61st Meeting of the NOAA Science Advisory Board
April 9-10, 2018

Location: Sheraton Silver Spring Hotel
8777 Georgia Avenue
Silver Spring, Md.

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:
Ms. P. Lynn Scarlett, Co-Chief, External Affairs Officer, The Nature Conservancy (Chair); Dr. Susan Avery, President Emeritus, Woods Hole Oceanographic Institution; Dr. Michael Donahue, Vice President and Director, Water Resources and Environmental Sciences, AECOM Corporation; Dr. Robert Grossman, Frederick H. Rawson Professor and Jim and Karen Frank Director, Center for Data Intensive Science, University of Chicago; Dr. Everette Joseph, Director, Atmospheric Science Research Center, University at Albany, State University of New York (SUNY); Dr. Eugenia Kalnay, Professor, Department of Atmospheric and Oceanic Science, University of Maryland; Mr. W. Christopher Lenhardt, Domain Scientist, RENCI University of North Carolina Chapel Hill; Ms. Jean May- Brett, STEM Partnership Coordinator, Louisiana Department of Education (ret.); Dr. Denise Reed, Professor Gratis, Pontchartrain Institute for Environmental Sciences, University of New Orleans; Dr. Robert Rheault, Executive Director, East Coast Shellfish Growers Association; and Mr. Robert S. Winokur, Consultant (ret. NOAA, Navy)

NOAA senior management and Line Office representatives in attendance:
Mr. Craig McLean, Acting Chief Scientist and Assistant Administrator, Office of Oceanic and Atmospheric Research (OAR); Mr. Ben Friedman, Deputy Under Secretary for Operations; Dr. Paul Doremus, Acting Assistant Secretary for Conservation and Management; Dr. Russell Callender, Assistant Administrator; National Ocean Service (NOS); Mr. Stephen Volz, Assistant Administrator, National Environmental Satellite, Data, and Information Service (NESDIS); Mr. Harry Cikanek, Director, Center for Satellite Applications and Research; Mr. Stuart Levenbach, NOAA Chief of Staff; Dr. Cisco Werner, Chief Scientist, National Marine Fisheries Service (NMFS); Dr. Gary Matlock, Deputy Assistant Administrator for Science, Office of Oceanic and Atmospheric Research; Mr. John Murphy, Chief Operating Officer, National Weather Service (NWS); Dr. Karen St. Germain, Director, Office of Systems Architecture and Advanced Planning, NESDIS; and Mr. Michael Tanner, Deputy Director, NOAA Center for Weather Climate, National Centers for Environmental Information (NCEI)/NESDIS

Staff for the Science Advisory Board in attendance:
Dr. Cynthia Decker, Executive Director and Designated Federal Officer; Ms. Elizabeth Akede; and Ms. Mary Anne Whitcomb

April 9, 2018

Opening Statement of the Chair and Self-Introductions by Science Advisory Board (SAB)

Members
Lynn Scarlett, The Nature Conservancy and Chair, NOAA SAB

Lynn Scarlett welcomed the attendees to the meeting and asked for introductions from new SAB members Robert Grossman, Christopher Lenhardt, Robert Rheault, and Martin Storksdieck. Ms. Scarlett thanked the members of the Priorities Subcommittee for their effort in advancing the work planning process. The SAB had been waiting for the NOAA leadership team to be in place before finalizing a biennial work plan to ensure it corresponds to NOAA priorities.

SAB Consent Calendar
Lynn Scarlett, The Nature Conservancy and Chair, NOAA SAB

- February 2018 SAB Teleconference Meeting Minutes
- Working Group Status Reports
- Approval of term extension for EISWG members

Jean May-Brett made a motion to accept the items on the consent calendar; Susan Avery seconded the motion and it passed unanimously.

NOAA Chief Scientist Update
Craig McLean, Performing the Duties of NOAA Chief Scientist

Summary

Craig McLean reminded the SAB of the administration's priorities, which include reducing the impacts of extreme weather and water events and increasing the sustainable economic contributions of our fishery and ocean resources. NOAA is grateful to have the Weather Research and Forecast Innovation Act (the Weather Act) that institutionalizes the way the agency should be conducting itself between research enterprises collectively and how the Weather Service can use and assimilate these products in order to advance the accuracy of its forecasting. Fully implementing the Act will be a challenge, but NOAA can get there with the FY 2018 funding level and other economic initiatives. Implementing the weather forecast and blue economy initiatives fully will require a stronger relationship with the private sector.

Reducing the impacts of extreme weather and water events

Within 18 months, NOAA has launched three satellites, utilizing substantial private sector investments to facilitate and deliver these three launches. The geostationary and the polar-orbiting satellites are in position and delivering advanced products, including radar-scaled imagery. NOAA is enlarging its hydrologic science efforts for weather forecasts. Protected resources, water availability, and flooding are being better addressed with the improved National Weather Model. The University Corporation for Atmospheric Research (UCAR), a partner with NOAA, is providing science talent to help NOAA advance the accuracy of the National Weather-Water Model, which is on version 1.2. The Water Center in Tuscaloosa, Alabama has a Sea Grant extension agent focused on bringing social sciences knowledge into the work of the Center. New radar is being installed to fill gaps around the country to provide quantitative precipitation information estimates. A partnership with the State of California is helping fill gaps in the San Francisco Bay area.

National Water Model Improvements

Though modest, the social science investments to the National Water Model are making a difference. Teaming social scientists with physical scientists and allowing them to develop their careers together in a professional relationship present real opportunities. NOAA would value any guidance the SAB has on how best to build these bridges to ensure the necessary disciplines (behavioral science, economic science, and social sciences) are blended with the physical sciences. This will provide NOAA with a return on investment dataset that could be used to help quantify NOAA's value.

Sub-seasonal to Seasonal Weather Prediction

Title I of the The Weather Act outlines NOAA's responsibilities in sub-seasonal to seasonal (S2S) weather prediction. Prior to the passage of the Act, NOAA had been looking at this time period as a climate question and for weather the time period only extended out about two weeks. That threshold is flexible and better extends our weather forecasting. S2S is now a weather subject, not a climate-based subject. NOAA is making several advancements in this area, including being able to forecast California snowpack with a high degree of reliability eight months in advance of the first snowfall. NOAA would like to focus on transitioning research programs into operations slowly, carefully and diligently. The agency held a workshop in February to bring together the private, public, and academic sectors to discuss the science agenda of S2S in order to implement the wisest science program. S2S forecasts depend largely on oceanography and ocean observation. NOAA is looking into how to transition some new commercially available technology to fit NOAA's mission, including drifters, gliders, and floats.

Increase the Sustainable Economic Contributions of Our Fishery and Ocean Resources

Increasing economic productivity of the U.S. Exclusive Economic Zone (EEZ) is a major goal of this administration, along with making America the leader in the area of ocean knowledge. NOAA highly values a comprehensive survey of the EEZ. The Mid-Atlantic Fisheries Management Council closed 38,000 square nautical miles because the ecosystem in that area was the nursery for commercially productive species harvested in other areas. By identifying and better understanding these important areas, industry leaders will be able to make better decisions in order to preserve these areas.

Emerging Technologies

Improved gliders developed at the Pacific Marine Environmental Laboratory (PMEL) allow for quicker oscillations with shallower dives, covering the water column more thoroughly. This is of significant value, particularly in the Artic. NOAA has created a new internal body for discussing program requirements and applications for emerging technologies for ocean observations NOAA-wide, then reporting back to NOAA's Observing Systems Council.

