

**51st Meeting of the NOAA Science Advisory Board
Silver Spring, MD
17-18 November 2014**

Presentations for this meeting have been posted on the Science Advisory Board (SAB) website:
http://www.sab.noaa.gov/Meetings/2014/november/november_17_2014.html

SAB members in attendance:

Ms. P. Lynn Scarlett, Managing Director for Public Policy, The Nature Conservancy (*Chair*); Dr. Susan Avery, Director and President, Woods Hole Oceanographic Institution; Dr. Eric Barron, President, Pennsylvania State University; Mr. J. Walter Faulconer, President, Strategic Space Solutions; Dr. Robert Hicks, Professor of Economics, College of William and Mary; Dr. David M. Lodge, Professor, Environmental Change Initiative, University of Notre Dame; Dr. Jennifer A. Logan, Retired (Harvard University); Dr. Molly K. Macauley, Vice President for Research and Senior Fellow, Resources for the Future; Ms. Jean May- Brett, STEM Partnership Coordinator, Louisiana Department of Education; Dr. Stephen Polasky, Professor, University of Minnesota; Dr. Jerry Schubel, President and CEO, Aquarium of the Pacific; Mr. Robert S. Winokur, Retired (NOAA, Navy); and Dr. Dawn Wright, Chief Scientist, Environmental Systems Research Institute.

NOAA senior management and Line Office representatives in attendance:

Dr. Kathryn Sullivan, Under Secretary of Commerce for Oceans and Atmosphere; VADM Manson Brown, NOAA Assistant Secretary for Observations and Prediction; Dr. Rick Spinrad, NOAA Chief Scientist; Dr. Holly Bamford, Assistant Administrator, NOAA National Ocean Service; Ms. Mary Erickson, Director, National Centers for Coastal Ocean Science.; Dr. Steven Fine, Deputy Assistant Administrator, NOAA Oceanic and Atmospheric Research; Ms. Laura Furgione, Deputy Assistant Administrator, NOAA National Weather Service; Dr. Richard Merrick, Chief Science Advisor, NOAA National Marine Fisheries Service; Dr. Patricia Montanio, Assistant Administrator, Program, Planning and Integration; Dr. Al Powell, Director, Satellite Applications and Research; RADM David Score, Director, Office of Marine and Aircraft Operations; Dr.

Staff for the Science Advisory Board in attendance: Dr. Cynthia J. Decker, Executive Director; Anna Hermes; and Mary Anne Whitcomb.

Monday, 17 November

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 SAB and other attendees, and everyone introduced themselves.

NOAA Update

Rick Spinrad, NOAA Chief Scientist, presented the NOAA update on behalf of Dr. Sullivan.

Summary

Changes in NOAA leadership.

Holly Bamford is now Acting Assistant Secretary of Conservation and Management. Holly served as the Assistant Administrator for the National Ocean Service since 2013 and has a Ph.D in organic and environmental chemistry. VADM Manson Brown is senior advisor and pending Assistant Secretary for Observations and Prediction awaiting Senate confirmation. VADM Brown retired from the U.S. Coast Guard in 2014; his last position was as the Deputy Commandant for Mission Support. Dr. Stephen Volz is the new Assistant Administrator for NESDIS comes most recently from National Aeronautics and Space Administration (NASA) where he was Associate Director for Flight Programs in the earth science division. Dr. David Yoskowitz is the new NOAA Chief Economist, on a one-year assignment from Texas A&M University Hart Research Institute.

Dr. Spinrad highlighted the top NOAA priorities for 2014-18:

- Make communities more resilient
- Evolve the Weather Service
- Invest in observational infrastructure and
- Achieve organizational excellence.

On the topic of organizational excellence, Dr. Spinrad highlighted the 16 NOAA scientists who contributed to the report by the Intergovernmental Panel on Climate Change (IPCC), another seminal step in the on the physical science basis of climate change which may be the most comprehensive science analysis to date. In other scientific assessments, NOAA scientists were three of the four editors of the Bulletin of the American Meteorological Society, “Explaining Extremes of 2013.” NOAA scientists also completed a technical report, “Sea Level Rise and Nuisance Flood Frequency Changes around the United States.”

On the issue of resilience there was an expansion of the existing Pacific Remote Islands Marine National Monument to six times its current size, resulting in 370,000 square nautical miles of protected area round these tropical islands. This expansion will protect coral reefs, sea mounts, and marine ecosystems unique to this part of the world, which are also among the most vulnerable areas to the impacts of climate change and ocean acidification. Commercial fishing and deep-sea mining are banned in the Monument but recreational fishing will be continued. There are demonstration projects for marine biodiversity under way. NOAA, NASA and

Interior's Bureau of Ocean Energy Management (BOEM) have joined together to support three demonstration projects in four areas—Florida Keys, Monterey Bay and Santa Barbara Channel in California, and on the continental shelf in the Chukchi Sea in Alaska.--that will be the foundation of a network in the future.

In the Great Lakes, the Thunder Bay National Marine Sanctuary has expanded from 448 sq. miles to 4300 sq. miles and will allow expansion of research and education efforts and enhance sustainable tourism. There is also a Great Lakes water level viewer under development; a new digital coast tool. The water levels in all Great Lakes rose 7-12 inches between summers of 2013-14; this tool provides planners with visual lake level scenarios for rise and drop information before these events happen.

Loss of wetlands is accelerating in the United States despite recent strides in conservation and restoration of coastal habitats. Development is a major factor; the NOAA Land Cover Atlas - August 2014 helps communities "see" vulnerabilities and craft stronger resilience plans. On Gulf restoration NOAA and National Damage Assessment trustees in the Deepwater Horizon oil spill signed a formal Record of Decision to implement a Gulf restoration Plan that includes 44 projects costing \$627 million and is the largest suite of Gulf early restoration projects so far.

A new NOAA study finds that Alaska fisheries are particularly vulnerable to the effects of ocean acidification as the region's seas continue to become more acidic. Red king crab and tanner crab, two important Alaskan fisheries, grow more slowly and don't survive as well in more acidic waters. Southeast Alaska is a hub for the fishing industry and while subsistence communities predominate in Southwest Alaska where ocean acidification could threaten food security. NOAA's ocean acidification program and the state of Alaska will develop tools for industry to cope with total impacts of ocean acidification.

On the topic of evolving the Weather Service and transition from research to operations the High Resolution Rapid Refresh (HRRR) model transitioned from the Earth System Research Laboratory (ESRL) to the National Weather Service in September. This is the first in a new generation of weather prediction models designed to better represent the atmosphere and mechanics that drive high-impact weather. The model features four times the previous resolution, from eight to two miles, and is a game changer in the improvement of weather predictions.

Also transitioning from research to operations in October was the Multi-Radar, Multi-Sensor System (MRMS) which merges multiple data sources, allowing forecasters to better analyze data and potentially make better predictions. MRMS combines data from adjacent radars and provides a clearer picture of a storm's intensity. MRMS data are also an input to the High Resolution Rapid Refresh model.

On NOAA's investment in observational infrastructure includes capabilities like the Tropical Atmosphere Ocean (TAO) array in the Western Tropical Pacific. After some concern, the TAO array is now back up to over an 83 % data retrieval rate. The budget now includes resources and ship time for maintenance of these data buoys, critical for achieving that performance target.

On organizational excellence there are several things to report. Greg Johnson and John Lyman at the Pacific Marine Environmental Laboratory are part of a team on IPCC on global energy storage. Global energy storage is the topic of an article in the Nature Climate Change, “Oceanography: Where’s the heat?” Sandy MacDonald has been named President of the American Meteorological Society (AMS) starting in January 2015.

Finally, Dr. Spinrad provided an update on NOAA’s Environmental Partnership Program, through which 1600 science, technology, engineering and math students graduated from Minority Serving Institutions. As a result of this program, 190 graduates now work in the private sector, 80 graduates work in NOAA and 173 Ph.Ds were granted in NOAA mission disciplines.

Discussion

Lynn Scarlett asked if the Natural Infrastructure Improvement Plan and Urban Water strategy reports can be shared. She also asked how the NOAA Land Cover Atlas is linking to communities and to decisions. Finally, she asked what economic analysis is being done as part of the Gulf restoration projects.

Rick Spinrad said NOAA will check when the Urban Water Strategy report can be shared; on Natural Infrastructure. He noted NOAA has begun an extensive dialogue with NSF Social and Behavioral Sciences Division for enhancing what NSF is investing in, such as the water-food nexus.

Holly Bamford said there has been work on green infrastructure through Hurricane Sandy funding. There should be a report out on this topic; perhaps the SAB could provide some input on the report. NOAA is working with Housing and Urban Development (HUD) and others who look to NOAA for evaluation of ecosystem services on natural infrastructure. This report will look at how NOAA uses its capabilities to address natural infrastructure.

