asked if written spend plans were available for the new funds and what metrics will be applied to guide those investments. Dr. Spinrad said the climate, economic development, and equity priorities are framing nearly everything NOAA does. Department of Commerce is finalizing its strategic planning and NOAA will be presenting how they fit into that plan, rather than developing their own independent strategic plan. Much of the funding in the acts is prescribed by Congress and NOAA is required by law to build spend plans around the funding categories, which will be released around January.

John Kreider asked for the Administrator's comments on how the Blue Carbon Program might bring a different perspective on solutions as opposed to basic research or NOAA's usual undertakings, as well as any comments on how he envisions approaching the blue carbon issue. Dr. Spinrad said the first step will be ensuring everyone is using the same terminology, which is why NOAA developed a draft document on what is included in the definition of blue carbon. The topic includes everything from primary productivity to fisheries, and opens the question of how the conservation of lands and waters are applied towards a blue carbon budget. Blue carbon activities have clear implications for aquaculture and discussions around marine carbon dioxide reduction. All of this feeds into understanding the role of the ocean in capturing and storing carbon and possibly with respect to changing the balance of carbon.

Jon Allan asked where NOAA's thinking is in regards to reflecting the shifting notions of tribal sovereignty. Dr. Spinrad said there are two parallel paths NOAA follows: one is ensuring the agency is fulfilling their treaty obligations and the other is how they co-develop capabilities by taking advantage of indigenous traditional ecological knowledge (ITEK). NOAA has participated in the first interagency working group on ITEK to explore how they can address this systemically. There is a lot of political attention to this issue, but NOAA is well-positioned due to its existing relationships and its history of working on the ground. A Tribal Specialist position at headquarters is needed, but this thinking also needs to be ingrained in everything the agency does.

Bonnie McCay asked how Dr. Spinrad comment on the relationship between the blue carbon agenda and the New Blue Economy. Dr. Spinrad said there is overlap, but they are really two different areas of focus. One area of overlap concerns aquaculture. IOOS and their archives are critical tools for new investments in aquaculture which bring together the new blue economy and blue carbon initiative.

Jon Allen asked how NOAA ensures that its ultimate goals are kept top-of-mind and guides the agency's decisionmaking, given that budgets typically force the agency to think more incrementally. Dr. Spinrad said there are segments of NOAA that do this really well, such as the satellite program. It is a difficult question, but having a dialogue about what the future requirements will be, and not just about what they are, is a good place to start.

Joellen Russell asked about the possibility of NOAA developing a Global Operational Forecast System that includes carbon, fish, and weather. Dr. Spinrad said a fully coupled, integrated, scalable prediction and projection system is their highest ambition and NOAA is ideally structured to create it. Even with the funding from the recent bills, NOAA will not have anywhere near the resources needed to complete this work and will have to depend critically on other agencies.

## **NOAA Science Update**

Craig McLean, Acting Chief Scientist

### Summary

Mr. McLean framed the science update around NOAA's three vision areas in its 2020-2026 research and development (R&D) mission: (1) reducing societal impacts from hazardous weather and other environmental phenomena; (2) sustainable use and stewardship of ocean and coastal resources; and (3) a robust and effective research, development, and transition enterprise. Mr. McLean first briefly discussed recent relevant Executive Orders and Memoranda. NOAA is well situated in the President's Task Force on Scientific Integrity, and the agency's scientific integrity policy has stood as a model for others to consider in their approaches. The NOAA Science Council is in the process of developing a Strategic Research Guidance Memorandum for FY 24. Narrowing down and defining what to ask for in FY 24 has been complicated by the absence of a FY 22 budget and new funds coming into the agency. Mr. McLean also briefly recognized former NOAA scientist Syukuro Manabe being awarded the 2021 Nobel Prize in Physics. Dr. Manabe's papers initiated the scientific undertaking on the relation of CO<sub>2</sub> in the atmosphere and increases in the global mean temperature.

The Global Real-Time Ocean Forecast System has been upgraded to include ocean and ice data assimilation, the first ever operational global mesoscale ocean data assimilation at NOAA. NOAA also upgraded the National Water Model (NWM) and Probabilistic Tropical Cyclone Storm Surge (P-Surge) model to improve flood forecasting. NOAA is in the process of selecting a Cooperative Institute to provide further focus on hydrology and, among other things, to work with the National Water Center on the NWM. The improvements to P-Surge are most pronounced in the period between 36-60 hours prior to tropical system landfall, resulting in better overall forecasts of storm surge in the critical 48-60 hour lead times. NOAA's new Experimental Automatic Fire Alerting System features a user configurable web dashboard to display newly detected fire events as a function of NWS fire weather products and is powered by an improved satellite fire detection algorithm. Several recent developments underscore NOAA's role as the authoritative source for mission-agnostic climate information, including the redesign of climate.gov, scientific contributions to the Intergovernmental Panel on Climate Change Working Group 1 report, and their presence at COP26, among other activities. While they benefit greatly from the contributions of other agencies, this is a core NOAA role and has been increasingly recognized as such.

The National Marine Fisheries Service (NMFS) and partners at Scripps Institution of Oceanography have developed a better understanding of the ecosystem shifts and the West Coast anchovy boom-bust cycle combining old and new analyses. Understanding this cycle and the fact that whales will follow these food fish, they realized they could couple this knowledge to what they are learning about marine heat waves, including the ability to forecast them months in advance. Heat waves were found to be coincidental geographically with a higher incidence of whale entanglements. Understanding the biogeochemical realities and the effect on fish populations allows scientists to get ahead of these problems instead of just responding to them after the fact. NOAA is also leading efforts with federal and state partners to investigate and respond to stony coral tissue loss disease (SCTLD) outbreaks on U.S. coral reefs and to facilitate surveillance, information sharing, and capacity building throughout the wider Caribbean region. NOAA's strategy for SCTLD response and prevention provides a framework for efforts to slow the disease's spread throughout the western Atlantic and to prevent/prepare for possible spread to the Indo-Pacific region. The National Ocean Service (NOS) is developing the next generation of land cover data for the coastal U.S. by advancing coastal mapping and management through

artificial intelligence and machine learning (AI/ML). Applying AI/ML algorithms has resulted in high spatial detail land cover and habitat datasets to inform regional and local coastal management decisions.

