Meeting of the NOAA Science Advisory Board
August 25, 2021

Location: Webinar

Presentations for this meeting have been posted on the Science Advisory Board (SAB) website: http://www.sab.noaa.gov/SABMeetings.aspx

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; Dr. Chelle Gentemann, Senior Scientist, Farallon Institute; Dr. Robert Grossman, Director, Center for Translational Data Science, University of Chicago; Dr. Jason Hickey, Technical Staff, Google Research; Mr. 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. 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. 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; Mr. Craig McLean, Acting Chief Scientist and Assistant Administrator for Oceanic and Atmospheric Research; Ms. Janet Coit, Assistant Administrator, National Marine Fisheries Service; Dr. Cisco Werner, Director of Scientific Programs and Chief Science Advisor, National Marine Fisheries Service; RDML Nancy Hann, Deputy Director for Operations, Office of Marine and Aviation Operations, and Deputy Director, NOAA Commissioned Officer Corps; Gary Matlock, Deputy Assistant Administrator for Science, Oceanic and Atmospheric Research; Ms. Mary Erickson, Deputy Director, National Weather Service; Dr. Steve Smith, Director, Office of Science and Technology Integration, National Weather Service; Dr. Mitch Goldberg, Senior Scientist, National Environmental Satellite Data Division and Information Service; Dr. Mr. Mark Osler, Senior Advisor for Coastal Inundation and Resilience Science and Services, National Ocean Service;.

Staff for the Science Advisory Board in attendance:
Dr. Cynthia Decker, Executive Director and Designated Federal Officer; Ms. Courtney Edwards; Ms. Tiffany Atkinson.

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

- June 2021 SAB Meeting Minutes

Jon Allan made a motion to accept the June 2021 SAB meeting minutes. The motion was seconded by Denise Reed and was passed unanimously.

Climate Working Group (CWG) review of the NOAA Climate and Fisheries Initiative Implementation Approach
Joellen Russell, University of Arizona and Co-Chair, CWG
Kirstin Dow, University of South Carolina and Co-Chair, CWG

On May 4, 2021, Version 4.0 of the NOAA Climate and Fisheries Initiative (CFI) Implementation Approach was distributed to the CWG for review and comment. The vision of the CFI is to ensure NOAA and stakeholders have robust climate and ocean hindcasts, predictions, and projections, and the decision support needed to guide rapid responses and climate-informed management strategies that reduce risks and increase the resilience of marine/coastal resources and the people that depend on them. NOAA currently lacks the nationally-integrated observing, modeling, and decision-support systems needed to deliver the climate information required to meet the agency's Living Marine Resource (LMR) mandates in the face of rapid changes. NOAA is preparing to make strides to fill key gaps that exist in its current ocean modeling and decision-support systems. Dr. Russell presented the CWG's five recommendations on the implementation approach and associated actions that NOAA should undertake. The recommendations included:

- The CFI should designate responsible parties within NOAA for each of the critical enhancements, the required components across the NOAA line offices, and stress the necessity of coordination between them.
- The CFI should elaborate on approaches to working with more diverse groups of interested and affected stakeholders in order to ensure that models inform management products providing usable information for decision-making.
- NOAA should continue its exemplary practices in assuring scientific integrity and consider how to further enhance trust as it engages with diverse stakeholders who are acting in a dynamic scientific environment with significant uncertainty.
- The CFI should engage parties across NOAA to upgrade the ocean observing system to fill crucial gaps such as physical observations on the shelf and nearshore, and biogeochemical observations in shelf, nearshore, and offshore waters.
- NOAA's CFI should extend to include steps towards development of climate-informed, multi-stressor predictions at multiple temporal and spatial scales that meet the needs of One NOAA managers and stakeholders.

<u>Discussion</u>

Jason Hickey requested more detail on the Integrated Modeling System, specifically what is being integrated and what the challenges are. Dr. Russell said the CWG would like to see the

CFI push farther towards an integrated approach including physics, biogeochemistry, and living marine resources. New information is needed to address pressing challenges in coastal waters. NOAA's capabilities that have been developed on the research side need to be transitioned to operational, which will require integration and additional resources. Steve Weisberg expressed concern that without additional elaboration on priorities, NOAA could view integration through multiple lenses. Dr. Russell said the recommendation on coordination and the responsibility for these products and their delivery was meant to highlight this issue. NOAA has many of the capabilities required; the problem is with organization. Dr. Weisberg agreed organization will be key, particularly from his perspective at the interface of federal, state, and local uses of these models.