Mary Erickson said there are a lot of funded entities on coastal restoration in the Gulf, including the National Academy of Sciences and National Fish and Wildlife Foundation. The NOAA program will include social sciences in its first Federal Funding Opportunity announcement.

Molly Macauley said with the US Army Corps of Engineers (USACE) there is a trade off between hard infrastructure and green infrastructure. She wanted to know if NOAA is funding research on physical benefits of green infrastructure and ecosystem services. Holly Bamford said these factors were being considered. The USACE is interested in quantifying resilience; NOAA also examines carbon sequestration and blue carbon. The most logical solution is a hybrid approach that includes both hard infrastructure and green infrastructure.

Dawn Wright noted the TAO update was good news and asked if there was collaboration with University National Oceanographic Laboratory System (UNOLS). RADM Score said NOAA has been coordinating with UNOLS and used a University of Hawaii ship as well as a contract ship and the NOAA vessel Ron Brown.

Stephen Polasky asked if the development of environmental intelligence as a dashboard for common decision making is this being driven by data available for what the state agencies and communities say they need. Rick Spinrad said, asking what services are needed is critical. The

NOAA Observing System Council asked if NOAA's operational systems are optimized and what should the priorities for investment be. The portfolio logic on prioritizing is the challenge for the agency and should be driven by needs.

Jennifer Logan commented that she was happy that Rick Spinrad highlighted the scientists who worked on the IPCC as this is usually a thankless task that takes up a lot of time.

Marshall Shepherd added that Laura Furgione, the Deputy Assistant Administrator for the National Weather Service, was elected to the Council of AMS as well.

National Weather Service and National Ocean Service: Partnering to Enhance Environmental Intelligence and Build Community Resilience

Holly Bamford, Acting Assistant Secretary of Commerce for Conservation & Management

Laura Furgione, Deputy Assistant Administrator, National Weather Service (NWS)

Mary Erickson, Director, National Centers for Coastal Ocean Science, National Ocean Service (NOS)

Summary

This is an informational briefing on creating strategic roadmaps to put continued resources and emphasis on customer service, and breaking down the communication barriers to integrated product development. A primary message was that improving environmental intelligence and services requires interdisciplinary program integration in NOAA.

There are a number of growing issues facing the Nation's water enterprise:

1. Population growth, agriculture and economic development
 - Stressing water supplies and water quality
 - Escalating socioeconomic risks of floods and droughts
2. Shifting population density
 - Increasing vulnerabilities
 - Changing climate
 - Impacting water availability and quality
 - Increasing uncertainty
3. Aging infrastructure
 - Forcing critical, expensive decisions

NOAA is at a crossroads for its scientific and societal challenges. Science must be connected to community challenges, at the scale and time needed to take action; examples include improved hurricane forecasts and products for emergency managers and port managers.

Mary Erickson said NOAA has developed a new storm surge graphic to meet joint needs in communicating hurricane storm surge forecasts. Previously NOAA provided technical details that didn't answer people's questions about when the water is coming to their door. They engaged social scientists on terminology, graphics, and color in developing the new storm surge graphic for this year's hurricane season.

Coastal Operational Forecast System Products

A decade ago, the SAB reviewed ocean modeling in the agency and recommended a more holistic approach. Now NOS and NWS are collaborating in the modeling and computing environment. They are operating the weather and coastal ocean models in the same system, which allows coupled modeling systems on same platforms. This backbone will also allow us to extend prediction into new areas such as ecological forecasting. The first effort in this area has been prediction of Harmful Algal Blooms (HABs) with NOS forecasts provided first to coastal managers then to the public via NWS distribution in beach hazards statements in the Tampa area. NOAA/NWS is also running experimental NOS models to predict *Vibrio* presence and distribution.. The ultimate goal is to have total water prediction from the land to the sea working with many partners within and external to NOAA.

NOAA is facing intersecting science challenges which require an interdisciplinary approach. Total water prediction involves linking inland/terrestrial freshwater with coastal/estuarine observing, modeling, and products. Ecological forecasting evolves ocean prediction to include biochemical components to address economic and health impacts. “Environmental Intelligence” synthesizes coastal observations, climate trends, and prediction systems to provide integrated products and services for decision making

Future directions include improving observations and predictions to address societal challenges and mitigate impacts on community well-being. In achieving this, NOAA will provide support to key Federal partners, e.g. Centers for Disease Control (CDC), the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA), as well as decision-makers at all levels of government and the public.

Discussion

Bob Winokur commented that the presentation was a nice example of a NOAA crosscutting program. He wanted to know what types of observations will need to be improved and what are the issues involved, Mary Erickson said new technology and reducing cost of observations will be necessary. For ecological forecasting NOAA will need lower cost for better coverage and higher resolution. NOS and NWS are looking to engage people for citizen science, e.g. community sampling and surveying, which also helps people take ownership and become stewards. NOAA is working to balance the modeling and observations; to take core observations then model to focus where the agency can use its more expensive technologies. Laura Furgione added NWS is trying to improve technologies and maintenance as well as deal with vandalism for the Tropical Atmosphere Ocean (TAO) array. Where NOAA already has sensors, NWS is evaluating where it could add additional sensors. It is also developing new technologies, such as gliders, with OAR that are cheaper, better and faster observation platforms.

Marshall Shepherd said the American Meteorological Society (AMS) Council spent time and defined a weather, water and climate enterprise, with water as an addition to the previous version. The leadership by NOAA in the water enterprise helped to make it a priority for AMS.

Molly Macauley suggested the SAB should ask questions about context; on the issue of transition, there is information but there must be a manager who is doing something with it. She doesn't see any reference to weather companies and meteorologists who get information out in user-friendly ways. The EPA and US Geological Survey (USGS) also have roles in water; how

does NOAA interact with them and other agencies? Laura Furgione said private weather companies and broadcasters tend to pick this up best through AMS. If there is a question on ecological forecasting, NOAA wants to make sure right person is answering questions and providing the education on this. Mary Erickson added that storm surge was discussed with the broadcast community, and then done in GIS framework in a layered way to synchronize with broadcast capability. With HABs there are other agencies with regulatory roles. Congress passed the Harmful Algal Bloom and Hypoxia Research and Control Act in June 2014 that directs agencies to work together on these issues: EPA, USGS, NOAA and Health and Human Services (HHS) agencies also work together. EPA has expressed appreciation for NOAA's role in prediction of HABs for use by that agency in its regulatory role.

Holly Bamford said NOAA is working with the private weather sector; however the agency hasn't quantified a private ocean sector and has funded a study on this. So far NOAA has identified over 600 private companies in the ocean enterprise. Ecological forecasting will likely be a market for the private sector. Laura Furgione said on water enterprise they are working across NOAA line offices; there is also a Memorandum of Understanding (MOU) signed with the US Geological Survey, Army Corps of Engineers and NOAA to facilitate cooperative work among agencies.

Susan Avery noted the SAB has now heard about products and communication but she would like to know about the underlying science context for these programs. Susan Avery wanted to know if the HAB products are nowcasting or forecasting and whether they are using physical or biophysical modeling; Dr. Avery also wanted to know what the results know in the context of the changing water cycle globally. These and other major science questions should be addressed.

Laura Furgione said this is a topic where the agency can further utilize the Environmental Information Services Working Group (EISWG) to tackle the problem and information on moving forward. It is a balance of modeling and observation efforts. Mary Erickson said NOAA can also involve the Ecosystem Sciences and Management Working Group (ESMWG). Across coastal areas of country is there are a lot of different problems in HABs that have different drivers and different tools. One of key questions NOS is working on now is toxicity of the algae - when it matters and when it has an impact. In hypoxia, the shifts due to minimum oxygen are challenging. Habitat and species modeling have also been added to the roadmap to be predictive—that is a partnership with NOAA NMFS.

Rick Spinrad said an example of a best practice in NOAA is the Joint Center for Satellite Data Assimilation (JCSDA). What has been learned here could apply to oceans and ecological forecasting. Finally, there are a lot of discussions in the Office of Science and Technology Policy (OSTP) about water quantity so there is a lot of good dialogue on all agency responsibilities with respect to water.

Lynn Scarlett said both the generation of science and the application of science increasingly involve questions of integration and coordination—integration across disciplines, across NOAA line offices, across other agencies, and between the public and private sector. This is needed for specific issues and across issue areas. Then integration is needed across different science

questions as well as across models and processes. This presentation provided one aspect of how NOAA acts on science and management questions.

Integrated Ecosystem Research in the Arctic

Ed Farley, Program Manager, Ecosystem Monitoring and Assessment Program, Alaska Fisheries Science Center, NMFS

Summary

Sea ice is an important component of Alaska's, subarctic (southeastern Bering Sea) and Arctic (northeastern Bering Sea and Chukchi Sea) large marine ecosystems. During the last 35 years, Arctic sea ice extent and duration during spring and summer has steadily declined. The loss of sea ice within these ecosystems presents a challenge to living marine resources that are dependent on sea ice and cooler sea temperatures as essential habitat for their survival.