Mr. McLean presented the Ocean Observations Viewer tool, which provides critical support to the Atlantic Hurricane Field Program. The tool integrates satellite, buoy, glider, floats, drifters, and other instruments NOAA has deployed to help planners in anticipation of tropical cyclones, and during the response, to align the deployment of assets and ensure they are making calibration-based measurements in each system. A balloon-deployed device, the High-Altitude Operational Return Unmanned System (HORUS), is sent up to 90,000' into the upper stratosphere and is piloted back down while making transects throughout the atmosphere. NOAA looks forward to HORUS becoming operational and providing more access for sampling the upper atmosphere. A modified Saildrone was deployed inside Hurricane Sam and penetrated the storm to its eyewall, confronting 140 mile an hour winds and 50' waves while sending back exciting images. Getting a meteorological station into that environment opens up new doors for the agency in terms of ability to develop forecast accuracy and enable in situ measurements of the air-sea interface during a storm.

### Discussion

Tony Wu asked if the boom-bust methodology could be applied to the right whale situation in the Gulf of Maine with respect to entanglements. Dr. Werner said it is possible in the sense that they may both be related to a shifting feeding environment, but in the case of California it was due primarily to a compression against the coast that resulted in the overlap of where the crab pots were and where the whales were feeding.

John Kreider asked if NOAA is attempting to develop an uncrewed aerial system for flying into hurricanes. Mr. McLean said the focus for NOAA's aircraft plan is in sustaining the human-occupied flights and seeing a transition from P-3s to the C-130 airframe. They are also focused on miniaturized uncrewed platforms that can be deployed and piloted, but could never have the strength to penetrate a hurricane. NOAA conducted a cost comparison of uncrewed systems with a large airframe and long-term endurance and found they were still not competitive compared to human-occupied systems.

Jon Allan asked about the current thinking and aspirations for onboard sensors that can detect genetic differences within a water column in real time. Mr. McLean said at least three Line Offices share this vision and NOAA is considering a joined science and technology strategy for 'omics research. NOAA continues to fund this effort every year and with a larger annual budget they could make real progress. Mr. McLean is pleased to see the collaboration across other federal agencies and academia working in this area and he meets with them frequently to discuss advancements. Dr. Weisberg added that NOAA has been a leader in this field and has initiated a second national eDNA conference to bring together federal agencies working on this topic with a focus on how to transition it into practice. While NOAA can initiate these activities, their implementation only happens when it is adopted at the local level. Dr. Werner said that in collaborating with academia they have found that some of these technologies are being brought onboard and made part of routine observations. It is not far-fetched to think they might be using these tools operationally in fisheries assessments.

Chelle Gentemann said it is exciting to see the miniaturization of devices and encouraged NOAA to engage the commercial sector as much as possible. These technologies will be transformative if they can get them onto uncrewed platforms. She asked if NOAA is engaged in NASA's Investigation of Convective Updrafts plan and if there were plans for how they would use this data in the future. Mr. McLean did not have information on whether NOAA is engaged on that particular proposal, but said that NOAA collaborates with NASA frequently. NOAA typically focuses on NASA data that is useful in forecasts, but new information brings new opportunities. He envisions the Earth Prediction Innovation Center (EPIC) playing a role in incorporating new data streams more efficiently and effectively. Dr. Uccellini added that NWS and the National Environmental Satellite, Data, and Information Service (NESDIS) are working with commercial groups to incorporate radio occultation data in their numerical models. They are also making a concerted effort with states that have been very aggressive in developing mesoscale networks. Miniaturized devices are a game changer but present challenges for coordinating all the data.

Bonnie McCay requested NOAA's comments on the advances in research concerning socioeconomic and decisionmaking. Mr. McLean offered to come back to the SAB with a targeted briefing on the agency's efforts to increase incorporation of social sciences into the physical science and where the social sciences have increased understanding of physical science. NOAA has made advancements despite this area being underfunded and underpopulated. Though it was not highlighted in this presentation, many of the efforts discussed have aspects of social science incorporated into them. Dr. Uccellini added that NWS has been embracing social sciences and have established a GS-15 position for a social science lead. The FY 22 President's Budget would also provide resources to bring more social scientists into NWS.

Louis Uccellini commented on Mr. McLean's upcoming retirement and thanked for his service and all he has accomplished for the agency.

### **NOAA Response to the SAB Environmental Information Services Working Group: Statement Concerning the Ongoing NWS Data Dissemination Challenges**

Michelle Mainelli, Director, NWS Office of Dissemination

The SAB's Environmental Information Service Working Group (EISWG) previously provided four recommendations related to NWS' ongoing data dissemination challenges. NWS has reviewed the recommendations and provided responses to each.