Aquaculture

For years, the aquaculture science generated inside of NOAA was exported outside the U.S. because of a lack of domestic industry interest. The Secretary of Commerce's Aquaculture Initiative seeks to expand and broaden aquaculture to reduce the fisheries trade deficit in the U.S. Sea Grant once had the greatest research investment for aquaculture, and this has been restored

in the FY 2018 budget. On the research side, aquaculture investments have yielded 6-to-1 returns on investment. There is a rich exchange of talent, with people moving between the commercial sector and the public sector making this type of activity more vibrant. NOAA sees itself as a vehicle to help industry make the necessary advancements for fulfilling the economic promise of aquaculture.

Coral Restoration and Resilience

In looking at how to measure what the forcing functions are behind the decline of coral, NOAA is considering multiple approaches to the problem. Globally defining the problem has not yet been done. A grow-out facility in the Florida Keys will collect coral specimens following weather events to rescue coral so it is not lost after being knocked off its reef stand. NOAA also provides funding to the University of Miami for a facility researching the coralline environment and the genetics of coral species to learn more about their vulnerabilities.

Notable Milestones

- 1.2 million Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT))simulations run in 2017
- 7,400 Weather Ready Nation Ambassadors
- 10 years of *Okeanos Explorer's* service at sea surveying over 1.5 million kilometers of the US EEZ
- 150th installation of Science on a Sphere
- 50 years of greenhouse gas sample collection

Education Partnership Program (EPP) Forum Highlights Student Research

To attract tomorrow's workforce, NOAA held an educational partnership forum centered on the Cooperative Science Centers. The most recent one was hosted by Howard University and drew about 140 participants. NOAA has historically looked upon the support of the EPP as an education program. However, providing educational opportunities for the students leads to a more enriched field of potential NOAA recruits. NOAA wants to get engaged with the universities to help promote recruitment of students that come from these programs.

2017 NOAA Science Report

The 2017 NOAA Science Report is now available online. The report reaffirms NOAA's leadership in several subjects as a federal agency. From 2011-2016, NOAA far exceeded other federal agencies in number of articles on oceanography and was third in the percentage of articles in the top 10% on weather.

IOC Decade of Ocean Science

The United Nations' Intergovernmental Oceanographic Commission (IOC) has announced the Decade of Ocean Science for Sustainable Development, 2021-2031. Mr. McLean serves on the IOC and is interested in hearing from SAB members what they think should be focused on for the decade. He hopes this study will deliver meaningful products in addition to science papers.

<u>Discussion</u>

Susan Avery pointed to a recent Science article on what is being done in Australia on the coral reef issue, developing new corals outside the ocean that are more resilient, and asked if there is any collaboration between NOAA and the Australian agency. Mr. McLean said there is a good collaboration between NOAA coral scientists and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). NOAA has also sponsored a National Academies panel to look at the state of the science. Studying the rate of decline is not enough, new approaches are needed, including whether physical amendments can be made to the environment.

Bob Grossman suggested that, as information is organized and made more available over the next few years, NOAA should track the number of publications that come not from new data but from reanalysis of existing data that might not have been available before. Mr. McLean said that is a good suggestion. NOAA has been reporting its bibliometrics to OMB or Congress to demonstrate productivity and utility. Now the agency is going beyond its own authors to include the Cooperative Institute authors as well. Christopher Lenhardt added that one way of tracking is through digital object identifiers (DOIs) assigned to datasets. He asked if there are other complementary efforts underway in data science. Mr. McLean said the Big Data Project is ongoing and has proven to be a worthwhile enterprise for the five entities that have chosen to participate. NOAA can look forward to more public attention on these data sets and encourage more science in the mining of existing data. Mike Tanner said that NESDIS has a cooperative research and development agreement (CRADA) with data cloud providers that will house all of the GOES and JPSS data that will allow more access more quickly. As access capabilities increase in the cloud, fewer people will visit the NOAA data archives; the utility of the data is increasing for users in the private sector.

Denise Reed requested more information on the process of operationalizing the National Water Center and the model. John Murphy said the model has been updated to the 1.2 version, with an emphasis now on getting people into the operation side. The model was used successfully during the floods resulting from Hurricane Harvey. Right now, if NWS put more work towards operations, development would slow. NWS is trying to get people for the National Water Center and expects a 5-year time frame for being fully operational. U.S. Geological Survey is playing a role in development and U.S. Army Corps of Engineers is contributing but has not assigned people to the Center. Academic partners are present as well. FEMA is interested in having a liaison but the project is not ready for that yet.

Lynn Scarlett asked if NOAA has identified models of successful public-private partnerships or if they have identified particular arenas where such partnerships might be most fruitful. Mr. McLean said NOAA has several models, such as the Office of Coast Survey moving to have commercial providers give NOAA data that are then verified and incorporated into nautical charts. The cost is split about 50-50 and allows NOAA to make the data publicly available. Other areas, such as incorporating satellite-derived data, are still in development. NOAA is a member of international bodies that have varying expectations of their members making data collection publicly available. NOAA is looking for the right ways for various models that make it appealing for industry to do business with the government and also for the interests of the public to be protected.

Lynn Scarlett asked how broadly "sustainable economic contributions of our fisheries and ocean resources" is defined. On one hand, it could pertain to commercializable or commercial activities; or it could be viewed more broadly to include the significant role of, for example, coastal oyster reefs or coral reefs to wave attenuation and enhanced safety of communities. Mr. McLean said the word "sustainable" captures it all. NOAA uses the commonly understood UN definition of "sustainable." The uses must be conscious of environmental impacts and laws that guide the nation in that regard. Ms. Scarlett said she appreciates that NOAA uses the term as understood with the UN definition, but was asking a different question. What one looks at as economically meaningful can vary from more traditional commercializable things to something like the risk reduction role of oyster reefs. Stuart Levenbach said NOAA views it as something broader than what can be monetized, though monetizing has real value in a budget or regulatory context. There is an interest in quantifying the value of some of these programs that may not be easily monetized.

Presentation of National Academy of Sciences Report: "Thriving on Our Changing Planet – A Decadal Strategy of Earth Observations from Space"
William Gail, Global Weather Corporation

Summary

National Academy of Sciences' decadal surveys are Congressionally mandated studies done every ten years in a number of fields that establish a framework or strategic plan for space-based activity. This is the second decadal survey for earth science and applications from space. The title emphasizes the juxtaposition between two key concepts: the increasing use of earth information in order for us to thrive in our daily lives, and that the planet is changing rapidly around us. The first and second chapters lay out a vision and strategy for pursuing that vision. The report then goes into the science and applications, utilizing a robust method of defining, through a traceability matrix, the science and application priorities for the next decade and the observations that are needed to address those priorities. The final chapter is devoted to the programmatics required to effectively implement the strategy. A key distinction between this survey and the previous one done in 2007 is that the previous study group was asked to prioritize satellite missions, while this one was tasked with prioritizing science and observations and to leave the implementation to the agencies. For its NOAA-specific tasks, they were asked to stay away from the operational system, which is planned out beyond the decade of this study. They were asked instead to look for "on-ramps," science that can be gained from NASA that can influence the longer-term evolution of the NOAA program and technology development that can be brought into NOAA to reduce the cost and risk of NOAA operational flight elements.