Fish and oceanographic data collected during National Marine Fisheries Service, Alaska Fisheries Science Center research surveys along the eastern Bering Sea shelf and within the Chukchi Sea were used to examine the potential impact of loss of sea ice on: 1) southeastern Bering Sea productivity and subsequent connection to walleye pollock recruitment; 2) movement of sub-arctic fish species northward to the Arctic; and 3) potential decline in Arctic cod abundance, a key stone species for upper trophic level predators in the US Arctic region.

The results suggest that continued warming and loss of sea ice in the southeastern Bering Sea will lead to a reduction in lipid-rich prey for walleye pollock, thereby reducing their fitness and survival. Moreover, models that utilize climate projection data indicate that the continued warming will result in a 40% decline in walleye pollock average abundance over the next 40 years. In the Arctic, a stable "cold pool" of summer bottom water temperatures (< 2deg C), that develops from melting sea ice during spring, will act as a barrier to sub-arctic groundfish species that are more dependent on warmer bottom water temperatures, thus preventing them from moving north. However fish that are distributed in the upper water column, such as Pacific salmon, will likely take advantage of warmer sea surface temperatures during summer, leading to an increase in their numbers within in the US Arctic. The warming sea surface temperatures in the Arctic will likely reduce growth rate and subsequent survival of Arctic cod, a lipid-rich prey, potentially depriving upper trophic level predators such as sea birds and marine mammals of their highest energy diet item.

Discussion

Marshall Shepherd asked if this study has been monetized, that is, has the economic impact of these results been determined for the Arctic Region (Chukchi Sea)? Ed Farley responded that there was no monetization as these are mostly subsistence fisheries in the Arctic; there is only one small commercial fishery for salmon in that area. Richard Merrick added that the real economic problem would be the 40% decline in the pollock fishery, which occurs in the southeast Bering Sea (subarctic); the pollock fishery is one of the largest commercial fisheries in the US; only subsistence fisheries are allowed in the upper Arctic. Laura Furgione added that the

National Weather Service has also studied the storm patterns; the big storms may move north in the future and will be a problem for the fishermen as well.

David Lodge asked if there are other species in these communities that might be exploited and what are unanticipated changes that might occur. The response was that there are “winners” and “losers”: in terms of fish populations: in the southeast Bering Sea pollock are likely the losers and arrowtooth flounder and jellyfish are the likely winners, for example. Richard Merrick added that one unknown is whether warming could change invertebrates; for example, it is unclear whether shrimp would return.

Dr. Sullivan, who joined the meeting at this point, noted the Arctic is a harbinger of things people will see elsewhere. Marshall Shepherd’s question about what these changes will mean for human social and economic adaptation is particularly important; there has never been such a rate of change seen at this scale of human and economic activity. There can be significant repercussions and NOAA has a role in defining what changes can be expected.

Lynn Scarlett said common threads among the themes of the talks so far today are change, connectivity, uncertainty, and complexity; these are some of the challenges NOAA is facing.

Strategy Session - The Way Forward

Dr. Kathryn Sullivan opened the strategy session by reminding the SAB that the purpose of the session is to move forward from the Executive Session at the July 2014 SAB meeting. In July, the group explored general questions posed and, in discussing these, some concepts emerged that were synthesized for this meeting. At this meeting the SAB should focus on topics or themes that appear promising for the agency to consider. Further, there will be an action plan as to how NOAA can receive the information and continue to engage the SAB in the conversation between now and the April 2015 SAB meeting. Internally, Rick Spinrad and his team have been working on the NOAA Research Agenda, and these efforts will continue in concert with the SAB’s efforts.

Lynn Scarlett said that there were many topics discussed at the July meeting, focused around the questions posed to the SAB for the Executive Session. The present discussion should aim for focal areas, products, and/or assessments moving forward. The three topics or themes that were discussed at the July meeting were: what does the future look like and how might changes in the future impact NOAA and its ability to fulfill its mission; how the NOAA Research and Development portfolio should be refined and managed; and how to make the interface between science and decision makers and users robust. Ms. Scarlett said that the third question should be considered a subset to the first two questions.

The discussion during the present session should emphasize how the future is relevant to the evolution of the Agency in terms of capacity building, priority setting, the research agenda, partner engagement, fiscal constraints, and organizational nimbleness. For the SAB’s purposes, the “future” is defined as near-term (5-7 years). Dr. Spinrad will present the NOAA Research Portfolio; the SAB should also consider whether there is other information needed for its

analysis. Lastly, the SAB should consider how it can pull information together quickly to help NOAA now.

The SAB could provide a number of white papers by the April SAB meeting. For example, the papers could address the value of NOAA's information or potential new partnerships. The SAB could also consider the major issues driving NOAA, e.g. the food-water-energy nexus, or the intersection of oceans, atmosphere, and communities. Are there presenters that would be useful to hear from in April on these topics, and are there other similar topics to consider?

Steve Polasky said that the SAB should start with a core set of issues that will drive NOAA's major research portfolio. Dr. Sullivan added that the SAB could also consider the information needs that drive the research portfolio.

Bob Winokur said that the group needs a manageable list of opportunities and/or needs to consider. Mr. Winokur provided an example of the Naval Defense Science Board, which conducts strategic studies on one topic within 6-9 months. A concrete list of needs or topics from NOAA would help the SAB achieve results within this time frame.

Jeremy Jackson highlighted the significance of the third question from the July 2014 SAB Executive Session. Serious discussions with the economic community are lacking in the national arena of environmental change. The SAB can come up with a list of important research topics for NOAA, but NOAA also needs to consider how it will communicate its efforts and translate them into action.

Dr. Spinrad said that NOAA might need fundamental cultural change. In five years, NOAA will be 50 years old, and national culture will be different in terms of the private sector and level of scrutiny of NOAA's research. While a list of research themes or topics is useful, it is also useful to discuss how NOAA positions itself to face cultural changes.

Jerry Schubel said that a list of problems could be turned into a list of challenges which are opportunities for early success. He suggested that there is an important opportunity in fisheries and aquaculture for NOAA to consider. Walt Faulconer agreed that fisheries and aquaculture are areas that directly align with NOAA's mission and are at the nexus of many integrated topics (e.g. energy-food-water; ocean-atmosphere-communities). Since fish is the last wild animal that humans consume, it is an important opportunity.

Dr. Sullivan said that the food-water-energy nexus is implicit in NOAA's thinking. The triad between communities-ocean-atmosphere could be considered a view of social, ecological, and environmental resilience. NOAA must provide the best information to society the best way it can as soon as possible.

Dr. Jackson is working on a book on sea level rise. In writing his book, Dr. Jackson read the work of Dr. William Nordhaus (Yale University), which shows that there are great uncertainties for economic loss related to environmental change. Dr. Nordhaus' work and others show there is a vibrant community interested in NOAA's work and how NOAA can build more connections.

Ms. Scarlett summarized the discussion thus far, stating the conversation suggests the SAB should consider repositioning or evolving the Agency for success now and into a changing future. There are two pathways to engage the SAB and NOAA for a product to emerge. One pathway is to focus on a particular set of issues and identify their drivers, and NOAA's constraints. Alternatively, the focus could be on characteristics for science and decision making that will be relevant across a suite of issues (e.g. capacity, technology, partnerships, and the incorporation of economics). Both the list of issues and crosscutting themes are important to consider.

Dr. Sullivan said the SAB can create a vision of the world for which the Agency should be prepared. The SAB does not design the policy or programs within NOAA, but tell the agency what it will be facing in the future. This is very valuable for the Agency, as well as for communication with the Agency's stakeholders (including Congress). The SAB could develop several scenarios for NOAA to consider.

Susan Avery liked this idea. She recently attended a meeting with over 600 investors for a sustainable future. As a representative of the scientific community, she pointed out economics as a grand challenge with many factors, including the culture of inclusion, people entering the middle class, resource depletion, and resilience to deficits in the U.S. and other countries. She framed scientific research under another overarching umbrella. What might the grand challenge for the economic portfolio be, and how would NOAA contribute to that grand challenge, especially in terms of environmental depletion and resilience?

Dr. Sullivan agreed that the SAB need not define the future of NOAA alone, but what the world looks like and how that applies to NOAA specifically. Are there research frontiers, emerging research domains that should be emphasized or prioritized, or emergent technologies that will change the way NOAA operates? How does NOAA define its role among changing landscapes? Dr. Spinrad said that these ideas resemble those that drive the Navy's Defense Advanced Research Projects Agency (DARPA) process. What are the seemingly unrelated capabilities across NOAA that could be combined, and what future capabilities should NOAA consider?