- EISWG Recommendation 1: Design and implement an emergency response.
  - NWS response: NWS conducted an in-depth analysis about what applications caused the greatest bandwidth constraints, worked directly with their partners, and implemented a solution that met partner needs for model data access. NWS also received \$1.5 million in FY 21 to look toward a longer term bandwidth solution and procured network-related hardware as a first step to alleviate the restriction. By the end of the third quarter of FY 22, NWS will upgrade the network bandwidth at both data centers to 100G.
- EISWG Recommendation 2: Strengthen engagement with the broader Weather Enterprise.
  - NWS response: The NWS concurred that direct engagement with the Weather Enterprise has improved current Integrated Dissemination Program (IDP) operations and their plans for the future. NWS welcomes this engagement and is

open to establishing regular fora to discuss ways to improve services for external partners and customers.

- EISWG Recommendation 3: Prioritize designing and moving to an appropriate scalable architecture.

Part A: Leverage content delivery networks.

- NWS response: NWS recognizes the value of using cloud for data dissemination and has leveraged Content Delivery Networks (CDN) successfully. NWS has hosted most weather.gov traffic on a CDN, offloading nearly 80% of the total internet bandwidth from websites that NWS data centers would normally serve. Depending on FY 22 funding, NWS will invest in expanding the use of a CDN provider to serve existing NOMADS and FTPRD services to the edge, reducing impacts to IDP on-premise infrastructure. In FY 21, NWS launched initiatives that utilize cloud computing and associated capabilities and will continue to expand these services in FY 22. NWS is working closely with its user-base to ensure that making model data available via the Big Data Program platform and cloud service providers will not disrupt end users' downstream processes.

Part B: Accelerate the migration to commercial cloud networks.

- NWS response: NWS follows the NOAA Cloud Strategy, which aligns with the federal Cloud Smart strategy and complies with the principles of free, open, and equal access to the public. NWS embraces the SAB suggestions and will ensure a proper emphasis in Phase 4 of the IDP Plan. Based on resources, NWS plans to move in parallel as they transition data access from on-premises to cloud and simultaneously refactor/re-architect/ready applications for the cloud migration. Based on the FY 22 President's Budget, the NWS can begin moving to the public cloud in the timeframe referenced in the IDP plan.
- EISWG Recommendation 4: Enhance user management, product availability announcements, and training programs.
    - NWS response: NWS agrees that reducing excessive demand is prudent given the current limitations of IDP. NWS is considering the use of a publish/subscribe system that would allow users to choose the information they would like to subscribe to for automatic updates. NWS intends to increase the number of webinars to provide enhanced notification to users and partners about upcoming upgrades, tests, etc. NWS has awarded a one-year contract with Forrester Research, Inc., to conduct a NWS Customer Experience Assessment. NWS is demonstrating a cloud-based version of its NWSChat process that allows for user subscriptions to alerts as enabled by the underlying commercial off-the-shelf product.

## Discussion

Jason Hickey asked at what point cloud providers are engaged as NWS moves forward with its cloud services and architectures. He also commented that cloud networks are typically operating at much higher levels of reliability than NWS' currently are. Ms. Mainelli said NOAA looks at the various pieces in determining the best match in a provider, and data delivery for NOMADS is available on three major cloud providers. Ms. Mainelli said they have to balance security and other pieces, ensuring that watches and warnings can get out to the people that need them regardless of whether there is an issue with a cloud provider.



Jon Porter said he was pleased to see the increased use of CDNs to offload requests from NOAA's infrastructure and the progress of moving to the cloud along with principles of free access to foundational data. He asked where Ms. Mainelli thinks NWS is operationally in terms of all the interventions undertaken by NOAA to address bandwidth considerations. Ms. Mainelli said their metrics show significant improvements, particularly with model data. Their stability will rely heavily on FY 22 appropriations, but the most important piece of NWS' value chain is the delivery and making sure all of their forecasts, products, warnings, and data services get out the door.

### **Priorities of Weather Research (PWR) Final Report**

Brad Colman, Climate Corporation and Co-Chair, PWR Study Team

Scott Glenn, Rutgers University and Co-Chair, PWR Study Team

The PWR Study Team representatives presented their final report, which represents nearly a year's worth of work from many participants. The PWR report is a comprehensive, forward-looking report that is focused on decadal priorities and builds upon the existing portfolio of ongoing work at NOAA. The definition of "weather" used in the report comes from the Weather Act and has a scope of 0-2 years out. The team briefly reviewed the directive from Congress to the SAB to provide policymakers with the relevant information necessary to prioritize investment in weather forecasting, modeling, data assimilation, and supercomputing over the next ten years. Three considerations focused the work of the group: (1) In 2021, as part of an increasing trend, the U.S. experienced 18 billion-dollar weather and climate disasters, resulting in over \$105 billion in damage; (2) Weather forecasts are used daily in business decisions, in addition to supporting food, water, energy, and national security decisionmaking and economic wellbeing; and (3) Weather disproportionately impacts historically underserved and socially vulnerable communities. The framework for the study centered around 3 pillars (Observations and Data Assimilation, Forecasting, and Information Delivery), which were supported by 4 foundational elements (science, computing, workforce development, and weather enterprise). Dr. Glenn reviewed the organization of the study teams and the process used to collect and compile the information. The five narrative themes used in the report illustrate the value of improved weather information. These are: the mission critical mile, highly reliable and fully accessible weather information, improved prediction of water cycle extremes and their cascading impacts, high-impact weather, and global leadership in weather prediction as a pathway to higher quality products and services. The report then goes into detailed findings and how the recommendations were developed across the three pillars and foundational elements. Each priority area contains multiple recommendations and each recommendation contains multiple critical actions. When taken as a whole, these investments and actions will be transformational, enabling NOAA and the nation's Weather Enterprise to meet accelerating weather, water, and climate challenges, better protect life and property, and promote greater economic prosperity and environmental justice for all.