Most of the recommendations in the report are to NASA concerning what gets flown over the next decade. The Program of Record needs to be executed as planned. They laid out four recommended NASA flight program elements that will hopefully be implemented to accomplish this program:

- Designated flight program element: a new program element for the -designated cost-capped medium- and large-size missions to address observables essential to the overall program and that are outside the scope of other opportunities in many cases. Can be competed at NASA discretion. Targeted observables include: aerosols; clouds,

convection and precipitation; mass change; surface biology and geology; and surface deformation and change.

- Earth System Explorer: a new program element involving competitive opportunities for medium-size instruments and missions serving specified -priority observations. Promotes competition among priorities. Targeted observables include: greenhouse gases; ice elevation; ocean surface winds and currents; ozone and trace gases; snow depth and snow water equivalent; terrestrial ecosystem structure; and atmospheric winds.
- Incubation: a new program element focused on investment for priority observation opportunities needing advancement prior to cost-effective implementation, including an Innovation Fund to respond to emerging needs. Investment in innovation for the future. Targeted observables include: atmospheric winds; planetary boundary layer; and surface topography and vegetation.
- Venture: Earth Venture program element, as recommended in 2007 with addition of a new Venture-Continuity component to provide opportunity for low-cost sustained observations.

For NOAA, the NAS panel tried to identify on-ramps into the NOAA system. They did this by working closely with the NOAA operational system planning process and looked at things that were coming out of that process that appeared unlikely to fly in the operational system due to lack of technological readiness or underlying science. They compared these things with possible overlaps with what they were proposing in this survey and what could be further enabled by collaboration with priorities in the NASA science program.

NOAA-specific programmatic recommendations in the report include:

- Make it easier to extend use of satellite data for NOAA purposes beyond weather.
- Further leverage US and international government partner observations, allocating budget as needed to do so.
- Be a leader in exploiting commercial observations.
- Establish with NASA a flexible framework to co-develop technology that will be used by NOAA.

The NAS panel came to believe that over the next decade the public will become much more aware of how important earth information is in their daily lives, but this needs to be communicated more effectively so that the need for investment in earth science is recognized. Programmatic implementation within each of the agencies will be made more efficient by increasing program cost-effectiveness, institutionalizing sustained science continuity, and enabling untapped interagency synergies. The end goal of all of this is the enhancement of societal value.

Discussion

Eugenia Kalnay asked about the problem of plastic accumulating in the ocean and if the report recommends that any agency focus on at least measuring the amount of plastic. Dr. Gail said he did not recall seeing that issue on the list and it is a good question as to why it's not included. Russell Callender said NOAA's Marine Debris Program is small but is trying to work globally to address the problem writ large. One of the big challenges is the assessment of the sources of

pollution so that control mechanisms outside of NOAA's authority can be picked up by another agency.

Christopher Lenhardt said that doing more on the community development side is a crucial element of all this. It seems to have been left out, perhaps because it is beyond the scope of the survey. Dr. Gail said there were many discussions along those lines, but the report is primarily focused on the observing system. Chapter Four of the report does try to include some of those things in the findings but not in the depth that is needed in order to better make use of the observations.

Susan Avery asked how much of the science discussion and framing was thinking through earth as a system versus processes that are critical to an understanding of the earth system. She also asked about maintaining support for ongoing observations that are deemed critical for system integration and application. Dr. Gail said they did consider the earth as a system and divided the system up into five focused panels, then held a workshop on integrating the themes. It is a challenge and they recognize they didn't accomplish it perfectly. Sustained observation was a major concern for the committee. They created the new Venture continuity line for just this reason and looked for ways that continuity could be maintained at incrementally lower costs.

SAB Biennial Work Plan: Discussion
Lynn Scarlett, The Nature Conservancy and Chair, NOAA SAB

After an initial discussion in which the SAB had aligned with three of the administration's priorities, as put forth by Acting Administrator Tim Gallaudet, the three priorities were ultimately collapsed into two: (1) reducing the impacts of extreme weather and water events and (2) increasing the sustainable economic contributions of our fishery and ocean resources. The work plan does not address how to handle *ad hoc* topics. The initial draft document was very rough and two committees were convened focusing on the two priorities, review the work plan, validate what was already there, and look for gaps and appropriate approaches. SAB members were provided with draft versions in advance of the meeting and the goal is to reach consensus on the work plan by the end of the meeting. The priority subcommittees were asked to walk through their thinking and highlight any changes from the earlier draft.

Priority 1: Reduce the Impact of Extreme Weather and Water Events

Bob Winokur discussed the addition of "enhance the strategic investment and use of unmanned and autonomous systems." This came about, in part, from a comment from RDML Gallaudet on the importance of autonomous systems. Cisco Werner will be discussing this issue later in the meeting and Mr. Winokur suggested waiting until after that presentation to reach a final consensus. All of NOAA's Line Offices are doing something with regards to unmanned systems. He believes that if the SAB decides to take on this topic, it will require augmentation of additional expertise to fully address it. He has not seen a coordinated agency-wide approach within NOAA, but the Acting Administrator views this as very important going forward and may have a plan.

Everette Joseph said that the group had a lot of discussion about the responsibilities of EISWG with respect to the Weather Act. He felt that engaging the EISWG more was important, even beyond the level of two liaisons. In strengthening the relationship between the SAB and the

EISWG, it may be helpful to have a sub-subcommittee of people working with EISWG as they perform their responsibilities under the Weather Act. John Snow will address some of these points during his presentation later in the meeting. One of the key things needed to make this work is for NOAA to make available the reports they are required to submit to the working group for comment.

Bob Grossman addressed some language modifications. Also, several topics related to artificial intelligence (AI), machine learning, and data science were consolidated into a single bullet.

Susan Avery suggested adding a look at the emerging possibilities of the use of observing system simulation experiments (OSSEs) in determining ocean observations, because extreme events definitely have an atmosphere-ocean coupling component to them. Starting to engrain OSSEs into the placement, development and acquisition of ocean observations would be useful to the community. She also said that Priority 1 should not be solely focused on atmosphere.

Lynn Scarlett asked if Priority 1 is doable in a 2018-2019 timeframe and said some level of specificity is needed around a timeline linked to who does what work and what sort of product will be delivered. This is not something the SAB will do at this meeting, but is needed before the work plan is finalized. Bob Winokur said the work is only doable if it is dispersed and task forces are set up that include outside experts. Denise Reed said there needs to be an SAB member who is really motivated to champion each one of the bullets in addition to having a motivated work group; how many of these the SAB can get done will be determined by their motivation and the ability of NOAA to be responsive to the SAB's needs.

Stuart Levenbach said the plan has been reviewed by the Policy team and reflects everyone's input. It is a lot to take on and getting it done in a timeframe that works would be a challenge. NOAA intends to move forward on implementing the Weather Act in FY 2018 so the SAB's input would be valuable to inform that ahead of time. Mr. Levenbach liked the idea of getting timelines, leads, and available resources pinned down. Ben Friedman said the plan is very ambitious and NOAA may be able to assist in some areas more readily than others. If the SAB is going to further prioritize, they should consider RDML Gallaudet's focus areas of social sciences and autonomous systems. Paul Doremus agreed that the acceleration of development and deployment of autonomous systems is a key area for the agency. An underlying research model issue pertains to best positioning the assets and the science of intramural federal research and development with various sectors of external expertise. Thinking methodologically at that level would be helpful for both priorities. Mr. Levenbach agreed and added that the need to leverage non-federal research and development spending and how NOAA can do that in implementing these priorities should be included in the work plan.