Ms. Scarlett agreed with Dr. Avery. The SAB could lay out a framework of context and characteristics of the future, and then focus on specific issues. For example, this would include seemingly unrelated characteristics or capabilities, rapid change, interconnections, the scales of problems, nonlinear dynamics, community engagement, and the growing expectation of society to be part of the decisions. Then the SAB could consider this context in terms of the energy-water-food nexus, or the ocean-atmosphere-community nexus. This would serve NOAA in two ways by: 1) providing general direction in terms of capacity building etc. and 2) addressing mission delivery in specific realms.

David Lodge added that decision-making under uncertainty is a key challenge and another important element of context. This is not a new challenge, and many are working on this. However, while reducing uncertainty is a goal of research, communicating uncertainty to public is an enormous challenge and decision makers must make decisions that are robust even in the face of uncertainty. This may be a potential topic on which it would be useful to engage external speakers at the April 2015 SAB meeting.

Dr. Schubel quoted, “Success in life is less about knowing how to play the game than knowing what game you play.” It is important to highlight NOAA’s successes in the short-term. Another framework to consider is how the future environment impacts human society, and how society, in turn, affects the environment. NOAA has some great examples of these relationships.

Dawn Wright agreed the SAB should focus on a grand challenge, and especially uncertainty in decision-making. There are many other players considering this challenge, such as the US Geological Survey, the National Science Foundation, the National Institute of Health, and many in the private sector. This challenge is certainly difficult in the informatics world. For example, how is uncertainty conveyed on a map? Dr. Wright supported Dr. Lodge’s suggestion to bring in thought leaders to discuss this challenge.

Ms. Scarlett summarized that there are two strains in the conversation. There are the contextual characteristics, and then linkages of the characteristics to NOAA and its particular issues. While uncertainty is clearly an important emerging theme, it is not the only characteristic shaping NOAA. There is also a growing set of expectations in communities that are beneficiaries of NOAA’s science who set priorities as well. The growing expectation of community engagement shapes how NOAA does business, but also relates to questions of how to communicate uncertainty. The SAB could develop a list of salient topics, and then have speakers address them at the April meeting. Ms. Scarlett asked whether the emphasis of the talks in April should be on one topic or on several.

Eric Barron thought that, fundamentally, NOAA’s role is to protect life and property, promote economic vitality, and be good environmental stewards. The ability to predict crosses all of these roles with environmental intelligence is the foundation. Dr. Barron expressed concern that the group would forget about NOAA’s three main roles. The SAB could step back and ask where NOAA has the capability to advance prediction in areas other than weather and climate. This discussion could determine what areas of NOAA’s environmental intelligence are weakest moving forward.

Molly Macaulay agreed much of the discussion could be interpreted through each of the three NOAA priorities. She noted there are still many unknowns such as community response to events or repeated events, impacts on supply chains, and whether there is enough involvement from citizen science and crowdsourcing. NOAA should also consider the role of disruptive technologies.

Dr. Lodge agreed, and said that the SAB could highlight opportunities that build from existing capabilities, such as forecasting species and/or ecosystems. Dr. Barron noted there should be a deliberate effort to bring forecasting to other areas of NOAA, making predictions that effect life, property, and prosperity.

Ms. Scarlett said that she heard several approaches for the future. One was a return to NOAA’s basic mission, which transcends the current NOAA priorities. The SAB could consider where NOAA is now in terms of its contribution to these three roles and the features that might challenge those contributions as well as what capacities, processes, or research needs are

necessary to go forward. In other words, start with NOAA's basic mission, then consider what NOAA does now toward the mission, what NOAA might look like in the future, and what challenges may arise. Another approach would be to start with NOAA's three priorities and ask how NOAA delivers on those priorities now and how it might in the future. Third, the SAB could begin with an issue focus such as the water-energy-food nexus, and then define NOAA's role in that issue. In addition to the water-energy-food and atmosphere-ocean-communities nexuses, Dr. Lodge proposed an ecosystems or species-specific focus. Given the three options, she wanted the SAB's opinion on how it should move forward.

Dr. Sullivan appreciated the reflections and discussion. Her sense was that all three options were addressing the same needs for NOAA from different facets.

Ms. Scarlett suggested a small subcommittee of the SAB could work with Dr. Spinrad to draft an outline of an initial framework that could then be shared with the framework with the whole SAB for further development. Marshall Shepherd asked how this could be used by the Agency. Dr. Sullivan said she expected the document would enunciate the attributes NOAA needs to ensure the agency's success in five-years. Strategies to achieve success will help inform how NOAA designs future programs and be a discussion point for NOAA's stakeholders.

Dr. Macaulay proposed that the subcommittee could come up with 5-10 questions that could be addressed by external experts on the success of environmental intelligence from a predictive agency. Questions could address the business enterprise, behaviors (or how people respond to NOAA's information), technology, and economic impacts.

Dr. Barron said NOAA alone provides practical predictions and operational forecasts. He said that this is what makes NOAA unique and useful. This predictive element is fundamental to NOAA and should be highlighted.

Dr. Shepherd suggested the 5-10 questions could be answered by TED-like talks by speakers who address the questions in ways the SAB and NOAA typically do not consider. He also suggested asking "grass-roots" speakers or users of NOAA information and as well as students to participate in the process.

Dr. Avery liked the aspect of focusing on operational forecasting as long as the group considers the full cycle that incorporates observations, process studies, modeling, test-beds, communication, and tool development.

Dr. Schubel said that NOAA's future opportunities in operational forecasts are increasing. The challenge will be to structure NOAA's capabilities and opportunities so that they are not overwhelming.

Ms. Scarlett said the framework will be considered within the context of NOAA's mission and priorities. In addition, operational forecasting is a fundamental to this as to this as well, particularly as it relates to the comments on uncertainty, non-linearity, etc. In this context, the subcommittee will identify a series of questions and compile information and/or materials for Dr. Spinrad. The subcommittee will have a draft for the SAB at the January teleconference meeting,

refine it per feedback from the SAB, and then compile invitations for speakers at the April meeting along with a revised document. Dr. Sullivan said that this mode of operation is new for the SAB, and it may mean multiple working groups and a need to collect information, explore ideas, and have discussions.

Steve Polasky, David Lodge, Susan Avery, and Jeremy Jackson volunteered to be on the initial subcommittee. Dr. Spinrad will work with the subgroup as appropriate.

Ms. Scarlett said that each SAB member should provide initial questions to the SAB Executive Director by the second day of the SAB meeting.

SAB members posed a few initial questions. Ms. Scarlett identified several implicit contexts from the questions. First, new technologies and capacities allow humans to access information in ways hitherto not possible. Can crowd sourcing contribute to paths to success? Second, communicating risk is extraordinarily important to build resilience in an uncertain world. How can NOAA's environmental intelligence develop to acknowledge uncertainty? Third, integrated observing systems are cross-disciplinary. What are the evolving and changing contextual realities that lead to the questions SAB members pose?

Dr. Sullivan said that she looks forward to working with the subcommittee. She added that society is already growing hyper-personalized expectations, including increased involvement. This is evident in weather forecasting, but also in coasts and ecosystems. The meteorologist of the future will have a mix of skill and aptitudes that may not mesh neatly with today's academic departments. What are the implications of this for developing talent, recruitment, and training needs? How are people moved around the organization? What early-career options would enhance NOAA's capabilities? Dr. Sullivan concluded the meeting by thanking the SAB members for their lively discussion.

Action 1: The SAB members agreed to form a subcommittee to consider a number of initializing questions to bring to NOAA for the next phase of discussion of the NOAA R&D portfolio logic.

The NOAA Research Agenda Now

Richard Spinrad, NOAA Chief Scientist

Summary

Under the leadership of the Chief Scientist the Research Council has worked to develop a clear concept of NOAA's research portfolio and agenda. Dr. Sullivan originally began the discussion on this topic to determine what NOAA needs to do to build out its research agenda and enterprise. There is a need for NOAA to lay out what is being done now and the next steps.

A Research Agenda is a guide for optimizing research investment and goes beyond priorities for budget submission. A Research Agenda is also a vehicle for assessing portfolio performance. It allows NOAA to focus on institutionalizing how investments are made (budgets, platforms, people) and on fostering creative collaboration (e.g. fisheries considerations of climate change), and improving effectiveness and efficiency of transition from research to applications, operations

and other uses. If done correctly, it is a useful tool that would allow everyone in the NOAA research enterprise to understand the contribution of their activities to meeting NOAA's portfolio of mission needs and should be equally useful to outside stakeholders (Office of Management and Budget, Congress, Office of Science and Technology Policy, and research partners). It should be foundational for strategic and implementation plans. Plans for moving forward should refer back to this research agenda and it should provide justification for why NOAA conducts research and development (R&D) in certain areas.

NOAA's R&D obligations in FY14 were \$666 million across all line offices. A research agenda would link the research portfolio to what is needed to meet NOAA's mission and help guide an optimization of research investment.

A Research Agenda would start with the operational components, capabilities and tools. It would define the respective roles and responsibilities of managing resources.