Since the tasking was to provide the information necessary to prioritize investments, the study team resisted creating their own prioritization. They did, however, provide insight on where to start. The ten areas where immediate first steps were identified were either critical gaps/shortfalls, steps required in order to get to next steps, or where there were high readiness/high reward opportunities. These immediate first steps fall across four core areas:

R&D, infrastructure, action and impacts, and prioritization and investment. The team reviewed each of the first steps and the justification for each. The report also makes suggestions for further engagement across federal agencies, the national and international weather enterprise, and the science community.

### Discussion

Denise Reed said the final report is a significant improvement over the draft. If the report is going to be reformatted in its final version, she recommended including the framework diagram used in the slides to demonstrate the linkages in the Executive Summary and provide more obvious visual context for the way the recommendations table is structured. The categorization of the immediate first steps as presented in the slides would also be helpful to have in the Executive Summary.

David Grimes complimented the team on the Executive Summary's improved impact and agreed that some of the graphics the PWR team used in the presentation could add value to the Executive Summary if it is to be taken beyond the NOAA audience. He recommended highlighting how broad the engagement was in arriving at these conclusions and recommendations.

Craig McLean was impressed with the level of work and accomplishment contained in the report. With a stationary budget, there is so much contained in the report that NOAA could not possibly realize all of the recommendations, though an influx of new funds provides an opportunity to make the kinds of guided investments recommended in the report.

Louis Uccellini said this will more than satisfy the people on Capitol Hill who have been looking for such a report. It is very hard to get resources to social/human behavioral sciences to assess and improve how NOAA is affecting decisions, which is the intrinsic value of everything the agency does. With respect to prioritizations, he cautioned against prioritizing services because each has an audience, a need, and a requirement. There are things that need to be prioritized, especially in the research-to-operations process.

Rick Spinrad said NOAA is extremely appreciative of all of the hard work that has gone into the report and he expects that the helpful, actionable, and comprehensive treatment they have provided will receive a lot of attention. He suggested not spending more time polishing or refining the document and that the SAB move with alacrity because of the many opportunities currently present to utilize this report.

Denise Reed made a motion to accept the PWR Final Report. The motion was seconded by Jon Allan and was passed unanimously.

### **Updates from SAB Working Groups**

#### *Climate Working Group*

Many new members have been approved for the working group. The Working Group has just begun discussing activities on three new white paper topics: emerging hazards and vulnerabilities, climate and air quality prediction, and organizing operational ocean forecasting. The CWG will continue to collaborate with other working groups as appropriate and continue to

comment on NOAA's climate portfolio as requested. CWG is working on content for the Spring 2022 meeting.

#### *Data Archiving and Access Requirements Working Group*

DAARWG is reviewing candidates for new membership and will be coming to NOAA soon with a proposed slate. They held two recent meetings, one focused on the NESDIS Cloud Archive Program and another on the Big Data Program. DAARWG is gathering ideas for reports to send to the SAB on each topic.

#### *Environmental Information Services Working Group*

About half of the EISWG was involved in some way with the PWR report, which drained the group's overall resources in 2021. They will be presenting on their Report to Congress later in this meeting. EISWG has a couple reviews under way, including a NEXRAD radar gap study and subseasonal-to-seasonal reports. They have received briefings on EPIC activities, among others. EISWG has formed the Social Science Subpanel to help bring a high level of support for the social sciences back to the physical sciences and address the co-development process.

#### *Ecosystem Sciences and Management Working Group*

ESMWG has several new members. They met to determine the scope of the Rapid Ecosystem Change white paper, which should be available to the SAB in time for its next meeting. They have focused on co-designing with stakeholders and engaging users throughout model development and implementation. They are looking further at having a more holistic human dimension regarding marine ecosystems, including ITEK, and will be focusing more on biological forecasting. ESMWG is collaborating with the SAB on the Leadership in Coastal Resilience (LCR) report.

#### **Public Comment**

There was no public comment.

#### **Adjourn**

At 4:37 p.m., this meeting of the Science Advisory Board adjourned.

#### **December 8, 2021**

#### **Opening Statement of the Chair**

John Kreider, Kreider Consulting and Chair, NOAA SAB

#### **Tsunami Science & Technology Advisory Panel Final Report**

Rocky Lopes, Co-Chair, TSTAP

Rick Wilson, California Geological Survey and Co-Chair, TSTAP

The TSTAP presented on their first quadrennial report to Congress. While the next TSTAP report to Congress is not due until 2025, the TSTAP's terms of reference state that they will

deliver an annual report to the SAB in the off-years for review. The Panel has eight major recommendation categories, with a total of 22 direct sub-recommendations, for NOAA and its tsunami program. The most significant recommendations relate to improvements to the NWS Tsunami Warning System and its two Tsunami Warning Centers. TSTAP believes NOAA is fulfilling its mission adequately for tsunami detection, warning, and notification with the resources and staff that are available. These recommendations are based on perceived gaps and inconsistencies through the tsunami forecast and warning process.

#### Recommendations:

- Improve unification and capabilities of the Tsunami Forecast System.
- Improve tsunami detection and observation systems.
- Provide more extensive, consistent, and accurate tsunami messages and products.
- Develop enhancements to Tsunami Warning Center forecasts and alert systems.
- Improve consistency in tsunami preparedness and mitigation products for communities.
- Produce guidance for improving long-term community resilience to tsunami hazards.
- Improve tsunami hydrodynamic modeling.
- Develop tsunami research priorities and leverage research opportunities.