Lynn Scarlett suggested adding a section on cross-cutting topics in addition to the two priorities, which would include social sciences. Bob Grossman said that if a cross-cutting category is created, the machine learning, AI, and data sciences topic should be moved to it because it has an equal impact to the blue economy. He also said that this may not be a near-term priority for NOAA according to what the Board has heard. Everette Joseph wanted to hold off on removing machine learning from the list.

Eugenia Kalnay volunteered to take the lead on the review of the use of OSSEs. Karen St. Germain said the Weather Act calls for more use of OSSEs and other analytic tools to inform

investments, particularly investments above certain thresholds. This is an area that the NOAA Observing System Council is beginning to tackle to establish new processes that ensure they are asking the right question for an OSSE and ensuring the OSSE is appropriately set up to answer the question. There may be a lot of ongoing NOAA work that the SAB can leverage and help shape as they go. Susan Avery wanted more clarification on whether OSSEs would be considered in a traditional stationary sense or are they looking at things that move through water. Cisco Werner said that OSSEs for biological systems would be very interesting, particularly for coupled environmental and ecological measurements. Craig McLean said NOAA would be looking at OSSEs in an expansive way and stressed that ocean observations are key to their weather forecasting ability.

On the topic of social sciences and decision support, Bob Winokur suggested reviewing some of Monica Grasso's reports.

Priority 2: Increase the Sustainable Economic Contributions of Our Fishery and Ocean Resources (Blue Economy)

Michael Donahue discussed the committee's process for developing the Priority 2 section. They decided on three distinct yet interrelated areas of focus: (1) sustainable marine aquaculture, (2) benefits of long-term and large-scale ecosystem restoration, and (3) coastal marine transportation and support infrastructure. The core of their approach centered around three workshops each focused on one of the three items. They identified the literature review and data gathering and analysis needs and suggested a 12-month timeframe for this.

Denise Reed said they modified the original draft by removing items related to economic analysis for the blue economy and smart technology for stock assessments. From what they have heard from RDML Gallaudet, aquaculture may not be quite as high a priority as they previously thought. Paul Doremus said he took RDML Gallaudet's remarks to mean that the emphasis on aquaculture was appropriate, but of the other topics he wanted focus on marine transportation. Dr. Reed said that the idea of how to leverage scientific and research investments within systems to support tourism and recreation could be reframed somewhat to reflect the Acting Administrator's comments and suggested this as a lens through which the benefits of large-scale ecosystem restoration could be viewed.

The topic of deep sea is not currently in the work plan. Lynn Scarlett said topics like deep sea that arise could be treated as an *ad hoc* topic, utilizing external experts. Dr. Reed said that as part of the topic on marine transportation the SAB has reached out to NOAA's Hydrographic Services Review Panel (HSRP) to work together. Russell Callender said the HSRP does have a keen interest in working with the SAB and the Vice Chair of the Panel, Ed Saade, will be present at the SAB's meeting tomorrow. He also said that for this area, informational infrastructure is one of the key areas where both advisory groups could benefit from dialogue. Tourism and recreation and the links to healthy coastal ecosystems and ecosystem restoration would be great and could provide a link to Priority 1 and the social sciences. Stuart Levenbach said that the benefits of ecosystem restoration should be broadened. There is interest in looking at a number of NOAA programs and the ecosystem services benefits of those programs along with the methodological approaches to calculating ecosystem services. Deep sea exploration seems to be isolated from other scientific disciplines, but is not if viewed in terms of what is being published.

Bob Rheault said NOAA's Marine Fisheries Advisory Committee (MAFAC) has a standing aquaculture subcommittee and, working with them, the SAB could have a relatively short turnaround on the topics of opportunities and challenges to an aquaculture program, and identifying scientific priorities and scientific needs, as well as make recommendations on extramural versus intramural opportunities. Dr. Rheault volunteered to reach out to the MAFAC.

Paul Doremus said that when NOAA is thinking about the blue economy, they are predominately thinking about seafood production and competitiveness. The four major topic areas under blue economy are (1) aquaculture, (2) marine transportation, (3) ocean mapping and exploration, and (4) tourism and recreation. He suggested narrowing the focus within those in order to have the greatest impact. Dr. Doremus also commented on the social science dimensions of aquaculture. Social license to operate is a big issue across the country for aquaculture; that is, there are debates about the quality of farmed versus wild seafood. How people perceive risk is a cross-cutting topic for both priorities. NOAA is grappling with issues about perceived risk and the underlying science and information around those risks.

Presentation of the Environmental Information Services Working Group (EISWG) Annual Report to Congress and Other Work Products
John T. Snow, University of Oklahoma and Co-Chair, EISWG

Summary
Letter to Assistant Administrators

In August of 2017, the Assistant Administrators for OAR and the Weather Service requested the advice and assistance of EISWG in addressing the requirements of the Weather Act. In EISWG's analysis, in the Weather Act there are 330 statements of things that should be done covering a wide variety of topics. After reviewing a number of documents and consulting with experts, EISWG believes it has developed a collaborative and consultative process that can lead to positive results. EISWG will utilize NOAA reports that are already being created in response to the Act rather than having the Line Offices produce additional material. EISWG offers to convene in a variety of small groups, perhaps supplemented by outside expertise, to have discussions responsive to particular questions or comments where each Line Office feels EISWG input is desirable. EISWG offered to devote one-third to one-half of their face-to-face meetings to any questions that come up on Weather Act compliance. EISWG has drafted a letter to the Assistant Administrators outlining the process and seeks SAB approval. One key item that is unresolved is the access to the draft NOAA reports. EISWG seeks timely access to these so they can make informed recommendations that would be useful to the agency. The EISWG has put all of this in a letter response to the AAs that is requesting the SAB to review and approve to send up to NOAA leadership.

Discussion

John Murphy noted that the word "evaluate" is not used in the Weather Act; it prescribes advice from the EISWG. The reports are not all coming out on the same schedule; the reports need to be reviewed through the Office of General Counsel. Once the process is sorted out, they will let the writers of the reports know that they need to get them to the EISWG with sufficient time for

meaningful review. Dr. Snow said the EISWG does not intend to provide any advice for the current report cycle.

Craig McLean said the EISWG has begun to address the two most pressing objectives - Title II sub-seasonal to seasonal weather and Title IV Weather Ready Nation. NOAA has almost completed the first batch of reports to send for multiple levels of review which can lead to lengthy delays. Instead of delaying the EISWG, they will focus briefing sessions the status of Title II and Title IV.

Bob Winokur made a motion to accept the letter as written and forward it to NOAA leadership; Denise Reed seconded the motion and it passed unanimously.

Summary

Annual Report to Congress

EISWG is obligated to make not less than one report per year to Congress. The work group shall submit to the SAB for transmission to the Under Secretary a report on progress made by NOAA on adopting the working group's recommendations. EISWG's recommendations will be made through the SAB to the Administrator. EISWG reviewed the Weather Act and convened a small group to develop a letter which Dr. Snow presented to the SAB. He reviewed the letter's content, which explains that they did not provide any recommendations this past year. EISWG spent this year creating a process for carrying out its assigned role. The letter also notes some of the things that impact the EISWG's ability to do the things that are asked of it. If the SAB has any additional comments on the letter, they can be added to it.