Zhaoxia Pu asked how the CFI addresses the weather and climate extremes anticipated in the Intergovernmental Panel on Climate Change's 2021 Report. Dr. Russell said that the CFI is specific to climate and fisheries and focuses on NOAA's effort to produce better tools to support decision-making under increased variability. NOAA must be even bolder in its work and accelerate integration in order to help address climate extremes. Dr. DowDow added that the CFI will also look at multiple stressors.

Chelle Gentemann was pleased to see the need for open development highlighted in several areas of the CWG's response to the CFI report. It is not only new information that is needed, but also new approaches.

Jon Allan said he would like to see more clarity on what the modeling piece looks like. What does the set of probabilities look like when the models includemany factors, and how can that inform local decision-making? Dr. Russell said that NOAA has the physical and biogeochemical models that work on the necessary scales, but implementation needs to occur in a more integrated fashion so that everyone has access to the information in formats that facilitate decision-making.

Anthony Wu asked how to eliminate the large uncertainties in order to get actual information in places that do not yet have collection capabilities. Dr. Russell said upgrading the ocean observing system is a key recommendation in this regard. Enhanced ocean observations could be coordinated with estuarine and other observations, which could also be made more operational. Civilian operational oceanography, as is done routinely in Europe, could assist in this endeavor as well.

David Grimes suggested making a stronger recommendation on open science and argued that open architecture and broader engagement will be critical to its success. He also suggested recommending an action in the stakeholder engagement section on framing risks and how they are changing or expected to change. He further suggested articulating what the implications of an integrated modeling system would be to NOAA as an organization.

Jon Allan made a motion to accept the CWG's report with SAB's comments included in the transmittal letter; Elizabeth Weatherhead seconded the motion and requested that the transmittal letter include a comment on the SAB's sense of the importance of the topic. The motion passed unanimously.

Climate Working Group (CWG) review of the Coastal Inundation at Climate Timescales White Paper

Kirstin Dow, University of South Carolina and Co-Chair, CWG
Joellen Russell, University of Arizona and Co-Chair, CWG

On May 4, 2021, Version 7.0 of the Coastal Inundation at Climate Timescales White Paper was distributed to the CWG for review and comment. The vision of the white paper was to guide development of a NOAA capability that produces authoritative data, products, and services that quantify and communicate the risk of subseasonal-to-centennial coastal flooding and inundation for the U.S. and its territories. This capability will be shaped by and responsive to NOAA stakeholder needs, developed by advancing NOAA;s existing capabilities, and sustained by a dedicated research and development (R&D) program that continuously delivers the best available science. Coastal communities and critical infrastructure are facing escalating risks due to increases in extreme and acute events and long-term changes caused by climate change. Managers and decision-makers currently lack the tools and information necessary to effectively plan, prepare, respond, and adapt for the coastal inundation challenges they are facing at local, regional, and national spatial scales. NOAA's mandates for the nation's coasts makes it critical that they work to fill these gaps. Dr. Dow presented the CWG's four recommendations on the white paper and associated actions. The recommendations are as follows:

- Clearly state the aspirational vision at the beginning of the document, including the need, the type of tools to be developed, NOAA's capacity, and how the initiative fits with the focus of several other federal agencies in planning for a more dynamic coast.
- Include a research plan on developing multi-scale inundation products or user-accessible downscaling tools for translating proposed coastal inundation forecasts into scale-appropriate decision-making information.
- Include a discussion of how the overall design of the suite of observations, models, tools, and products will provide off -the-shelf public options that are sufficiently refined and tailored to be directly usable by under-resourced and underserved communities.
- Consider including, and begin planning for, the extensive coordination that will be necessary for this effort to be a success. This will include both internal, cross-line office coordination and external, interagency coordination.

Discussion

Denise Reed suggested making the recommendations and actions more direct, as opposed to the high-level approach presented. She suggested emphasizing the connectivity between stakeholder engagement and delivery of products and services. Dr. Reed was pleased to see vertical land motion included and thought more on that topic would be appropriate. The review needs more clarity on climate scenarios, joint probabilities of different forcing events, and model uncertainties. Dr. Reed was surprised not to see coastal morphodynamics discussed in the report, and it thought it could be included in the recommendation on collaboration.