A Research Agenda includes a set of fundamental principles that must be obvious, clear, and actionable. Characteristics of NOAA's R&D enterprise should include:

- Mission focus
- Innovation
- Balance in research spectrum between basic and applied science that can be flexible to address needs.
- Based in strong partnerships
- Credibility
- Capability
- Realistic given agency capabilities

The Research Agenda would help NOAA establish some fundamental principles for research. There is a need to line up the mission needs as a science-based service agency. Research needs should be aligned to services, but not "hard-wired." In terms of capabilities, NOAA has an extraordinary mix with labs, CIs, observing systems, etc. and a research agenda would help NOAA help optimize those capabilities. The roles and responsibilities need to be defined between different entities internal and external to NOAA. It is time to rethink various responsibilities. There is a need to define NOAA's best practices and expectations and include accountability. This should include means how to accelerate, shelve, and perhaps terminate research activities if they are not serving the mission needs. The research agenda serves many needs and will also be a critical tool for budget development and guided investment priorities.

The next step for the Research Agenda is to engage the external community including CI directors.

The Research Council wants feedback from the SAB to assess the research agenda plan, structure, focus, and utility. The Council would like to know how the SAB thinks the Research Agenda should be developed, used, and promulgated.

Discussion

Mr. Winokur started the discussion by stating he thinks the Research Agenda is on the right path. He mentioned the NOAA research budget pie chart that divided the budget by Line Office and suggested a variety of other ways to divide the pie such as focus areas or community interest in the research areas and suggested looking for cross-cutting efforts. The Research Agenda could be used as an investment strategy if it can define a reasonable number of focus areas. Another way to look at research investment is dividing between short project R&D and longer-term, mission-driven research. The other type is R&D for acquisition in areas like satellites. He also wondered if the priority setting would be bottom up or top down or a combination.

Dr. Spinrad replied that the budget pie chart division by Line Office was not to advocate that it was the proper way to consider the research budget and agreed there are many ways to parse the budget. Another thing to consider is that research investment over the past several years has grown as a direct consequence of natural hazard response, which was great for the research community, but not necessarily a good way to develop a strategy for approaching hazards overall.

Dr. Avery asked about NOAA's portfolio and the split in investment between research and development. She wanted to know how much is discovery-based and how much is strictly operational and who would define the mission needs. Dr. Spinrad responded that the research budget should not be just R&D, but also test, evaluation, and transition. The priorities will be NOAA priorities, some of which are defined through legislation. In the budget development process, NOAA needs a good approach to portfolio management, balancing mission and how that translates into R&D. Not all investments have to be related to a mission priority. NOAA also should invest in research that will result in quick, meaningful results as well as high risk, high reward opportunities.

Dr. Avery noted that stakeholders and users could have an immediate need, whereas scientists may have a different, longer-term goal.

Dr. Macauley asked what are R&D outputs. Dr. Spinrad explained there are many types of R&D outputs such as a list of publications, but it also includes products such as the development of High Resolution Rapid Refresh (HRRR) model capacity in NWS. And at NWFSC outputs included research results that helped with interpretations of catch-share policies.

Dr. Wright appreciated the mentioning of cooperative institutes, especially given the recent CI discussions and wondered if the CI directors would be involved in the overall discussion of the R&D portfolio. Dr. Spinrad responded that absolutely yes the CI directors would be. NOAA must re-think its CI model; this discussion should involve past directors, current directors, PIs, and Sea Grant.

Dr. Faulconer stated that a lot of the areas in R&D have grown with reaction to natural events. Therefore, it might be insightful to characterize the portfolio as proactive versus Reactive and look at how to make it more strategic. Dr. Spinrad responded that they haven't done that yet, but it would be interesting to see. Managing uncertainty is an important skill in NOAA and it should be clear how all the Line Offices are dealing with this. There should be a more disciplined

approach to develop relationships between researchers and operators. The process should be less dependent on personalities involved and more institutionalized.

Ms. Scarlett stated that a starting point would be determining how to depict the allocation of resources, with emphasis on partnerships and their leveraging. It could be useful to perhaps show NOAA's allocation of resources in a focus area, federal vs. leveraged dollars. Dr. Spinrad responded that currently there is no clear way to identify the research in the budget every year. In order to do this, NOAA has to create a fundamental data call every year. In terms of the leveraging question the data are robust and strong, but the question of who leveraged who and by how much does not tell the whole story and the information needs to be better. Metrics are absolutely necessary to track accountability but must be well designed to be meaningful and must account for getting the mission accomplished.

Mr. Winokur stated that the allocation of funds is difficult. Clearly projects that are not delivering must be cut. He said it would be good to avoid a formulaic approach to funding research as a certain percentage. He wondered the best way to allocate funding in a time of declining budgets. Dr. Spinrad responded that there needs to be phasing of research. Some projects require an investment now that will pay off in 20 years. There needs to be a project by project phasing and set of expectations. NOAA has to be nimble enough to support both long-term and short-term projects.

Working Group Updates

Climate Working Group (CWG)

Molly Macauley reported that in-person CWG meetings are now being held at NOAA facilities where there are strong climate activities so the group can be strongly engaged with those groups. Recent meetings were held at the Climate Prediction Center and the Geophysical Fluid Dynamics Laboratory. The group is working on thematic issues including tropical ocean observation extending to 2020 and beyond; integrated modeling at the regional scale and multi-model ensemble forecasting.

Data Archive and Access Requirements Working Group (DAARWG)

Dawn Wright reported that DAARWG Chair Chris Lenhardt had a meeting with CWG Chair Holly Hartman to discuss cooperative efforts. The SAB heard, in a presentation about the partnership between the National Ocean Service and the National Weather Service, that these organizations were looking at how data should be structured and used. This is a reminder that, in addition to the Environmental Information Services Working Group being included in this effort, DAARWG should also be involved as they move forward. DAARWG had a recent meeting that covered the establishment of the National Environmental Information Office. As they discussed the reorganization of the NESDIS data centers that would occur as part of this effort, members asked about the goals and impetus of this reorganization as well the metrics of success and how data centers will keep up quality and level of service. The group received an update on the status and future of the Comprehensive Large Array-Data Stewardship System (CLASS). CLASS has

been an area of concern for DAARWG since the group started in 2006 with members asking how NOAA should take advantage of emerging technology for data archive and storage. The Big Data Request for Information (RFI) was a topic for discussion as well as discussion of what would happen to private sector responding to RFI if no money was available to fund projects. The group was also concerned about the ramifications of moving data to the cloud and the strategy for doing this, especially with regard to security. The DAARWG also discussed the Geostationary Operational Environmental Satellite-series R (GOES-R) level 0 data and will make a report on this topic to the SAB at a future meeting.

Environmental Information Services Working Group (EISWG)

Bob Winokur reported that the next EISWG meeting will be December 2-3; the last meeting was in April. The draft meeting agenda includes discussion of the Big Data RFI, the national plan for civil earth observations, commercialization of satellite observations and a briefing from Senate staff on the Weather bill that has been introduced in the House. There will also be a briefing from the NOAA Chief Scientist and continued discussion on how to move forward with Open Environmental Information Services (Open EIS). At the April meeting, the Co-Chairs had Bill Hooke, former Assistant Administrator of the NWS, to facilitate a discussion of the NWS in 2025, including cultural changes, changing roles of government and private sector and other topics; this was an excellent exercise for the group.

Ecosystem Sciences and Management Working Group (ESMWG)

The ESMWG met in October in Anchorage, AK. The meeting focus was on NOAA's Arctic research and ecosystem services valuation. During the meeting, members heard about NOAA Arctic programs from the NOAA line offices, collaboration between NOAA and the Bureau of Ocean Energy Management, and about capabilities in ecosystem services valuation in the National Ocean Service and National Marine Fisheries Service. The ESMWG is also discussing future topics; some being considered include integration of traditional ecological knowledge into modeling, ecological forecasting and use of genomics for forecasting. Current plans are to have a teleconference meeting in the winter and an in-person meeting in May in the Washington, D.C. area and to provide reports on the Arctic and ecosystem services valuation to the SAB at either the summer or fall meetings. The ESMWG will also have a request for an extension of a member at an upcoming meeting.

Kathy Sullivan asked if traditional knowledge included local knowledge. Richard Merrick said that traditional knowledge is another name for local knowledge; the plan is to use the Arctic as a test bed for evaluating the use of traditional knowledge.

Gulf Coast Ecosystem Restoration Science Program Advisory Working Group (RSPAWG)

Jean May-Brett reported that the RSPAWG provided its comments on the NOAA draft Restore science plan. The RSPAWG very much appreciated how NOAA responded to its comments. The Science Plan is now out for public comment; there are also engagement webinars and the

SAB members have been informed about them. There is a planned RSPAWG teleconference meeting in December, the group will also engage with the ESMWG on possible collaborative efforts.

