

**28th Meeting of the NOAA Science Advisory Board
6-7 March 2007
Silver Spring, Maryland**

Presentations for this meeting will be posted on the SAB website at
<http://www.sab.noaa.gov/Meetings/meetings.html>

Meeting Attendees

SAB members in attendance: Dr. David Fluharty, Chair, and Wakefield Professor of Ocean and Fishery Sciences, School of Marine Affairs, University of Washington; Dr. William Ballhaus, President and CEO, The Aerospace Corporation; Mr. David Blaskovich, Program Director, Deep Computing, WW Government/Research Segment, IBM Corporation; Mr. Michael Keebaugh, Vice President, Raytheon Company; Dr. Frank Kudrna, President and CEO, Kudrna & Associates, Ltd.; Dr. James Mahoney, Environmental Consultant; Dr. Len Pietrafesa, Associate Dean for External Affairs, North Carolina State University; Dr. John Snow, Dean, College of Atmospheric and Geographic Sciences, University of Oklahoma; Dr. Gerald Wheeler, Executive Director, National Science Teachers Association

NOAA senior management and Line Office representatives in attendance: Vice Admiral Conrad C. Lautenbacher, Jr., U.S. Navy (Ret.), Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator; Brigadier General John (Jack) J. Kelly, Jr., USAF (ret.), Deputy Undersecretary for Oceans and Atmosphere; Mr. Scott Rayder, Chief of Staff; Ms. Maureen Wylie, Chief Financial Officer; Dr. Richard Spinrad, Assistant Administrator, Office of Oceanic and Atmospheric Research; Mr. Craig McLean, Deputy Assistant Administrator for Programs and Administration, Office of Oceanic and Atmospheric Research; Dr. Alexander MacDonald, Deputy Assistant Administrator for Laboratories and Cooperative Institutes and Director, Earth System Research Laboratory, Office of Oceanic and Atmospheric Research; Ms. Mary Kicza, Assistant Administrator, National Environmental Satellite, Data and Information Service; Dr. William Hogarth, Assistant Administrator, National Marine Fisheries Service; Mr. John Oliver, Deputy Assistant Administrator for Operations, National Marine Fisheries Service; Dr. Steven Murawski, Director of Scientific Programs and Chief Science Advisor, National Marine Fisheries Service; Mr. John Jones, Deputy Assistant Administrator, National Weather Service; Ms. Mary M. Glackin, Assistant Administrator, Office of Program Planning and Integration; Dr. Paul Doremus, Deputy Assistant Administrator, Office of Program Planning and Integration; Dr. William Corso, Deputy Assistant Administrator, National Ocean Service; Rear Admiral Samuel P. DeBow, Jr., Director, Office of Marine and Aviation Operations

Staff for the Science Advisory Board in attendance: Dr. Cynthia J. Decker, Executive Director; Kristen Laursen; Joshua Sladek Nowlis.

Tuesday, March 6, 2007

Opening Statement of the Chair and Self-Introductions by SAB Members - David Fluharty – Chair, NOAA Science Advisory Board

Dr. David Fluharty, Chair of the NOAA Science Advisory Board (SAB), called the meeting to order. The members of the SAB and the NOAA representatives introduced themselves.

Welcoming Remarks - Vice Admiral Conrad C. Lautenbacher, Jr., U.S. Navy (Ret.) – Under Secretary of Commerce for Oceans and Atmosphere & NOAA Administrator

VADM Lautenbacher welcomed the SAB and provided information on major NOAA accomplishments, such as the operational U.S. Tsunami Warning Program, reauthorization of the Magnuson-Stevens Act, fleet modernization, and the activation of a climate and weather supercomputer. He noted NOAA's collaboration with the Department of Homeland Security on placing weather radios in public classrooms, activities supporting the latest Intergovernmental Panel on Climate Change (IPCC) International Climate Science Report, and the launch of the Geostationary Operational Environmental Satellite N (GOES-N, now GOES-13) and NOAA instruments on MetOp-A, a European polar-orbiting satellite for operational meteorology. VADM Lautenbacher discussed the most recent budget and legislative actions, including Joint Resolution 20, which funds the Federal government through the end of the fiscal year, NOAA's funding trends, and other budget highlights including support of the U.S. Ocean Action Plan. With the recent passage of the Joint Resolution and the Fiscal Year 2007 spending plan under development, it will be a challenging year to meet all expectations. NOAA's legislative priorities were mentioned, as were its Hill-related activities on climate. Upcoming international science activities were addressed, such as the International Whaling Commission meeting in May. The International Polar Year is from March 2007 through March 2009; NOAA is participating through a number of significant research activities. 2008 will be the International Year of the Reef, with which NOAA will also be involved.