Chelle Gentemann noted that the report does not discuss open requirements with or for data partners. It is important that the paper addresses documentation of openness very clearly as a requirement.

Jon Allan asked for some acknowledgement of the inundation issues on the Great Lakes' U.S. coastline, which are non-tidal but highly dynamic systems. It is also important to recognize that more than 85% of the nation's shoreline is managed through at the local community government level.

Elizabeth Weatherhead requested more clarity on how this work interfaces with what the Federal Emergency Management Agency (FEMA) has planned. Dr. DowDow said some of the recommended action items are intended to urge NOAA to figure that out. Dr. Russell said it is NOAA's responsibility to provide predictions and it is important that they be useful to FEMA, which does not make predictions. Dr. Weatherhead said FEMA is doing probabilistic climate scale risk assessments and has plans to be more dynamic and responsive. This seems like a ripe area for coordination, but NOAA should also be prepared to respond to questions of redundancy.

Jason Hickey requested more specific actions for the Next Steps and Recommendations, particularly around what success looks like and how it will be measured. Dr. DowDow said the CWG assumed that would be the next stage as NOAA moves into more detailed planning.

Brooke Fisher Liu suggested including where the social science recommendations' objectives and actions came from and perhaps include an "Other" category for research that originates from or responds to community needs. Table 4.1 could include more of an acknowledgement of partnerships with community organizations and nonprofits that have relationships with underserved communities.

Anthony Wu said that inundation tends to focus on tides and storm surge from a non-scientist perspective. There is also a need for addressing wave overtopping, which probably stems from a lack of data on coastal bathymetry and structures. He also noted that there are many highly detailed inundation models for local areas that could be incorporated into this effort to better coordinate with communities and accelerate finer scale efforts.

John Kreider requested more direct statements on the need for partnerships and NOAA's role as a leader on this effort. This should either be a recommendation or included in the transmittal letter.

Rick Spinrad said NOAA wants the SAB to be the advisory body that is steadily applying pressure and course correction to a science and technology enterprise that lasts decades, but also helps with course corrections from changes in leadership. The current administration has made the decision that NOAA's climate products and services will prioritize and focus on those products/services that address the needs of vulnerable, underserved communities. The equity recommendations in this review are particularly relevant, and the SAB can help NOAA by taking this into consideration as they draft the transmittal letter. There is a vast panoply of products and services just in the inundation arena, and the SAB's input on how NOAA should prioritize what they develop is very valuable.

Mark Osler said that the NOAA team has always anticipated the next step would be a separate implementation plan for the ideas contained in this report.

Jon Allan made the motion to approve the CWG report with the SAB's comments incorporated into the transmittal letter to NOAA. Elizabeth Weatherhead seconded the motion and it passed

unanimously. Mr. Kreider asked that Dr. Reed touch base with one of the CWG Co-Chairs to reconcile if and how morphological changes should be included in the white paper.

Review of the Report and Recommendations to the NOAA Science Advisory Board Concerning Tsunami Science and Technology Issues for the United States from the Tsunami Science & Technology Advisory Panel (TSTAP)
Rocky Lopes, Former NOAA, retired, and Co-Chair, TSTAP
Rick Wilson, California Geological Survey and Co-Chair, TSTAP

The TSTAP's first report to be delivered to the SAB is intended to provide advice to the NOAA Administrator on matters regarding tsunami science, technology, and regional preparedness. Taking the SAB's feedback into account, the TSTAP will make further adjustments to the document at their September meeting in order to be consistent with the current approaches and available information. The July 28 magnitude 8.2 earthquake off the coast of Alaska was the largest U.S. earthquake since 1965. Earthquakes in this region are a threat not only for Alaskan communities, but also pose a risk for distant source tsunamis in Hawaii, California, Oregon, and Washington. Fortunately, this earthquake only resulted in a minor tsunami in California, but the event amplified many recommendations included in the TSTAP report. The Tsunami Warning Centers did a good job with the accuracy of their wave height forecast, but it took three hours for the National Tsunami Warning Center to provide a forecast for the West Coast. If this had been an event requiring evacuations, West Coast communities would have only had 30-60 minutes to respond before the tsunami arrived. Emergency managers have stated that they require no less than three hours for implementing response and evacuation plans. Reducing the time to make forecasts and improving messaging about estimated impacts throughout the first three hours following the earthquake would have been very helpful for emergency managers. The event demonstrated the importance of improving the continuity between Tsunami Warning Centers, expanding the Tsunami Detection Network (especially tide gages in Alaska), and other recommendations discussed in the report.