Ocean Exploration Advisory Working Group (OEAWG)

Jerry Schubel said that this was his last chance to talk about the OEAWG as it was terminated as planned now that the new Ocean Exploration Advisory Board (OEAB) has been established. The OEAWG began work in 2006. Highlights of its work included: two workshops in 2007 to plan for the maiden voyage of the *Okeanos Explorer* and establishment of a new paradigm for exploration including the “doctors on call” as a way of having remote scientific expertise during cruises. The OEAWG also organized the decadal review of the Ocean Exploration program. One final major effort was on the Ocean Exploration 2020, a partnership with OEAWG, the Ocean Exploration program and the Aquarium of the Pacific that provided a community review and endorsement of an ocean exploration model. The first meeting of the OEAB, chaired by Vice-Admiral Paul Gaffney, USN (retired), will be held in Washington, D.C on December 2-3.

SAB Membership Update

Kathy Sullivan said Marshall Shepherd and Eric Barron are at their last meeting of the SAB. Marshall Shepherd has served as liaison for the Satellite Task Force and Climate Working Group. Eric Barron came to SAB in 2009 as Director of NCAR, then served as President of Florida State and is now the President of Penn State University. Dr. Sullivan thanked both members for their service.

Public Comment

There were no public comments.

Tuesday, 18 November

A Proposal for New Cooperative Institutes Review Process and Review Criteria under NAO 216-107

Philip Hoffman, Director, Cooperative Institute Program Office

NOAA Research Council Cooperative Institute Committee and Cooperative Institute Directors invited to call in.

Additional Attendees: Sonya Legg (Geophysical Fluid Dynamics Laboratory), Dave Checkley (Cooperative Institute for Marine Ecosystems and Climate CIMEC), Michael Banks (Cooperative Institute for Marine Resources Studies CIMRS), Robert Moorhead (Northern Gulf Institute NGI); Steve Ackerman (Cooperative Institute for Meteorological Satellite Studies CIMSS), Don Anderson (Cooperative Institute for the North Atlantic Region CINAR), Judy Kleindienst (CINAR), Kristen Averyt (Cooperative Institute for Research in Environmental Sciences CIRES), Waleed Abdalati (CIRES), Steve Miller (Cooperative Institute for Research in

the Atmosphere CIRA), William McAnally (NGI), Jeff Hare (Joint Institute for Marine and Atmospheric Research JIMAR), Beth Turner (NOS representative to the NOAA Research Council Cooperative Institute Committee), Mike Uhart (OAR Laboratories and Cooperative Institutes)

Summary

The purpose of this presentation was to follow up on previous discussions about cooperative institute (CI) review criteria. The presentation described the current review process and some of the steps that could be taken to improve on it.

The overarching categories for the CI reviews are good: 1) Science Plan, 2) Science Accomplishments, 3) Science Management, 4) Education/Outreach. However, the details of each section will need to be adjusted and expanded. For example science management should include a separate administrative review that focuses on how the university supports the CI administratively. This is important for best fiscal management practices.

Education and Outreach is not well funded by NOAA and little direction has been given to CIs about expectations. This is slowly changing under new Task 1 policy.

A key decision for NOAA is whether the final review result should be quantitative (scale 1-5) or qualitative or some combination. Currently there is little guidance therefore the committee must agree what is an appropriate score for each theme and then craft a narrative to justify that score.

It is important to ensure the Review Chair is well prepared and some suggestions were made for improving the timeline of the reviews. An analysis of review schedules indicated that a three-day CI review could broaden the opportunities for stakeholder, student, and PI engagement with the review panel.

The goal for the revised CI Review Plan is to finish reviews and surveys and incorporate feedback by December 1. The plan will be revised and presented to CI committee and CI directors for vetting. Discussions will continue through December. By January the review plan will be given to the Research Council (RC) for review and approval. Then, the CI implementation handbook and guidance to CIs will be revised. The first 2015 review is scheduled for Hawaii in February. They are preparing for the review under the current structure.

Discussion

Sonya Legg began the discussion by asking about the three-day review schedule and expressed concern that one day is not enough time for the administrative review and she felt two days is more appropriate. Mr. Hoffman responded that the schedule presented was an example and it can be adjusted depending on the individual CI. The schedule was organized to make the best use of time for the panelists, convey information in clear and useful ways, and not be too burdensome for the CIs. The reviews could be longer if it seems necessary for the CI.

Michael Banks observed that there is a significant difference in the sizes of CIs and wondered how the review process would be modulated for different sizes and capacity.

Steve Ackerman stated he was disappointed by the suggested changes, because he sees it as largely the same process when there was hope for something much different. Education and Outreach (E&O) continues to be a big focus, but less than 1% of the funding goes to E&O.

Dr. Legg added that a scoring system that simply gives a number is not productive. The CIs would like constructive recommendations.

Kristen Averyt wanted to hear comments on the idea that each CI develops its own criteria for the review that would showcase the best characteristics.

Robert Moorehead agreed with Dr. Ackerman that this revision does not seem to be in alignment with the mandate from NOAA to the CIs to go out and leverage NOAA funding for education and outreach and yet even with limited NOAA funding for education and outreach a large amount of the review focuses on that.

Don Anderson asked about how the administrative aspects would be folded in to the review and observed that, given audits by funding agencies of the university that are independent of the CI reviews, it seems this might be duplicative effort.

Mr. Hoffman responded that the different sizes of the CIs is always a challenge and it will be necessary for CI reviews to have a discussion with panel chair and the CI director about how best to represent their CI. Mr. Hoffman responded to questions about education and outreach by stating that translation of CI work into products is a critical mission for the CIs just as it is for NOAA. NOAA does not give them a lot of money to do this but still the CIs should have an opportunity to highlight the successes in this area. If the reviews exactly matched the proportion of funding for each effort the education and outreach would shrink so much that the review panel would barely hear about it, but it's important. When education and outreach efforts have been successful there has been leverage. These review concerns will be further discussed.

Mr. Hoffman noted the SAB or Research Council must decide on a revised scoring system for the CIs. Scores on a numerical scale can be a useful tool, but are not always the best way. The reviews will always give more than a number. The idea of the CIs developing their own individual criteria would be possible, but these should fit into NOAA's metrics. NOAA could provide metrics for all CIs and the CIs could develop individual details and consult with NOAA through the process to tailor the metrics.

Mr. Hoffman addressed the administrative review concerns by clarifying the goals are to determine how offices are providing function. It is true there are already good audit and site visit documents available and there could be more effort to make the most of those reports to get at the administrative pieces that are important to NOAA and the CI.

Eric Baron thought the presented proposal addressed SAB's concerns from previous discussions regarding better guidance to Chair, categories of scoring, and a better sense of criteria, but still could bolster the "context." He suggested at the beginning of a review give important background such budget, structure, partnerships, etc. and that these characteristics could allow the reviewers to put CI budget into context immediately. Then, change scoring to reflect

individual CI expectations and possible ratings would include significantly exceeds, exceeds, or meets expectations. It is important to have context from beginning then reviewers can contemplate and evaluate each CI in context of its budget.

Jerry Schubel agreed with Dr. Baron and agreed it is very important to set the context. Each review should require the CI director to share the uniqueness, criteria, and accomplishments of the CI. Guidance for the review really should be on the CI director. The preamble to the reviews should include budget, structure, partnerships, etc. – characteristics that allow the reviewers to put the budget into context immediately. He added that he is more inclined to be in favor of qualitative results, but acknowledges that quantitative can be helpful.

Dr. Avery agreed with Dr. Baron and Dr. Schubel in that context setting is critical for each CI review. The CIs should have the opportunity to give the science highlights and how do they tie to NOAA's needs.

Mr. Winokur followed up on scoring and wanted to better understand a ranking such as “satisfactory” that has come to have a meaning similar to “failed.” He thought it should mean there is room for improvement and suggestions for improvement should be made.

Jean May-Brett added she has chaired two CI reviews with one CI being large and established and the second being small and new so the context of the CI is critical. The CI director has to have time to give a sense of what was done and what could be done. She was able to use her discussions with the SAB to help the review panel understand the task. That is information that is critical to all Review Chairs. She agreed with Mr. Winokur that the meaning of a “satisfactory” rating is unclear.

Dawn Wright agreed with many of the comments and added that she had looked at the meeting notes for July and shared the scoring system that was developed: exceeds expectations (what can be leverages for the future); meets expectations (continue with no conditions or continue support with conditions; does not meet expectations (suspend support, discontinue support)

Jeremey Jackson added that the reviews need to be a self-critical assessment by the CI on the spectrum of its research and how it has played out. The CI directors must have plenty of time for discussion with the review panel.

Ms. Scarlett thanked Mr. Hoffman for his hard work and summarized the key points of the conversation. She acknowledged the nearly unanimous agreement on the importance of the context for the reviews and that evaluations must be flexible enough to reflect the context and the need for more performance gradations. She stated that there are mixed feelings on whether qualitative, quantitative or a hybrid scale is best, but all agree that the language must be clear in terms of what a single ranking means.