#### Discussion

John Kreider said that, in listening to the recommendations, he did not come away with a sense of the adequacy of the current system. It was not clear if these items are urgent things that need to be done to get the system up to the level it should be or if they would be nice to have. Dr. Lopes said the warning centers are adequate to meet the current needs, but there are major gaps in unification of the centers. Legislation has called for each center to be able to back the other up if one goes out, but they still cannot do that completely. Other issues that have been identified include inconsistent messaging and that the system is not useful in its current state for Impact-Based Decision Support Services. Mr. Wilson said that many of the recommendations confront the urgency for improving the whole process, from the national to state to local levels, ensuring that mitigation and preparedness activities are adequately addressing the need and gaps. Dr. Lopes said the nation is heavily reliant on the DART (Deep-ocean Assessment and Reporting of Tsunamis) buoy system, which go offline from time to time. There is a great need for additional detection capabilities which are on the cusp of being implemented. Mr. Kreider asked the SAB members if there would be value in highlighting the more urgent recommendations.

Jon Allan agreed that it would be worth highlighting the more urgent recommendations. He was looking for a sense of what these investments would provide relative to the risks people are experiencing. Dr. Lopes noted that this is included in the paragraph under “Urgent Need for Action.” In drafting the report, the TSTAP was operating under the assumption that they should not state anything that would have budget implications. Mr. Wilson added that the eight recommendations were ordered by importance.

Donald Wuebbles asked how the impact of sea level rise and tidal events were taken into account in these recommendations. Dr. Lopes said they had a briefing on the potential impact of climate change and sea level rise on tsunami activity during their preparation of the report. They do not

necessarily see sea level rise presenting a problem for tsunamis, but for tsunami evacuations, since more areas are potentially at sea level or at risk for greater inundation. Part of the recommendations includes improving bathymetry and topography for mapping capabilities. They can address sea level rise issues as inundation and tsunami evacuation maps are updated. Mr. Wilson pointed out the sub-recommendation that proposes bringing more information in to the forecasts, which would account for high tide or storm conditions offshore and fold them into the tsunami forecast.

Robert Grossman suggested adding a short paragraph explaining the consequences if the top recommendations are not implemented. The TSTAP took this under advisement, but much of the possible scenarios are conjecture and most of the panelists are hard scientists uneasy with making prognostications. If the SAB accepts the report, a transmittal memo to NOAA could include that type of information. Chair Kreider said his concern with that approach is that the report and transmittal letter may become separated. He felt the report needed to capture why the top recommendations are important. SAB members proposed several ways for addressing this issue with regards to the first recommendation and backup capabilities.

Dr. Decker said that the SAB's transmittal letter could be made part of the report so that the two will not get separated when sent up to Congress. Members agreed with this approach and discussed some of the items they want to see highlighted.

Christopher Lenhardt made a motion to accept the TSTAP Final Report and SAB staff will work with the TSTAP co-chairs to draft an integrated transmittal letter highlighting key aspects of the report. The motion was seconded by Robert Grossman and was passed unanimously.

Elizabeth Weatherhead volunteered to assist in drafting the transmittal letter.

### **NOAA Response to SAB Environmental Services Working Group Report: Recommendations to the NOAA SAB Concerning the Hurricane Forecast Improvement Program**

Frank Marks, Director, Hurricane Research Division, NOAA's Atlantic Oceanographic and Meteorological Laboratory

In 2018, NOAA prepared a Hurricane Forecast Improvement Program (HFIP) plan that outlined specific research, development, and technology transfer activities necessary to address the three primary focus areas stated in Section 104 of the Weather Act. NOAA also prepared a five-year HFIP Strategic Plan that expands on the plan sent to Congress identifying specific goals, six key strategies to achieve those goals, and metrics to measure progress toward them. The plan was reviewed by EISWG who developed five recommendations which were approved by the SAB and transmitted to NOAA in October 2020. NOAA's response outlines how they are addressing the EISWG recommendations.

- EISWG Recommendation 1: To address The Weather Act Title I, Sec. 104 (c), the expanded scope must be mapped to necessary resources and timelines.
  - NOAA response: NOAA base support and short term supplemental projects under the Bipartisan Budget Act of 2018 and the Additional Supplemental

Appropriations for the Disaster Relief Act of 2019 were used to accelerate four key strategies outlined in the 2019 HFIP Strategic Plan:

- Development of the Hurricane Analysis and Forecast System to improve forecast guidance on track and intensity, including rapid intensity change
- Social, behavioral, and economic science (SBES) research to improve communication of risk
- Increased R&D High Performance Computing (RDHPC)
- Provide grants to broaden expertise and expand interaction with external community
- HFIP budget reduction in FY15 slowed rate of progress towards 10-year goals. To address expanded scope HFIP requires \$22 million a year. FY18 and FY19 disaster supplemental resources provided one-time support of ~\$20 million over three years and \$25 million for RDHPC.
- EISWG Recommendation 2: Expand participation through dedicated science campaigns that cross the atmosphere-ocean interface to improve model physics and data assimilation, and increase the use of probabilistic forecasts to quantify uncertainty. Continue Hurricane Analysis and Forecast System (HAFS) development and train more external researchers.
  - NOAA response: HAFS development is leveraging the advancing in the Unified Forecast System (UFS) and Joint Effort for Data Assimilation systems through disaster supplemental, UFS research-to-operations (R2O), EPIC, and federal grants, which also serve as touchpoints with broader community efforts. HFIP developed collaborations with Office of Naval Research on the Tropical Cyclone Rapid Intensification initiative and OAR/Global Ocean Monitoring and Observing (GOMO) and IOOS on use of ocean observations to improve rapid intensification guidance.
- EISWG Recommendation 3: Communicating storm surge risk should be prioritized, account for uncertainty from multiple sources, and address diversities of human perception, behavior, and needs. Evaluation and improvement of operational storm surge models should also be prioritized.
  - NOAA response: Owing to the budget reduction, storm surge R&D is now largely being supported by the Consumer Option for an Alternative System to Allocate Losses (COASTAL) Act and UFS. Current storm surge modeling activities are now coordinated under UFS through the Marine and Land Working Groups. Disaster supplemental and COASTAL Act supported extension of storm surge forecast lead times to three days with the same skill as two-day and the OCONUS development of storm surge guidance for Puerto Rico, U.S. Virgin Islands, Hawaii, and Guam. UFS is setting up a testbed to compare community coupled atmosphere-wave-ocean-hydrology models to assess their relative performance.
- EISWG Recommendation 4: Watch and warning products need to address risk from multiple threats. Developing a strategic plan for SBES research with milestones and metrics should be a high priority to ensure forecasts and forecast products address diverse societal needs and impacts.
  - NOAA response: HFIP Strategic Plan Appendix A.2.4 outlines the goals and metrics for SBES research to improve hazard guidance and communications of