Discussion

Cynthia Decker pointed out that the report is in the form of a letter to Lynn Scarlett, so it will be reformatted before being sent to the Acting NOAA Administrator; that is, it will be recast as a letter to NOAA and Congress

Everette Joseph asked what EISWG's thinking was on the development of the recommendations to NOAA and the interaction with the SAB on the front end. Dr. Snow said EISWG does not know what NOAA is doing at this time because they have not seen their reports and so they cannot comment on it. They intend in the future to look at what NOAA is reporting and if the EISWG has any ideas for meeting the intentions of the Act, they would bring them to the SAB for further discussion. It is unlikely that the EISWG would produce a long list of recommendations. They are also going to meet with groups that advise NOAA, such as UCAR (University Corporation for Atmospheric Research). This will occupy a large portion of the EISWG's time for the near future. They also want to hear from Neil Jacobs on the EISWG's direction.

Susan Avery asked how long the reports are expected to be. Craig McLean said 6-10 pages for the shorter ones, and up to 18 for the longer ones, and they will be released in rolling cycles.

Lynn Scarlett asked if it was EISWG's intention to review clusters of reports and comment on them to the SAB or wait and present them all at once. Dr. Snow said they would prefer not to give them all at once. At some point it would be helpful to hear from the liaison in this process because they want to be careful how they frame any recommendations. John Murphy said that advice on prioritization of all the things NOAA is instructed to do would be helpful; perhaps through a workshop to discuss the pressures working against some of the activities.

Bob Winokur made a motion to accept the letter and attached materials as presented; Christopher Lenhardt seconded the motion and it passed unanimously.

Update on Data Archive and Access Requirements Working Group (DAARWG) Work on Data Science as it Relates to the SAB Work Plan
Christopher Lenhardt, Renaissance Computing Institute, SAB Member and Chair, DAARWG

Summary

Data archiving focuses on the value-added activities to support the full data lifecycle of ingestion, curation, and reuse. In the satellite data world, the gold standard conceptual framework is the Open Archival Information System (OAIS). A newer conceptual version is that data curation should support FAIR Principles: Findable, Accessible, Interoperable, and Reusable. Scientists think that they spend 80% of their time finding their data and getting it ready to use, and only 20% on analysis. As concerns over replication have increased, DAARWG has looked at what other NOAA products might be important to include as a "first class object" from a curation standpoint. These items include models, code, and even physical specimens. Along with the changes to curation, came the rise of big data. In 2014, NOAA came up with the idea for its Big Data Project (BDP) whose overarching goal was to improve access to NOAA data. One example of a BDP success story is the transfer of the entire the Next Generation Weather Radar (NEXRAD) Level 2 Archive into various cloud providers and making it accessible to users. It is viewed as a success because the data usage has increased by 2.3 times while the NCEI server load has decreased. If the SAB would like more information on this project they should contact Dr. Ed Kearns, NOAA's Chief Data Officer, for a further presentation. DAARWG has had several briefings on the program and discussed issues such as hidden costs, challenges of potential multiple copies of data, tracking usage and receiving credit, storing data in the cloud versus curation of data in the cloud, and privatizing a public good. In spite of all of the concerns, DAARWG has been enthusiastic about the experiment.

DAARWG has also been examining the topics of information products, decision-support data, social science data, and models and software. Other areas before the SAB that DAARWG has not yet addressed include: 'omics data, other data platforms (e.g. Internet of Things and drones), and citizen science. DAARWG would like to explore information sharing with other working groups because there is a lot of potential overlap. Some of the conversation about data science may tie in with the Terms of Reference conversation later in the meeting which may lead to further modifications.

Discussion

Lynn Scarlett asked for more information on the discussions DAARWG had about issues with BDP, specifically the challenges of potentially having multiple copies of data. Mr. Lenhardt said that for identifying hidden costs, next generation radar (NEXRAD) data was the only example of finding previously unidentified hidden costs which, in this case, was the cost of transferring the data to the cloud, much of which had been stored on tape that had deteriorated. No matter what, there will be costs to NOAA because data is not moved with the simple push of a button. Scientific stewardship needs to be more disciplined on NOAA's end so that the data is correct when it is made available. Multiple copies will be dealt with, in part, by NOAA saying it has the master copy and other copies can be validated against the master. The issues of tracking usage and receiving credit are still unresolved. DAARWG will be looking into cloud technology more generally in the future. Privatizing a public good includes a theoretical concern over providers deciding not to make the data publicly available any longer because it is not economically viable. Mr. Lenhardt would rather see that fundamental distribution right stay in NOAA's control.

Karen St. Germain said that at the same time more and tougher questions are being asked about the value proposition of the observations and information services NOAA provides, this trend puts NOAA in a position of having less and less insight into who is using their data. Historically, when NOAA knew who was using its data and how, the agency had well-understood processes for making changes. Cloud-based storage potentially leads to a future where NOAA won't know who will be impacted until after a change is made. That's not to say NOAA shouldn't do it; it's just a lot to consider and DAARWG is a good partner for thinking through how to adapt to this new world.

Bob Grossman said that cloud storage has led to a greater use of the data than ever before. With the greater use, you get a lower cost to an individual to use the data incrementally, especially if it's provided with FAIR Principles. The trade-off space is tricky. If you have a model in which federal agencies make data available as part of their mission, then there could be the privatization of services and derived products around that. There's a lot of room to play in the space, it's just a different space.

Mike Tanner pointed out the Cooperative Institutes have really helped with this project and have been a valuable partner through all of this.

Continued Discussion on SAB Proposed Work Plan Topics

In order to get some clarifications on timeline, processes, and work products for the items within each priority, Lynn Scarlett and Cynthia Decker will take the SAB's input and rewrite the work plan with added clarification and circulate that to the Board members for comment. Ms. Scarlett said that they recognize that different approaches will be necessary to address the various topics. The SAB also wants to avoid duplicating efforts underway by other FACAs within NOAA. Craig McLean said he appreciates diverse approaches to diverse subjects and that NOAA owes the SAB clear expectation.

Priority 2 Discussion Continued

Bob Rheault further discussed the work of the MAFAC working group on aquaculture. They are experts from around the country on all aspects of the issue. They have been tasked primarily to address production and regulatory issues but if asked they could provide meaningful input on what they perceive as the main scientific roadblocks and needs. A series of presentations by webinar would probably work and would be very informative. There have been radical developments in aquaculture in the last decade and many issues of the industry have been addressed. Lynn Scarlett asked if MAFAC would be addressing the social license to operate question. Dr. Rheault said negative perceptions of aquaculture have been a significant barrier to the industry in the U.S. and they are well-versed in it. He did not know if science-based answers can be brought to bear on the issue. MAFAC's efforts have been focused on how to increase aquaculture from many angles.

Craig McLean said that, as the SAB tries to narrow its focus, if there is already a FACA taking on this issue, it is best not to distract from the SAB's time and resources. If the SAB believes that there are views that are not making their way through the MAFAC that should come out, then there may be value to it. Dr. Rheault said the MAFAC has not asked its working group to lay out the scientific and technical challenges to increasing production. Lynn Scarlett added that getting a sense of what the regulatory questions are might give the SAB a sense of what science questions there might be now or in the future.