Discussion

John Kreider appreciated the report's prioritization of recommendations and asked for clarity on TSTAP's next steps. TSTAP is pleased with the draft but they consider it a work in progress and will discuss it in further detail at their next meeting. If the report is consistent with the feedback they receive from the SAB, they will turn it into a finalized report and provide it to the SAB for approval in advance of the next meeting.

Jesse Ausubel asked if it would be appropriate to offer an aspirational target on lead times and if other countries have a target that NOAA might consider matching. Mr. Wilson said that NOAA is very good about getting forecasts out for local events within about 5-10 minutes, but the interregional effects are more complicated. Even if the Tsunami Warning Centers do not get a full forecast out, some messaging about their expectations within the first hour would be helpful.

Mary Erickson said the draft report touches on several known issues and adds a few more for NOAA to consider as they move forward. Clear, consistent, and actionable recommendations presented in a cohesive manner will be a driver in some of the changes NWS is considering. NOAA is in ongoing conversation with the U.S. Geological Survey (USGS) on their Earthquake Early Warning System and how it may connect with Wireless Emergency Alerts (WEA). Any

recommendations that might contribute to those discussions would be valuable. Dr. Lopes asked if FEMA's Integrated Public Alert and Warning System (IPAWS) are included in the discussions with USGS. Dr. Erickson said they are very connected with IPAWS on everything they do with WEA. Dr. Lopes said the three all work together but somewhat independently. The TSTAP will look at these issues as they finalize the report.

Jon Allan asked which of the 18 recommendations the TSTAP considered most critical if they could only fund two. Dr. Lopes said they tried to make the report budget-agnostic and developed priorities for what they thought was most important then presented them in that order.

John Kreider thanked the TSTAP Co-Chairs and said the SAB would look forward to the presentation of the final report at its next meeting.

Update on Priorities of Weather Research (PWR) Report
Brad Colman, Climate Corporation and Co-Chair, EISWG
Scott Glenn, Rutgers University and Co-Chair, EISWG

The PWR team representatives provided an update on the status of the PWR Project and sought the SAB's feedback on the report structure, flow, and high-level content. The team hoped to encourage alignment on key priority topics at the current transition point between the data gathering phase and the integration phase. The PWR team will deliver the first draft of the report for the SAB's review by mid-October. They will continue holding working sessions with the SAB staff on execution and will invite interested SAB members to meet with them to discuss the report in early November. The PWR team expects to have a final report for SAB approval and transmission to NOAA in December 2021. Dr. Glenn reviewed the proposed table of contents, focusing on Section 5: Priorities for Federal Investment, which includes narrative themes, pillars, and foundational element cross-cut priorities. The narrative themes are: mission critical mile, pathway to global leadership in weather prediction, high impact weather, improved prediction of water cycle extremes and their cascading impacts, and achieving highly reliable, fully accessible weather information. The PWR team is taking a consensus approach to a portfolio balanced between operational transitions and research innovations. The criteria they propose for high priority weather research recommendations include:

- Must have high reward and benefit with a clear connection to value, impact, or transformational potential.
- Has strong linkage to NOAA through identified requirements or aligned with Mission Service Areas (MSAs).
- Is clearly advantageous to achieving NOAA's weather mission.
- Has favorable context with respect to the NOAA enterprise and the changing external world.
- Reflects a favorable balance between probability of success and reward.

The report will also include linkages to NOAA requirements, drawing from Weather-Ready Nation MSAs, Technology, Planning and Integration for Observation (TPIO) requirements, and Government Performance and Results Act (GPRA) goals.