risk for all hazards. Due to budget reduction, HFIP is not able to support social science research at the levels planned or desired. Disaster supplementals provided ~\$3 million for this research to support six projects. Additionally, the Office of Oceanic and Atmospheric Research (OAR) Weather Program Office and NWS Science Technology and Integration budget portfolios are providing ~\$1.5 million to support an additional five SBES projects for research, testing, and evaluation of hurricane hazard services.

- EISWG Recommendation 5: Increase internal coordination across OAR, NWS, and NOS, and expand science and technology partnerships to achieve Weather Act goals.
  - NOAA response: Enhanced collaboration across OAR, NWS, and NOS is occurring through the UFS R2O project, NOAA Climate and Modeling Board, Disaster Supplemental, Storm Surge, GOMO's Extreme Events Ocean Observing Task Team, and COASTAL Act. For overall hurricane research to operation enhancement, HFIP integrates more with NOAA testbeds such as the Joint Hurricane Testbed, Developmental Testbed Center, Joint Center for Satellite Data Assimilation, and Hazardous Weather Testbed.

### Discussion

Jon Allan said that at some point he would like to hear what the team has learned across the range of social science projects they have done. SAB members are very interested in how NOAA products are resonating and how they can motivate further.

### **Review of Draft 2021 Report to the United States Congress from the Environmental Information Services Working Group**

Brad Colman, Climate Corporation and Co-Chair, EISWG  
Scott Glenn, Rutgers University and Co-Chair, EISWG

EISWG's 2021 report to Congress focuses on the Working Group's 2020 activities and does not provide detailed information on their 2021 activities, which will be included in the 2022 report. Completing report reviews is a long process that can be challenging and frustrating, but it is effective in that it allows for communication. The one plan EISWG reviewed in 2020 was for the HFIP. Now that they have heard NOAA's response, the response will likely be included in the 2023 Congressional report. There are several commonalities with previous reports, including the need for increased investment, an all-sciences approach, and broader collaborations across NOAA, other federal agencies, industry, and academia. The report also includes a preview of what will be included in the 2021 report, including the PWR study, new reports, and a transition back to a more productive year following the completion of the PWR study. EISWG will be looking for opportunities for more frequent and informal dialogue with NOAA liaisons and NOAA leadership to ensure alignment on priorities and optimization of process. The EISWG is all volunteers and there is an ongoing balancing between EISWG resources and opportunities moving ahead into 2022.

### Discussion

Bonnie McCay said the report includes a distinction between earth system sciences and social/behavioral sciences and recommended language that integrates the two.

Jon Allan made a motion to accept the EISWG Report to Congress pending this alteration. The motion was seconded by Ilene Carpenter and was passed unanimously.

### **NOAA Response to SAB Climate Working Group Report: Precipitation Prediction Grand Challenge Strategic Plan Review**

Jin Huang, Chief, Earth System Science and Modeling Division, NOAA/OAR Climate Program Office

In early 2020, NOAA's Weather Water Climate Board set a Grand Challenge to improve precipitation prediction and requested CWG and EISWG review the strategic plan. The SAB review of the Precipitation Prediction Grand Challenge (PPGC) strategy document provided one grand recommendation, and five more specific recommendations. NOAA agreed with the recommendations and they have been incorporated into the next version of the Strategic Plan, as well as informing the Implementation Plan.

SAB's grand recommendation was to emphasize the "grand" in the plan and clearly stating what the biggest push is that would make the biggest difference. NOAA agrees and has already identified six large pushes, which are listed in the introduction section of the PPGC strategy document.

- SAB Recommendation 1: Structure the strategic plan for R2O2R, from the identification of needs in science of prediction and predictability, to the co-development of products to service.
  - NOAA response: NOAA agrees with the review team and the SAB, but retained the order of sections recommended by the SAB. A phrase was added to the introduction of Objective 1, which provides a nod to the SAB's Recommendation
- SAB Recommendation 2: Explain the specific sources of the substantial improvement (or the lack thereof) in precipitation prediction from the last 20 years, especially lessons learned from observations, modeling, and prediction.
  - NOAA response: Appendix A, Table A1 details the specific sources of improvement over the past 20 years as recommended.
- SAB Recommendation 3: Explain the specific sources that will lead to substantial improvement in precipitation prediction over the next 20 years.
  - NOAA response: Appendix A, Table A2 details the specific sources that will lead to improvements in precipitation prediction in the next 20 years as recommended. Making substantial improvements requires a portfolio of integrated efforts across the value chain from understanding to observations, to modeling, to services, with user engagement throughout.
- SAB Recommendation 4: Highlight clear, quantitative goals and connect those to the improvements distinguished in Recommendation 3.
  - NOAA response: Section 3: The Future includes clear, quantitative goals for the next two, five, and ten years.
- SAB Recommendation 5: Consider delineating the role of the community and how NOAA and partners will work together to achieve these outcomes.