Lynn Scarlett recommended a larger scope of ecosystem health rather than just restoration. Impacts to tourism/recreation are important but are part of state of knowledge on ecosystem health and restoration. There are a number of considerations raised in the paragraph that are distinct from just ecosystem valuation. Denise Reed said there is an opportunity to weave together something about NOAA's role around coastal and near-shore environments, managing and investing toward healthy ecosystems, and a stated is probably not going to have much resonance with the current administration. Adjusting it slightly could help, perhaps by pointing to naturally occurring infrastructure that helps shoreside resilience and coastal communities prosper. Susan Avery said that, given the way the administration has defined blue economy, pushing this sort of restoration in terms of infrastructure and connecting it to the blue economy might be the right approach. It is also a way of making it relevant to big cities and small coastal communities. Lynn Scarlett said that "restoration" doesn't quite capture the sense of it; it is in some cases restoring, in others maintaining. The cost-effectiveness of natural infrastructure is another element to include. Scale is also very important to include. Bob Grossman suggested including information resources about some of these four issues is directly related to a broader economic potential for the blue economy. Susan Avery agreed and said that she characterizes the blue economy as an information economy.

Coastal and Marine Transportation and Support Infrastructure

Russell Callender said that it may be useful to engage with the HSRP to see if there is any intersection, because the SAB doesn't want to spend its time and energy on a topic if another group is already doing the work. The HSRP is looking at the use of autonomous vehicles for mapping, charting, and supporting port infrastructure. Their ideas on how to better engage the private sector in mapping and charting and commerce side would also be helpful. Denise Reed said that while some members are intrigued with the idea of collaborating with the HSRP, they

need a champion to take this on so the SAB is not overstretched. Perhaps they could convince the HSRP to do something that the SAB can support instead of the other way around. Bob Winokur said the rapid migration toward larger autonomous vessels needs to be considered and how this will affect the marine transportation system, blue economy, and a variety of science issues. Craig McLean added that once we move to more autonomous vessels, there will be a higher level of desire, need, and scrutiny on marine weather forecasts. There is an industry component that will come along with this in forecasting in order to facilitate unoccupied large commercial transport or science vessels. Susan Avery noted that autonomous underwater vehicles are also being used for security infrastructure. The Wilson Center has been looking at this in terms of port security and delivery of domestic goods. How far NOAA would find this to be of interest is unclear. Lynn Scarlett asked if NOAA had active engagement with Department of Defense in this area and if there would be benefit from exposure to cutting edge technological evolution. Craig McLean said there is an active engagement, but getting more active given RDML Gallaudet's military background. He encouraged the SAB to push NOAA in that matter. Norway and Canada are both ahead in this area and it would be interesting to see what they are doing. Bob Rheault said Canada has done a great job of mapping their bottom which led to a decrease in fisheries fuel consumption of 30% while increasing sustainable fisheries yield over 20%.

Lynn Scarlett and Cynthia Decker will rework the work plan and hope to have something available in the late spring timeframe.

Public Comment

There was no public comment.

April 10, 2018

Welcome
Lynn Scarlett, The Nature Conservancy and Chair, NOAA SAB

Lynn Scarlett welcomed everyone to the second day of the meeting. She announced she would need to leave the meeting early and Susan Avery will perform the duties of Acting Chair in her absence.

Lynn Scarlett introduced Ed Saade, Fugro USA and Vice-Chair of the HSRP. The SAB sent a request to the HSRP about the possibility of coordinating their efforts. The HSRP is very eager to find out about overlap between the groups. The HSRP does a lot of science and technology work, much of which is instrument- and data collection-driven on a variety of sensors and applications.

Denise Reed asked for a description of how the HSRP operates and what they produce. Mr. Saade described the composition of the Panel. Their meetings usually consist of small panels of local representation, internal technical briefings on where the technology is headed, and at the end of the meeting they write a letter to the Administrator summarizing their take-aways from the meeting. In addition, when there is a topic that is particularly important to the Panel, they write a two-page position paper to make their statement.

Updates to the Terms of Reference (ToR) for Climate, Data Archive and Access, and Environmental Information Systems Working Groups

John T. Snow, University of Oklahoma and Co-Chair, EISWG
Paul Knight, Senior Scientist, World Climate Service and Co-Chair, CWG
Christopher Lenhardt, Renaissance Computing Institute, SAB Member and Chair, DAARWG

The Ecosystem Science and Management Working Group's ToR was determined not to need any changes.

EISWG

Summary

Primary proposed changes to the EISWG ToR included:

- The movement of the largely historical Background section to be an appendix.
    - Language about the EISWG's creation and original charge would be included
    - Language about the EISWG's authorization under the Weather Act would be added
- The addition of a preamble.
- A revised Charge section.
    - Information contained in the Charge section of the previous ToR was used to create the current preamble in the Background section of the revised ToR
    - Current charge reflects what is mandated of the EISWG by the Weather Act
- A revised Membership section
    - The proposed version contains language that is consistent with what is expressed in the composition section of the Weather Act
- The addition of a Reporting section.
    - Added to the proposed ToR due to the reporting requirement of the working group in the Weather Act
- Language reflecting what is written about the EISWG in the Weather Research and Forecasting Innovation Act of 2017

Discussion

Lynn Scarlett asked if there are any notable changes in terms of how the EISWG goes about performing its work. Dr. Snow said no. They tried to make the language more succinct and the main issue was to integrate the requirements of the Weather Act for EISWG into its broader mandate.

John Snow said that historically, EISWG has worked most closely with NWS, OAR, and NESDIS. By the current and proposed ToR, EISWG is a NOAA-wide organization and he would like NOAA to recognize that. If there are areas where EISWG could be helpful, they are ready to serve.

Bob Winokur made a motion to accept the EISWG's ToR revisions; Denise Reed seconded the motion and it passed unanimously.

Climate Working Group (CWG)

Summary

Primary proposed changes to the CWG ToR included:

- Language to reflect the change in mission that been happening within NOAA and the weather and climate enterprise.
    - Included analytic and predictive capabilities as an asset that CWG expertise can provide
    - Added the CWG's working definition of climate, which is in its broadest sense from sub-seasonal to multi-decadal
- Stated explicitly that the CWG will meet at least twice a year, once in person, with additional virtual meetings as needed.
- Added "understand modeling requirements" to what the CWG would bring to help strengthen NOAA's climate portfolio.
- The CWG shall be composed of more than 10 outstanding scientists and leaders with an expertise in matters related to issues of climate, weather, and society. New candidates will be suggested to the SAB on a bi-annual basis for consideration.

Discussion

Christopher Lenhardt asked for more information on the data management piece that is referenced in the ToR. Mr. Knight said the CWG is trying to get a better focus on the cross-working group relationship to avoid redundancy. Because the CWG includes members involved in data management matters it was included in the CWG's expertise.

Susan Avery suggested being consistent in the wording of number of members. She also asked if the CWG was working with the OceanObs 2019 conference and providing any advice. Dr. Knight said they are a part of that effort.

Russell Callender asked if the CWG will be focusing on the challenges of impacts of climate on the coast, such as resiliency, impact on trust resources or species. Mr. Knight said they have some interest in the impacts of climate, particularly in the Artic. This is a result of the expertise represented in the group currently. The ESMWG is more likely to be the working group that addresses those issues with greater precision. This is an area where there could be opportunities for cross-fertilization.

Craig McLean said that NOAA is making budgetary adjustments for sub-seasonal to seasonal, taking what currently resides in the Climate Program Office and moving it to the Weather Sponsorship Office so that the appropriation and budget look the same as the authorization. He encouraged the CWG to continue in the direction of citing sub-seasonal to seasonal and not follow the surgical precision NOAA is using for budgetary adjustments. NOAA has had a Climate Board whose ToR has expanded to include weather and water, so all of these topics are mixed for the sake of internal discussions and coordination. To the extent that NOAA could rely

on the CWG for the entire suite of subjects, there is an opportunity based on the way the CWG has made the adjustments to its ToR.