Regional Collaboration in NOAA - Mary Glackin - Assistant Administrator, Program Planning and Integration

The briefing provided information on NOAA's new efforts on regional collaboration and served to initiate a dialogue with the SAB on the implementation of regional collaboration to enhance NOAA's effectiveness. Further updates will be provided as activities progress. NOAA has been gradually improving regional coordination, and this effort represents a significant initiative to blend national and regional capabilities, improve services and value, better leverage current and emerging regional partnerships, and improve recognition of the NOAA "brand." In addition to internal efforts, external demands necessitating regional collaboration have multiplied. Highlighting the importance of regional collaboration, this year's NOAA Senior Executive Service (SES) Summit IV focused on "Advancing NOAA's Priorities through Regional Collaboration."

Regional Collaboration will also be included in the management practices and portfolio of all NOAA Senior Executives.

Initial focus will be a blend of high priority national issues and existing and emerging regional needs. The national priority areas are: 1) hazard resilient coastal communities; 2) integrated ecosystem assessments; 3) integrated water resource services; and 4) outreach and education. These areas are at the intersection of three requirements: 1) required geographic specificity; 2) stakeholder demand and visibility; and 3) corporate strategic priorities. Other regional priorities also exist and vary by region. Regional teams will address national priority areas as appropriate while meeting NOAA's commitments to on-going regional efforts. Key regional commitments include support to regional ocean governance initiatives (e.g., Gulf of Mexico Alliance).

Regional Collaboration is managed by an Executive Oversight Group composed of Line Office Deputy Assistant Administrators and Goal Team Leads. Efforts are carried out by Priority Area Task Teams and Regional Teams. An evolving designation of the regional areas was discussed, noting that the boundaries are not true divisions but that regions can blend as needed. Next steps for the Priority Area Task Teams and the Executive Oversight Group were discussed. Evaluation processes are in development to track progress.

Discussion:

A member of the SAB noted that stakeholders look for a response to their input through new funding and activities, and asked if there is a strategy to effectively respond in a timely fashion. Ms. Glackin noted some examples such as the increased funds accompanying the National Integrated Drought Information System (NIDIS) legislation. The high level support from the Gulf of Mexico Alliance also strengthens NOAA's plans and communications regarding budget and legislative issues in that region. The key is engaging at an appropriate level, often with state Governors. Another member noted that targeting governors was the right level but cautioned that different groups of them have different levels of organization and that they turn over with election cycles. Getting the right stakeholders was an acknowledged challenge, and Ms. Glackin noted that this effort provided NOAA a strong tool to engage regional input to strategic planning. Governor recognition of and feedback to NOAA varies depending on the states' interests; these various interests need to be addressed around the country within a national NOAA framework.

It was noted that the granularity of regions seemed appropriate and that parallels could be drawn with the regional structures of the Environmental Protection Agency (EPA) and the United States Army Corps of Engineers (USACE). Though different, the methods of these agencies may be useful models for obtaining annual state-level feedback and providing a regional NOAA point of contact for use by governors. It was asked if there is a NOAA representative in each region who will educate governors. Ms. Glackin indicated that attempts to make such connections are in process.

A member mentioned that misalignments between the Line Office regions and the regional collaboration framework could create potential for confusion. Ms. Glackin responded though some regional divisions do not quite align, major regions in the area of fisheries and weather do line up fairly well. NOAA is not realigning to match the regional framework; potential confusion will be alleviated instead by education efforts. A member noted that education was not overly stressed in the presentation and so challenged NOAA to think of education with a regional focus addressing varying needs in each region. This was an opportunity to identify NOAA with users in various communities. In addition, it can advance strategic planning by strengthening bridges between Line Offices while maintaining their individual technical excellence and effective delivery systems within regions to produce long-term benefits. Ms. Glackin appreciated the thoughts on strategic planning, noting that NOAA is moving forward with regional education programs that can enhance overall NOAA efforts in education and environmental literacy. This effort also links well with the regionalization work of the SAB's Extension, Outreach, and Education Working Group (EOEWG).

It was asked how Sea Grant was incorporated into regional collaborations, how other agencies have responded, and how regional and international boundary relations are handled. All of these are being considered. Sea Grant and the Cooperative Institutes are major strategic partners and NOAA is looking to extend connections through Coastal America partnerships. Interagency groups created in the Ocean Action Plan governance structure place great emphasis on regional collaborations, because implementation and translation of science to management must occur regionally and locally. International and Large Marine Ecosystem relationships are also being addressed, including, for example, cooperative regional agreements with Northeastern Governors and Eastern Canadian Premiers.