- NOAA response: Appendix B delineates the roles and actions for everyone in the community.

NOAA coordinated the PPGC Strategic Plan across Line Offices as well as with the Global Precipitation Experiment (GPEX), which may provide further opportunities for broader collaborations in the future. The World Climate Research Programme (WCRP) is considering GPEX as a new Lighthouse Activity, which would be a great opportunity for NOAA to leverage national and international capabilities to achieve their PPGC goals. Coordination is critical to the Grand Challenge and sustained resources are important for implementation.

### Discussion

Joellen Russell said she was pleased to see the U.S. Global Change Research Program and WCRP interactions as well as metrics for improvements.

Elizabeth Weatherhead asked if there was any aspect of what the PPGC program is doing that is observationally limited that they wish the observation community was more responsive to. Dr. Huang said observations are a key aspect of this effort, not just of the atmosphere but also ocean observations. Given their limited resources, they cannot observe water everywhere, so they may focus on the tropical Pacific area which provides more predictability. Moving forward they want to emphasize integrated observation for modeling strategies and also identify the gaps in observations.

John Kreider said that with long-term goals on a complex problem like this it is easy to lose sight of short-term progress. He suggested developing key performance indicators for each goal, putting them in a dashboard, and reviewing them on a regular basis to keep front and center the progress being made.

### **Discussion of SAB Topics**

Denise Reed led a brief discussion on the Leadership in Coastal Resilience (LCR) effort. LCR was started in January 2021 and was intended to have a quick turnaround focused on identifying R&D for the longer term that will support NOAA's leadership in coastal resilience. She reviewed the activities of the group over the year. They are about to draft a relatively short report which will focus on a few overarching recommendations with examples of actions that could be taken. They expect to deliver the draft to the SAB at their Spring meeting. Dr. Weatherhead asked whether people are generally happy with the way things are going, if there are problems, or if there is a past problem the team is trying to help NOAA avoid in the future. Dr. Reed said they were not trying to solve a particular problem, but rather to solidify a position and identify a vision for NOAA going forward. Ms. McCammon said there are so many players in this space that one big need that has been identified is for NOAA to serve as a coordinating hub to showcase best practices, share tools, etc. Dr. Weatherhead said she would be interested to see how bi-directional the information flow is on what works and what does not. It's not about pushing out services, it's about working with stakeholders. Ms. McCammon said one item that has been suggested is exploring what can be done in terms of R&D to help communities decide how to make investments when they are confronted with multiple stressors and limited resources.

Mr. McLean said this has become an increasingly crowded field and helping the public understand where to go to get the best information would be helpful. Community-based needs are well defined with programs such as Sea Grant and the Coastal Zone Management Program. A coastal resilience equivalent to climate.gov that could serve as an integrator may be something to look into in the future. Dr. Spinrad agreed with this and added that the coastal resilience field is very fast-moving. The SAB's focus on the science aspects to this is welcome, but he cautioned about getting too deep into the policy and application side. He suggested focusing attention to where there are connection points with other programs, especially the fundamental research NSF is supporting.

Joellen Russell led a discussion on two topics the SAB identified as high priorities for the CWG to study: (1) earth system prediction and predictability and (2) technology, data, and observations to improve understanding and prediction of earth systems at subseasonal-to-seasonal-to-decadal time scales. Since the CWG has already produced reports addressing aspects of these topics, they sought additional guidance on what the SAB was looking for in order to avoid duplicating previous efforts. Chair Kreider said he would want to compare the work statement the SAB created and what the CWG has previously produced to see if there are gaps before providing any guidance to the work group. Dr. Carpenter commented that the length of time from tasking a report, drafting and approving it, and getting a response from NOAA is relatively long compared to the pace of change in technologies. It may be less useful to focus on those in this type of exchange unless something specific needs to be investigated that has not been covered in the PWR report. Dr. Joseph said it might be best to wait for NOAA's response from the new leadership before providing specific guidance to the CWG. Dr. Gentemann commented that the Earth Science Decadal Survey set a good model to follow. They focus on the science questions and gaps in scientific knowledge that could advance capabilities in specific ways and then allow the agency the flexibility to find the best technology or data to solve the scientific problem. In the future, it may be valuable to ask them to shift the question in that way so that the report is not out of date by the time it has gone through the process. Dr. Russell said the CWG has avoided leaning on a particular instrument, but rather advocated for observing system design experiments that are not being carried out frequently. Dr. Dow added that these topics suit the strengths of the CWG and in their next white papers they intend to delve more deeply into questions about climate and air quality prediction. They will also be studying emerging hazards and vulnerabilities, which might also fit into this topic. Mr. Grimes said shorter briefs on over-the-horizon subjects might be helpful. Dr. McCay suggested looking for ways other forms and sources of knowledge can be used or at least help to inform thinking about these issues. Chair Kreider recommended that the SAB liaisons meet with the CWG Co-Chairs, along with any interested SAB members, to review the SAB request and the documents that have been produced and provide feedback to the SAB on the best path forward.