Paul Knight said that an upper bound for membership should be 10-15 in order to ensure engagement of the members. The SAB discussed the issue of bounding membership numbers. Craig McLean said that, even though there may be a desire to put bounds on memberships, the SAB and its working groups should be flexible. As long as there is a sense of reasonableness in interpretation, perhaps the subject matter should guide the diversity of views on a board. Bob Rheault said that group dynamics studies have shown that boards larger than nine encourage social loafing. To avoid getting caught up on this issue, Lynn Scarlett proposed approving the ToR with a caveat that an upper bound in the number of members will be provided by the CWG.

Jean May-Brett made a motion to accept the CWG's ToR revisions with the proviso that an upper bound to their membership will be provided; Susan Avery seconded the motion and it passed unanimously.

DAARWG

Summary

DAARWG's current ToR did not include reference of membership numbers so it was not discussed during this process. 8-11 has been the practice historically.

Primary proposed changed to DAARWG's ToR included:

- No major changes to the substance of the ToR.
- Shifted the emphasis toward the focus on aspects of archiving and broader understanding of what might need to be archived.
- Less emphasis on prioritizing what data to archive.
- Updated language to reference relevant policies and procedures in place that had not yet been created when the original ToR were drafted.
- Included some language referencing newer or emerging technologies and topics that align with SAB discussions.

Discussion

Bob Grossman asked if the Chair of the DAARWG has been announced yet. Mr. Lenhardt said that the SAB has recommended Chelle Gentemann but they are still awaiting NOAA approval.

Susan Avery made a motion to accept the DAARWG's ToR revisions with the proviso that a lower and upper bound to their membership will be provided; Bob Winokur seconded the motion and it passed unanimously.

Discussion of SAB Report on Emerging Technologies for NOAA Ocean Research, Operations and Management in the Ecosystem Context

Cisco Werner, Chief Scientist, National Marine Fisheries Service
Gary Matlock, Deputy Assistant Administrator for Science, Office of Oceanic and Atmospheric Research

Summary

The SAB's recommendations and observations contained in their Emerging Technologies report included continuing to invest in 'omics technologies and illustrated that the types and applications for unmanned robotic vehicles are exploding. NOAA should pay attention to sophisticated imaging systems, automated measurement systems, passive acoustic sensors on moorings and mobile platforms, and sensors for new orbital and suborbital platforms including ship-launched drones, aircraft, and satellites. NOAA thanked the SAB for their thorough report and their specific recommendations on what should be considered. By way of a response, Dr. Werner presented some examples of things NOAA has been doing since the report in each of the areas and where the agency stands in terms of identifying the technologies and, in several instances, their implementations are in advanced stages of research-to-operations. NOAA wished to underscore its concurrence in the need to invest in training the personnel required to extract the full extent of what technologies offer.

NOAA recognizes that emerging technologies are necessary to sample more broadly, more quantitatively, more efficiently, and in an integrated way across the components of the earth system. NOAA recognizes that resources are needed for laboratory development, engineering and sensor development, and testing in the field, as well as development and training of personnel. The research-to-operation transition, including capitalization costs and understanding the relation between measurements from new technologies with instrumentation currently in use, is something that NOAA needs to pay attention to. There is a fair amount of coordination across NOAA line offices, such as with regards to 'omics, small unmanned aerial systems (UAS), and gliders. These offices work well together and try to keep each other well-informed. There is also a lot of work with academic, private, and international partners through CRADAs, joint surveys, and funded external projects. It is very clear to NOAA that they can't do it alone. NOAA thanked the SAB for their thoughtful advice and remains open to future input and recommendations on this important topic.

Discussion

Bob Grossman asked if NOAA is currently or planning to do broad ocean surveys of 'omics data. Dr. Werner said that from the Fisheries side, they haven't thought about doing broad surveys and are instead focused on developing methods to address the surveys they are responsible for. This conversation is taking place in the broader community. Rather than NOAA engaging in the surveys, they are collaborating with international partners and getting a global picture that way. From OAR's perspective, Dr. Matlock said there is planning underway, but it is very limited at this point because the program is small and there is little funding for it at this point. As NOAA's capabilities progress, they are attempting to get as much information, research, and capability identified as they can. Craig McLean commented on the international Decade of Ocean Science. The IOC is trying to work toward really high order objectives, including using eDNA in the monitoring of all ocean basins. The development of this technology

is rapid and it is reasonable to say that by the time the Decade of Ocean Science is underway, they will have useful tools that can be deployed.

Everette Joseph asked for more information about long-range unmanned aerial systems allowing for beyond line-of-sight operations and if NOAA is engaged with commercial partners operating drone testbeds. Dr. Werner said that getting permits to fly hexacopters is a bit of an issue, but they have them. The range of hexacopters, which is currently only 45 minutes flying time, needs to be expanded. There are areas where NOAA can operate beyond line-of-sight. If there are testbeds testing beyond line-of-sight flying, NOAA would be very interested in hearing more about it, as it would change the way they do their surveys. Dr. Joseph said there is a lot of interest in UAS within academia, and asked if there is a systematic effort to partner with universities to provide training opportunities for the next generation of NOAA scientists. Dr. Werner said that NOAA does have a training site in one of their centers and the next step is to train other scientists and to have dedicated people on the ships that know how to fly. There are a lot of people outside NOAA flying drones and they should think about coordinating that training to maximize learning from one another.

Susan Avery said the presentation demonstrates a very nice portfolio of using the new technologies that have emerged. She thanked NOAA for their work in putting them together with many other elements to allow forecasting to occur on a regular basis. She asked if NOAA is involved in any way with the Ocean Observatories Initiative (OOI). Dr. Werner said NOAA is supporting some of Heidi Sosik's OOI work, as well as others on shelf-ocean exchange and the impact on fisheries. He needs to look further into how to take the work that Heidi Sosik and Scott Gallagher have done and translate that into something NOAA can use.

Eugenia Kalnay asked if NOAA is thinking of combining its satellite and local observations with data simulation models which would significantly increase the coverage and value of the observations. Dr. Werner said the data simulation they can now get is part of the assimilative approaches that have been used. The combination of the biological and the physical assimilation can improve the overall performance of the modeling. This is something NOAA is investing in directly.

Christopher Lenhardt asked if NOAA does much in the way of developing catalogs of physical samples that other scientists could search. Dr. Werner said that the answer is probably yes on the genetic side. NOAA needs to look into how to better automate some of these things. They are looking at making more data publicly available as a result of the Public Access to Research Results (PARR) program, but the relational aspect of the data is perhaps something NOAA needs to think about as much as what to do with it. NOAA is probably not as advanced as it should be in this area.

Steve Volz said that assimilating the data sets NOAA has for satellite and environmental data and other observations is a key objective with real value in broadening their capabilities. He wants to follow up with Mike Tanner on possible NCEI pilots for making NESDIS assets available.