Discussion

Jesse Ausubel was pleased to see reproducibility referenced in the outline, but felt the report could be more scientific and include a systematic treatment of the limits of predictability in meteorology and how specific actions would lead to improvements in predictions. Dr. Glenn said one of the recommendations is to pursue these types of studies to be able to make those decisions more clearly. The process of determining which improvements would be the most beneficial will take time and is part of the recommendations, immediate priorities, and follow-up recommendations. Mr. Ausubel suggested presenting a framework, or even recommending a Cooperative Institute on the Limits of Predictability in Meteorology that could dig into this topic and take advantage of all of the work that has been done in this area.

Denise Reed said the structure of the report works very well but suggested the PWR team emphasize the element of timeliness and highlight opportunities for action.

Jon Allan asked if part of the conception of a Weather-Ready Nation includes mundane things individuals can do to prepare for weather events. This piece should not be overlooked due to a focus on large-scale investments, like satellites and models. Dr. Colman said the report will include information delivery and how NOAA can work with industry to address those aspects of Weather-Ready Nation. The report will not address all the details, but rather highlight that there is more to readiness than just NOAA's products and services.

David Grimes was pleased that the outline captured many of the SAB's comments from its previous meeting. He wondered if the report's target audience would look at the annotated outline and come away thinking it is a comprehensive plan versus one that might focus on the priorities. There are areas that need more attention than others and the report needs to make clear where the most benefit would be derived, but it is not clear contextually how the PWR team is going to present this. He also wanted to see where the international consensus is on earth system modeling and how NOAA can leverage other countries' efforts as they determine where to invest resources.

Anthony Wu said the outline provides no sense of what metrics are available for improvements in weather research. It includes some references to greater involvement with the private sector but primarily cites federal investments to move this effort forward. There are many remarkable commercial weather products available now or under development that the federal sector could take advantage of. He suggested considering whether the report should include a description of what the market looks like and where there are opportunities to take advantage of collaborations with the private sector or academia. Dr. Glenn said that some of the metrics are specific to applications and they will try to capture those where they have can. What is available on the market and anticipating new markets is part of how this project will evolve over the next decade, and Section 7 addresses the need for flexibility and adaptability within NOAA.

John Kreider said the cross-cutting themes are especially important and that the PWR team may want to expand upon them further. He also encouraged them to use tables, figures, and flow charts as much as possible in further iterations of the report in order to focus their thinking and present information in a more concise and absorbable format.

Rick Spinrad indicated briefing the Interagency Council for Advancing Meteorological Services (ICAMS) will be crucial. He added that the National Science Foundation (NSF) is eager to collaborate in meteorological research with NOAA. The more this report is informed by and informative to NSF and other potential partners, the more valuable it will be. Dr. Spinrad also said that the PWR team and the SAB are well-positioned to advise NOAA on what the agency's risk horizon should be, especially in the technological readiness level (TRL) 1-3 areas. Dr. Colman said the team took a NOAA-centric approach, but did not conceive of NOAA in isolation. They view interagency, industry/academia, and international partnerships as essential and are trying to maintain that context for addressing where NOAA should make investments. NOAA and SAB feedback on whether the direction of the report is balanced would be very helpful.

Craig McLean cautioned that the requirements driving investments not be solely defined by the operational side, since there are many innovations coming from the research community well ahead of the operational capability to perform them.

Elizabeth Weatherhead said the presentation does a good job showing how what the PWR team is doing is being evaluated by lots of different communities using many different metrics. That is a valuable concept that should not be lost as this work moves forward.

Public Comment

There was no public comment.

Review of Actions

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

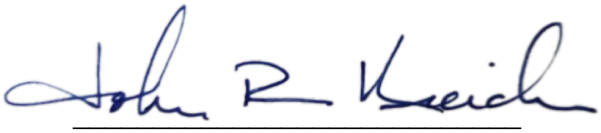
Dr. Decker reviewed the actions from the meeting, including:

- Approval of the consent calendar.
- Approval of the CWG review of the CFI Implementation Approach, which will be transmitted to NOAA with a cover page that includes the SAB's comments.
- Approval of the CWG review of the Coastal Inundation at Climate Timescales White Paper, which will be transmitted to NOAA with a cover page that includes the SAB's comments.
- The TSTAP will develop its report further at its September meeting, which will then be circulated to the SAB in advance of its next meeting.
- The PWR team will invite interested SAB members to working sessions to discuss the development of its report.

Adjourn

The meeting was adjourned at 3:35 p.m.

Minutes Certification



John Kreider, SAB Chair

16 December 2021

Date