Additional study topics have been raised for the SAB to take on. These include: diversity, equity and inclusion (DEI); open science; public-private partnerships; and the UN Decade of Ocean Science for Sustainable Development. Chair Kreider suggested reviewing the four topics to decide if they want to proceed and then the SAB staff can reach out to members to finalize teams that will take them on. He asked if there is a question on DEI that the SAB could bring some insight to that is not already being addressed elsewhere. Dr. Gentemann suggested sending out an email to volunteers for the topics and have them formulate a question that the SAB can ask and

then poll the SAB members to see if they want to move forward on it. Dr. Weatherhead suggested that it could be multiple questions, an assessment of the situation, identification of any problems, or if there is a desire for recommendations. Dr. Joseph said that NOAA had come to the SAB with specific requests on DEI and before formulating their own questions, the SAB should reengage with NOAA on what they would want the SAB to focus on in developing their scope. Chair Kreider recommended looking back to the one-pagers previous groups have prepared with the question and the development process as examples of what they should include in theirs to convey the intent of the work. Dr. Decker said they are handling this differently than the last time, but the SAB staff could contact the most relevant people in NOAA to assist the small groups. Chair Kreider asked for members to sign up for the small groups they are interested in and the SAB staff will then coordinate meetings early in 2022. Mr. Grimes asked if the UN Decade of Ocean Science is really of similar scale as the other three topics. Mr. Ausubel said he did not believe the U.S. has articulated its objectives for the UN Decade of Ocean Science for the nation, the federal government, or for NOAA itself. The SAB could perhaps be helpful in making sure the goals are beneficial, stimulating, and elicit the kinds of partners they want. Mr. McLean said that they did succeed in incorporating the U.S. ocean science and technology strategies and the UN implementation plan reflects those, but there is no articulation of what the U.S. objectives are. The U.S. National Committee has proffered ideas for what the country should be undertaking and the next step is for federal agencies to embrace those. Having the SAB provide input on what NOAA is doing and what they are missing with respect to this effort could be helpful.

Dr. Wu proposed the topic of what can be done at the local level that can help anticipate and perhaps mitigate harmful algal bloom (HAB) formations. Dr. Decker said NOAA has a large program focused on HABs and the SAB could get a briefing on their work before deciding whether there is something the SAB could provide advice on. Ms. McCammon said the ESMWG would also be interested in looking into HABs. Dr. Weisberg and Dr. Wu noted that the SAB may be able to help in the areas of sensors, modeling, NOAA's coordination with other federal agencies like EPA, and mitigation. Ms. LeBoeuf welcomed the opportunity to brief the SAB on NOS' HAB activities and interagency coordination. If the SAB has particular questions or areas they would like addressed, that would be useful to help hone the presentation.

Dr. Hickey said that open science was a significant topic in the PWR report. In addition to supporting innovation, it also supports equity, environmental justice, and more. The private sector knows how to build reliable and scalable services and this would be very useful for the data dissemination problems that have been discussed. Dr. Decker clarified that SAB members interested in each topic, such as Public-Private-Partnerships and Open Science, would convene, become informed about NOAA's efforts in that topic, and then draft a scoping document. Dr. Carpenter said that there is overlap between Open Science and DAARWG's work as well and they should consider how data access and open science are converging. Dr. Gentemann said that Jeff de la Beaujardiere could provide helpful insight on this.

SAB working groups are supposed to be reviewed every two years and the last review was in 2017. It would be appropriate to initiate another review in 2022, which involves convening the working group co-chairs, the SAB liaisons, and the NOAA liaisons to review the need for the working group and their terms of reference. The SAB office will reach out to set up meetings in

early 2022. Mr. Allan asked if there have been any issues or concerns with the structure of the working groups. Dr. Decker said there is some history behind the original request for reviews and the decision to include it in the concept of operations, but she was not aware of any current issues. It is useful to look at how well the working groups are meeting the intentions of what they were created for and if they are still performing work that is essential for the SAB. At the very least, it is worth looking at the terms of reference to see if they truly reflect the work that the group does and what they could do.

John Kreider said that Dr. Perry had stated that past meetings have focused heavily on climate science and it would be good to dive deeper into the newer topics on Dr. Spinrad's climate agenda. She also suggested blue economy initiatives as a topic; with the acceleration of renewable energy development and other climate-smart innovations, it would be good to better understand NOAA's short-term thinking and longer-term strategy for blue economy initiatives. Dr. Spinrad said this would merit further discussion and lends itself to very valuable advice from the SAB.

### **Plans for Next Meeting**

Cynthia J. Decker, Executive Director, SAB, and Designated Federal Official

SAB staff will send out a poll with potential dates in late March/early April 2022 for the SAB Spring meeting. Mr. Allan requested a synopsis from NOAA on how they are proceeding with social and behavioral side and what some of their learnings have been. He also wanted to hear a deeper reflection on where Tribal capacity and Tribal sovereignty fits into the conversation.

### **Review of Actions**

Cynthia J. Decker, Executive Director, SAB, and Designated Federal Official

Dr. Decker reviewed the actions from the meeting, including:

- Approval of the consent calendar.
- The SAB accepted the PWR report and the study team is considering the suggested edits. It will be transmitted to NOAA along with a transmittal letter.
- The SAB accepted the TSTAP report. SAB staff and Dr. Weatherhead will work with the co-chairs to incorporate the SAB's feedback into the transmittal letter. It will be sent out to the SAB to ensure their concerns were adequately addressed, then integrated into the report.
- The SAB approved the EISWG Report to Congress. Some minor edits were proposed and will be incorporated into the report before it is finalized.
- The LCR team agreed to look at NSF's coastal resilience activities and consider how best to engage them in the development of their report.
- Dr. Joseph will work with the CWG Co-Chairs to review the reports they have produced to identify gaps and next steps.
- SAB staff will convene the meetings of small groups to draft one-pagers and connect them with relevant NOAA participants.
- Dr. Decker will send out a copy of the last working group review report.

- SAB members recognized Dr. Uccellini's excellence in his role as Director of NWS and his international collaboration that has brought benefits to the U.S. and the global weather community.

### **Adjourn**

The meeting was adjourned at 4:46 p.m.