Building a Community-Driven Vision for the Next Generation U.S. Weather Enterprise – A Study in Development by the Board of Atmospheric Sciences and Climate
Amanda Staudt, Director, National Academy of Science Board on Atmospheric Science

Summary

The National Academies of Science Board on Atmospheric Sciences and Climate (BASC) works to advance understanding of the earth's atmosphere and climate, and serves as a source for objective, independent advice to the federal government and others. They have a lot of advisory groups working on many issues and how to best align and coordinate these advisory functions to create the most value is an issue Dr. Staudt would like to get input on from the SAB. In April of 2017, NAS hosted a scoping meeting to discuss emerging societal needs, technology and science changes, and other future challenges and opportunities for the weather enterprise with community leaders. They found that the time is ripe for an effort that brings the community together around a clear framework for future coordination. Areas that could benefit from more coordination include model development, sustainability of observations, and research priorities and funding. Many questions were raised, however, about the specific nature of a possible new National Academies activity, such as how this activity would interface with existing coordination and strategic planning efforts. One of the desired characteristics of the study is to enhance the public awareness of the national investment in weather. The draft statement of task states that the committee will engage the broad weather community and ultimately create a report that will describe the weather enterprise today, consider how the weather enterprise may change in the next few decades, describe a comprehensive ideal vision of a robust and successful weather enterprise for the next decade and beyond, and recommend key steps to enable the weather enterprise to achieve the vision. In terms of the scope that is currently being considered, the committee will consider the full continuum from research to decision making. Community engagement would include ongoing two-way discussions, in-person workshops, and open sessions at committee meetings. Ms. Staudt is concerned that BASC is going to be asked to do multiple studies looking at the needs of the weather enterprise as they pertain to particular agencies. Her personal view is that it would be more efficient to do one study that looks across the different needs of the weather enterprise and then think about follow-on activities that look at individual agencies' needs. BASC is working with the American Meteorological Society, which has allowed BASC to be in charge of the first day of its Summer Community Meeting on August 7 in Boulder, Colorado.

Discussion

John Murphy expressed concern that, because National Academies studies are highly regarded, it just takes a few voting members in the right body to get the idea that things could be changed, which could lead to unintended consequences. Dr. Staudt appreciates this and said the study should not be set up in such a way that suggests there are things wrong with the weather enterprise, but instead looks for what can be elevated to the next level. Mr. Murphy said the U.S. has the best weather enterprise in the world and needs to be very cautious about making recommendations that are influenced by one small sector of the enterprise that could undermine others.

Steve Volz said one of the biggest challenges NESDIS has is to be aware of all the existing guidance and systems that are in place or in development. NESDIS has the direction to conduct its own study through the Weather Act and is looking at the input from the BASC and working within NOAA to figure out what its response is to this proposal. Dr. Staudt said there is an ongoing parallel discussion that the World Bank started about the weather enterprise.

Gary Matlock asked, given the language in the Weather Act about the role of EISWG doing something similar to what was described in this presentation, if there has been discussion about the inclusion or reliance upon EISWG by the National Academies. Dr. Staudt said they have had preliminary discussions with the EISWG but they are premature, in part because the EISWG is still trying to figure out what it is going to do with respect to the Act. BASC is very willing and interested in having that conversation. John Snow said EISWG has done some preliminary budget analyses of what it will cost to carry out the things spelled out in the Weather Act. It is very clear that the NOAA budget will not support accomplishment of all the things that Congress has directed. They are going to need a lot of support and the National Academies are a good way of getting some publicity. Dr. Staudt said a role for EISWG may be in taking BASC general advice and outputs and interpreting them in a way that is more relevant to NOAA specifically.

Craig McLean said it would be terrific if a report could put a spotlight on the lack of resources for implementing the Weather Act and the potential benefits were that investment to be made. The commercial community shows great promise and is expected to play a much larger role in the coming years. A question that is interesting is how NOAA can start moving now in anticipation of or to facilitate today the delivery of the industry on-ramp into the enterprise. He asked the SAB to advise NOAA on how to use the National Academies most effectively in achieving its mission.

Discussion of Next Steps on SAB Biennial Work Plan
Susan Avery, Woods Hole Oceanographic Institution and SAB Member

Cynthia Decker said she had already received recommendations for revisions to the language of the two priorities. As soon as possible, she and Lynn Scarlett will work on a further draft that takes into account the SAB's input and distribute it to the members to sign off and implement. There was a suggestion that Lynn Scarlett have a conversation with new Assistant Secretary Neil Jacobs. One issue for the SAB is the role of the working groups in the work plan. Mike Donahue said it would be important to take decisive action on the work plan before the next in-person meeting. He commented on the challenge of the SAB accomplishing its work plan given resource limitations, while at the same time the work groups have available resources but lack direction on where to focus their efforts. It would make sense to have a clear and definitive process where the SAB moves on its responsibility to give direction to the work groups. Bob Winokur said that at some point the SAB needs to agree not just on the elements in the work plan but also how it will be implemented. Cynthia Decker said the work plan will address that in its next iteration.

Denise Reed said that, while it's crucial the SAB speak to these two priorities, to some extent the separation of the topics by priority is constraining.

Christopher Lenhardt said that, from the working group perspective, they are eager to help and welcome direction. The role of the liaison is critical to relationship between the SAB and the working groups and is underutilized. The bullet on AI technologies and improving collection, management, dissemination, is within DAARWG's domain. They haven't yet looked at 'omics data and autonomous vehicles but would like to. For some topics, multiple working groups should review it or work collaboratively.

Michael Castellini, Chair, Ecosystem Science Management Working Group, said their work has been looking at citizen science and holistic ecosystem restoration areas. His expectation of the direction this subject was headed has changed since the previous day's discussions. The ESMWG is ready to adapt to whatever the work plan defines the ecosystem assessments in Priority 2. He also noted the National Academies' post-doctoral program that puts young fellows into NOAA labs all over the country and is a fantastic opportunity for training and work force development.

John Snow said liaisons going between EISWG and NWS and OAR have been very helpful and it would be good to get someone in that role for NESDIS or even the Ocean Service. He intends to call on other working groups and coordinate if they already have groups focused on a given topic.

Paul Knight, co-chair of the CWG, said alignment is key to understanding the current situation. The CWG would like to support the SAB and NOAA however it can. Its areas of expertise include: tropical Pacific Ocean, monitoring going on there and the ingestion of that data; importance of resiliency of the marine ecosystem in the Artic and advances going on with sea ice and its role in seasonal and sub-seasonal prediction; seasonal to sub-seasonal; and modeling, translating that to skill; climate science and decision making and trying to understand the social science elements of this as well.

Susan Avery asked Dr. Knight if the CWG is organized with the right people to venture into the area of increasing sustainable economic contributions of fisheries and ocean resources if asked. Mr. Knight said he was not sure they have the right people to address it but would be open to expanding the group.

Denise Reed said the SAB should be more available to work with the working groups in addition to taking advantage of their efforts. Bob Winokur said that working groups should brief the full SAB on tasks they are working on in relation to the work plan rather than just the liaisons, so they can get feedback mid-way through their work. Susan Avery noted that the SAB's meeting materials packet usually contains a summary of all the work the work groups have done; it is important that the SAB members read the reports ahead of meetings, given time constraints.

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

Cynthia Decker said the SAB accepted the report to Congress and the response to the AAs that the EISWG presented. She will work with Lynn Scarlett to transmit those from the SAB to NOAA.

Terms of Reference were approved with caveats to the CWG and DAARWG's pending adjustment to language about membership. Once they are fully approved they will go up on the website as revised.

Cynthia Decker will work with Lynn Scarlett to write the next iteration of the biennial work plan and expect to see something come out for review soon.