Mr. Hoffman responded that setting the context for the CI is an important step and doing it properly depends on funding, size, research scope, and history. The CI Directors currently do a good job of setting context, but they tend to do it in a brief time and rely too much on documents prepared in advance. He wants to see greater opportunity for Directors to set context and

suggested that perhaps context-setting be the first half day of discussion during reviews. The shift in language toward expectations would be useful. The caveat that NOAA has a larger number of CIs now; when NOAA first competed them the agency set expectations very high, but the implementing CI resourcing was significantly lower. If CIs are going to be classified based on expectations it is crucial that reasonable expectations are set especially in when compared to the initial competition. He commented that nothing discussed thus far was out of line with the CI office's thinking and the office could make changes to the current proposal. The quantitative format is linked to Sea Grant, which is also highly structured and quantitative. Another aspect is that cooperative agreements have special award conditions and other means of adjusting the expectations. The language is there because when CILER received a Satisfactory, NOAA could make changes using these legal mechanisms to ensure changes were made.

Dr. Ackerman responded that there are still fundamental problems with expectations versus reviews and believes that the process needs to be revised from scratch.

Dave Checkley added that it is useful to state the review objective and intent. The review should be an opportunity for constructive dialogue to develop the best means to optimize services to NOAA. They inform the university as well as NOAA in terms of what's good and bad and the steps forward.

Dr. Ackerman further asked who would set the rubric and the expectations. Would it be done by the directors or NOAA or a joint effort?

Dr. Spinrad thanked the SAB members and the CI directors for their comments. He commented that the CI review process must be considered in the context of the broader NOAA research and development portfolio. The CI reviews are not isolated, but in fact are part of larger subject of how NOAA works with all its research partners and how NOAA optimizes these valuable resources. He continued that it was clear from the discussion are that the lab review context and expectations are essential and need to be built into the discussion. He stated the need to look at roles and responsibilities during the review process. Also, he agreed that review process does not require a rigorous approach for everything and that NOAA can build in latitude and tolerate different approaches as long as the NOAA's review process goals are met creating a dexterous and flexible process for all involved. He reminded the group that the final product also needs to be easily defensible to Congress and others and can be built on the foundation we already have under construction.

NOAA Response to the Comments from the Gulf Coast Ecosystem Restoration Science Program Advisory Working Group (RSPAWG) on the NOAA RESTORE Act Science Program Draft Science Plan

Mary Erickson, Director, National Centers for Coastal Ocean Science, National Ocean Service

Members of the RSPAWG were invited to call in

On the phone: Bob Dickey, RSPAWG Co-chair; Pam Yochem, RSPAWG member; Julien Lartigue, NOAA RESTORE Act Science Program Engagement Coordinator

Summary

The purpose of this presentation was to provide NOAA's response to the SAB's initial comments and recommendations on the NOAA RESTORE Act Science Program's draft science plan. The SAB's comments were drafted by its Gulf Coast Ecosystem Restoration Science Program Advisory Working Group (RSPA WG). NOAA also provided an update to the SAB on the current status of the draft science plan and the Program's initial federal funding opportunity (FFO) and provided an overview of the path forward for the SAB RSPA WG.

Ms. Mary Erickson outlined key findings and recommendations made by the SAB and NOAA's responses to those.

- The draft plan used focus areas to organize it; however, the SAB noted that doing so created confusion and areas of overlap and duplication. In response, NOAA removed the focus areas from the revised plan. This change addressed many of the SAB's comments.
- The SAB suggested that the importance of science in informing management decisions and to improve understanding could be strengthened in the draft plan. The plan was revised to emphasize this point.
- The SAB comments provided great help on reorganizing, clarifying and focusing priorities in order to reduce redundancy.
- The post Deep Water Horizon (DWH) era is complex in terms of the different parties involved. The working group suggested NOAA include a chart that describes the various DWH entities, and asked NOAA to be thoughtful about the agency's role moving forward as programs and priorities are outlined by other Gulf organizations. The revised plan includes a table that describes each of the DWH-funded entities (themes, funding, timeframe, and geographic scope) and a figure that illustrates the funding sources for each of the DWH entities.

Ms. Erickson then described progress of the NOAA RESTORE Act Science Program since the July 2014 SAB meeting. The revised draft science plan was released for public comment from October 30 to December 15, 2014. Also, with the publication of the Treasury Interim Rule for RESTORE Act funds in October 2014, the Program is allowed to grant funds. Initially, the Program has \$20 million available from the Transocean settlement. The timing and amount of additional funding remains uncertain. The Program's first federal funding opportunity (FFO) will be released in early December for \$2-2.5 million. The FFO will emphasize the Program's short-term priorities (first released in the Program's Framework in 2013), which focus on the synthesis of existing information, analysis of gaps, and development of strategies to advance understanding of ecosystem modeling, ecosystem health indicators, and monitoring and observation efforts. There will be a 30-day period for letters of intent, and then full proposals are expected in spring 2015.

Ms. Erickson outlined three general areas that the NOAA RESTORE Act Science Program wishes to advance working with the RSPA WG:

- 1) Options for science prioritization, focus, and interdependencies. What science topics are the best to start with? What research priorities can be conducted in parallel? What priorities are interdependent?
- 2) Ideas on how to integrate and coordinate science investments from the various Gulf of Mexico DWH-funded entities by utilizing the RSPAWG's membership – many of the subject matter and programmatic experts with whom the Program needs to coordinate are members of the RSPAWG.
- 3) Feedback regarding how the Program should be reviewed and assessed. What are measures of success and long-term goals? How can the Program maximize its impact? How are those impacts measured?

Ms. Erickson solicited feedback from the SAB on the Program's progress and steps moving forward.

Discussion

Dr. Bob Dickey thanked Ms. Erickson for summarizing the comments. He thinks that the science plan will be useful to the Gulf community and hoped it would be used to coordinate with other programs. Looking forward, he thinks the RSPAWG can help ensure that outputs from investments of the NOAA RESTORE Act Science Program are used by resource managers to better understand the ecosystem and the links to human communities. He also thinks the RSPAWG can aid with coordination and integration among DWH-funded programs so that they complement one another and are not in competition.

Dr. Steve Polasky added that based on the NOAA presentation, the top research priority seems to be having a more comprehensive understanding of the Gulf of Mexico ecosystem and that should be elaborated on. Ms. Erickson acknowledged the dialogue to define "comprehensive" or "holistic" understanding is underway and that the Program is looking at developing a better understanding of interactions between living coastal and marine resources, habitats, and human communities. One approach for getting at this comprehensive understanding is to study ecosystem services, which by definition include the human element.

Dr. Polasky added that the National Research Council committee on ecosystem services in the Gulf of Mexico noticed that a baseline knowledge and data is lacking. This baseline data is critical for understanding and measuring the impacts of environmental perturbations to the ecosystem. NOAA should think systematically about what data should be collected in order to document ecosystem services so that NOAA can assess changes to those services should another disaster occur. Ms. Erickson agreed with Dr. Polasky and added that the baseline data should be uniform across the Gulf of Mexico.

Dr. Rob Hicks asked how the Natural Resource Damage Assessment (NRDA) Program was informing others, acknowledging that NRDA is outside the purview of the NOAA RESTORE Act Science Program. Ms. Erickson responded there is a group inside NOAA as well as external entities that work on NRDA and support the RESTORE Act Gulf Coast Ecosystem Restoration Council and they get together at least monthly. NRDA has restrictions in terms of

communication of findings due to ongoing litigation, but can lend support, steer conversations, and give some indications of what kinds of investments would be potentially helpful. However the timing can be a challenge because while we are still assessing the impacts of the disaster via the NRDA process we are also investing lots of money in projects aimed at supporting recovery. Since the NOAA RESTORE Act Science Program is just starting and many other programs are already established, it is essential that the NOAA Program coordinate with the others.

Dr. Susan Avery noted there are high expectations for the Program and offered three general comments. First, she inquired about measures of success for the Program -- should they be quantitative or qualitative? The RSPAWG may be able to help define what success is for the Program and how to measure it. Second, she suggested that a role for RSPAWG could be to coordinate an integrated observing system that combines collection of baseline data now and additional data in the future -- but who would design that system? Third, she noted that the RSPAWG could help define ecosystem services, which are usually defined as services to humanity, not necessarily services for and health of the oceans. She noted the importance of balancing measurements of ecosystem services, which are often monetized, with measurements of ecosystem health.

Ms. Erickson noted that measures of success critical because if you don't know what success looks like then you will never get there. She said we intend to share the Program's plan for performance management with the RSPAWG for feedback and recommendations.

Ms. Erickson also said that an integrated observing system has been discussed among the different funding entities (the National Academy of Science (NAS) Gulf Research Program especially). The RESTORE Act Science Program can't build and maintain an integrated system given its expected budget, but might be able to develop a plan that includes needs, requirements, and recommendations on how to move forward. NOAA will continue to coordinate with NAS and other interested programs on this important topic.

Dr. Richard Merrick added that already the Gulf of Mexico Coastal Ocean Observing System (GCOOS), NAS and NOAA funding are involved and eventually the centers of excellence (CoE). All involved agree on the need for an integrated observing system.

Dr. Eric Barron thinks the preamble to the draft plan, including the vision and the overarching objective, is much better in the current draft. He appreciates that because the SAB has spent a lot of time talking about it. He was curious about NOAA's overall commitment to the concept of environmental intelligence (EI). If the vision is a sustainable Gulf then EI is the foundation of that sustainability. NOAA should be inserting that into the plan so it is clear this is the goal. Ms. Erickson responded that it is something for the group to think about as they go back and finalize. Because NOAA is a steward of this Program in coordination with others, we must balance the requirements of the Program (per the legislation) with ensuring we are responsive to regional stakeholders. The principles of EI are absolutely critical for all of these.

Dr. Kathy Sullivan added that EI is a leadership concept and there is a need to be more consistent in using it as an organizing concept even for Program's with requirements to coordinate and collaborate with others.

Ms. Lynn Scarlett thanked everyone very much for the work, which was extraordinarily complex. She commented that the chart in the presentation shows how the money flows, but the complex web of the process for implementation in both the near and long term and of user engagement is not clearly shown. She flagged this because research priorities really should interface with user communities (public or private). The whole point of decision support tools is that users utilize them. Indicators should not be done separately, but need to reflect the sense of priorities and what is important to measure. There is a challenge in coordinating science. She asked about the adequacy of the process to engage relevant user groups on an ongoing basis, so that indicators reflect both what people think is important to measure and what leadership thinks should be measured for decision support tools, etc.

Ms. Erickson responded that regional engagement sessions could be held anytime as the Program moves forward. These would include listening sessions with active dialogue for getting feedback. The RESTORE Act Science Program will continue to have these kinds of meetings in the future with stakeholders.

Dr. Dickey emphasized that communication across different entities is important; in that regard the work of the Centers of Excellence and the five Gulf States should be better integrated into NOAA RESTORE Science Plan. He noted the proposal for the State of Texas was just finished and emulated the structure of the NOAA science plan so it could integrate and build from the strengths. He also said NOAA's role is to lead from a high level and reach across different states, each with different needs and priorities, to lay out the framework. NOAA is doing a good job of this so far.

Mary Erickson thanked the SAB and RSPAWG again for all the work they have done with the science plan.

NOAA, Society and the Economy: Connecting Social Science with NOAA's Priorities

David Yoskowitz, NOAA Chief Economist

Summary

The purpose of the presentation was to give an informational briefing to update the SAB on work to implement short-term, highest priority social science actions and to initiate a discussion of the challenges and next step for social sciences being connected to NOAA's priorities.

Dr. Yoskowitz presented a variety of ways social science can help support NOAA's mission by: 1) using integrated risk assessment, risk communication and a better understanding of human behavior to help manage, mitigate and communicate risk; 2) using economic statistics and valuation studies to help society value NOAA's products and services and value what is at risk; 3) assessing ecosystem services to enhance societal value of resource stewardship; 4) accessing social indicators as a way to link earth systems to human wellbeing which includes things such as housing, job security, clean water; 5) developing performance metrics that measure long-term successes and societal impacts.

Over the last decade NOAA's use of social science has greatly expanded and many success stories have resulted. However, some challenges remain to fully institutionalize social science, utilize the NOAA's current social science capacity and increase NOAA's capacity for social science to support NOAA's missions.

Discussion

Steve Polasky stated he liked the areas highlighted of importance and asked about the return on investment (ROI) that social science develops and wondered when Dr. Yoskowitz mentioned ROI was he meaning ROI as a communication device to show successes or ROI more as a diagnostic for planning to make wise investments. Dr. Polasky also asked about funding and the best way forward for social science in a challenging budget environment.

Dr. Yoskowitz responded that ROI can definitely be used in both ways to show success and to assist in planning. In terms of the budget, the plan is to leverage what social science now has in NOAA, build on that in the near future, and incrementally add capacity. The agency can have more communication across lines to ensure it does not repeat efforts, but instead builds on its strengths and capabilities.

Dr. Sullivan pointed out that 2011 severe weather events especially in Tuscaloosa, AL and Joplin, MO catalyzed the acceleration of social science in NOAA. It would be hard to overstate the impact on the realization of a need for social science, because the physical sciences performance provided accurate modeling and physics, and yet hundreds of people died. This demonstrated the need for social science to understand people's decision-making process and how to save lives. Clearly there are still physical processes that need improvement, but entire elements of social science were not considered on how people receive and use information in making decisions. The realization that specific social science information could help save lives led to changes in conversations with leadership. In 2013 NOAA leadership talked about priorities and focused on NOAA being a science-based service agency. The agency has world class science, but there was something missing in services. NOAA still needs to better shift the agency priorities to be more integrated and outcome-oriented. It is necessary to define NOAA's role versus partners' role in providing services. NOAA should shift the understanding of itself as a science-based service agency. The current four priorities are more integrated and outcome oriented and are especially focused on community resilience.

Dr. Faulconer asked about the type of analysis that was completed after Joplin to understand what contributed to the high number of deaths.

Dr. Sullivan responded that NOAA does a service assessment after any weather event with loss of life. The results showed people did not understand the scientific language used in the bulletins and sometimes even the broadcasters were unsure what they meant. That demonstrated a need to shift to clear and direct language about what could happen in the severe weather event. It must be clear that people should move, why they should move, and where a safe location is.

Ms. Scarlett commented that the flood panel presentation held at the SAB meeting in Boulder in July showed the importance of direct language when the scientists worked with emergency managers.

Dr. Hicks expressed the importance of institutional support at the highest level, but also need to get social science involved at the ground level where decisions are being made. It would be helpful to have social scientists included with the physical science teams when decisions are being made. He wondered if there are there successful examples of this from fisheries. These types of success stories would help gain momentum for social science in the institutional culture.

Dr. Yoskowitz responded that there is a need to look for those “big win” stories to clearly show that having social science involved from the beginning helps ensure success.

Dr. Wright agreed it is great there has been some institutionalization of social science into the biophysical science, but wondered where there might be more physical/quantitative perspectives infused into social sciences, specifically spatially integrated social science and the emerging trend of digital humanity.

Dr. Yoskowitz acknowledged that social science could use a socio-economic observing system analogous to the integrated ocean observing system. After the Deepwater Horizon oil spill members of Congress wondered what impact the spill would have on subsistence fishing but there were no long term data. A socio-economic observing system would provide such data and could begin to fill in the gaps. Social science could gain from biophysical sciences experiences in gathering big continuous data sets.

Jennifer Logan pointed out the difficulty in applying the return-on-investment concept to a scientist doing basic research.

Dr. Yoskowitz responded the importance of basic science is reflected as part of the value chain even if the value is not measured in dollars, because the research is critical to outputs and outcomes.

Dr. Jackson noted he heard a different emphasis between the social science presentation and Dr. Sullivan’s comments and he would like to see like to see the clear connection between resilience and social science. It seemed clear to him that if NOAA can’t communicate the product, then the service is not done successfully. He wondered what the next step forward is to get NOAA to achieve successful social science. Dr. Yoskowitz responded that he focused on return on investment and the value of NOAA products and services, but there is more going on with social sciences in general. The real value of social science is moving research into operations and then measuring the impact.

Ms. Scarlet thanked Dr. Yoskowitz for the presentation and noted that NOAA delivers a lot of science in partnerships and there is a lot of social science out there about how physical science is taken up by organizations. She wondered how NOAA efforts and partnerships are being developed to take advantage of the social science that is already available.

Dr. Sullivan answered that she and Dr. Spinrad had met with the National Science Foundation (NSF) to leverage the work funded through that agency. She acknowledged that social science is a key issue for the NOAA R&D portfolio and NOAA must decide what research to fund and what to gather elsewhere. The NWS opened a discussion with NSF on decision making in natural hazards and now NOAA has opened a discussion with NSF on the water-food-energy nexus and how to best frame that to the research community.

Dr. Spinrad added that the discussions happening at the program level are bringing dialogue from OSTP. These are mega-issues and NOAA should be able to report back in six months. Dr. Sullivan added that some of the SAB members are on NSF committees and could help with this discussion.

The session concluded with Ms. Scarlett thanking all the members and NOAA representatives for taking part in the discussions. She looks forward to the meeting in April.

Meeting Adjourned

The meeting was adjourned at 1:00pm EST.

Summary of Actions

Action 1: The SAB members agreed to form a subcommittee to consider a number of initializing questions to bring to NOAA for the next phase of discussion of the NOAA R&D portfolio logic.