It was noted that NOAA had not actively engaged external partners to date but had begun that process. The SAB was asked for its thoughts on how to approach such people with existing connections to NOAA. The SAB responded that this makes the role of regional focal point all the more important, and that NOAA should emphasize that this will evolve from the existing network of connections while highlighting further beneficial connections to other parts of the agency. The SAB noted that it may be helpful to ask the stakeholders how they think it may improve their situation. An initial focus should also be placed on groups that can potentially bring more resources to the table, such as governors and corporations. The SAB members were asked whether they thought that full-time regional coordinators should be appointed. This may be helpful, but letting the situation evolve is also important. NOAA should seek feedback on how to do its job better, acknowledging that ecosystem concerns go beyond NOAA activities but that those activities form a backbone to support ecosystem work. The SAB was asked to provide NOAA with their feedback as well as feedback it receives from others so that NOAA can address issues as they arise and capitalize on opportunities.

Reaching out inside NOAA within regions is also important so that individuals in the field can use NOAA's full portfolio of activities in addition to their own. Regional activities should include both other NOAA and external partners. This can extend

NOAA products and services into new areas that answer critical needs for a broader range of people. It was noted that the NOAA Environmental Satellite and Data and Information Service (NESDIS), for example, is not regionally active but is moving to gain such connections through such activities as CoastWatch.

Implications of Ocean Acidification for Marine Life - *Richard Feely – Supervisory Oceanographer, NOAA Pacific Marine Environmental Laboratory*

The purpose of the presentation was to provide information on ocean acidification to the SAB and to request guidance on NOAA's plans for ocean acidification research. Background on carbon dioxide (CO₂) chemistry in the oceans was provided, noting that human activities beginning in the industrial age have been shifting the pH and ocean CO₂ chemistry to a state that has not occurred for hundreds of thousands of years. This may have serious impacts on open-ocean and coastal marine ecosystems. Calcium carbonate (CaCO₃) is the major component of shells, tests, and hard corals; as such, formation of this molecule is essential to food webs. Increases in atmospheric CO₂ can change ocean chemistry because the oceans act as a sink for this greenhouse gas. Increased CO₂ increases ocean acidity (i.e. lowers ocean pH) and the carbonate ion concentration. Increased acidity makes the chemical reaction forming CaCO₃ more difficult, decreasing the ability of organisms to form CaCO₃ shells. Below a certain carbonate ion concentration, these shells would actually begin to dissolve, effectively stopping their growth.

Limited information exists on the overall biological impacts of such potential changes in ocean carbonate chemistry. Most current studies are short term, involve extreme pH changes, and are on single species or strains. Little is known about synergistic effects, responses by genetically diverse populations, acclimation and adaptations, species replacement, community to ecosystem responses, or impacts on overall global climate. There are both adverse and stimulating effects of ocean acidification on different organisms, which can in turn affect ecosystems differently. Some experiments indicate that CO₂ levels possible by the end of this century may cause animals to no longer be able to produce their shells. Other experiments in the open ocean indicate that this tipping point may occur sooner; the open ocean includes additional stresses than are present in controlled environments. Regardless of timing, increased ocean acidity due to increased CO₂ will likely increase the mortality of fish and king crab larvae. Modeling work is underway to predict how, when, and where acidification may affect the entire water column. Models are also being used to evaluate potential effects on coral reef calcification.

NOAA is conducting such research in several areas across the agency as well as with other federal agencies, universities, and foundations. NOAA has developed a five-year interdisciplinary program focused on ocean acidification research in order to provide leadership in coordinating research and engaging stakeholders and decision makers in this issue. The plan includes 1) establishing coral reef metabolic monitoring stations at major U.S. coral reefs designed to track changes in the system-level metabolic performance; 2) conducting physiological research; 3) socio-economic modeling; 4)

technology development and standardization; and 5) ocean acidification environmental modeling. These five elements will include new directions and approaches for research as well as opportunities for international collaboration. Several key scientific questions were discussed, as were the legislative and strategic requirements that these efforts support. The former includes the 2006 reauthorization of the Magnuson-Stevens Act that calls for a National Research Council (NRC) review of how ocean acidification may affect fisheries. The SAB was asked if NOAA's ocean acidification research plan seemed appropriate to address NOAA's requirements for science and policy information and if NOAA should be the lead federal agency for ocean acidification research in the United States.

Discussion:

A member asked if coral reefs are essentially the "canary in the coal mine" for ocean acidification. Dr. Feely responded that they are, because they are the organisms most sensitive to changes in the ocean. Another member asked what other agencies could lead the work on ocean acidification. Dr. Feely noted that all agency efforts could be combined into a national plan so that federal agencies could each contribute their own piece to a greater whole. NOAA, however, has ecosystem responsibility in the oceans and the clearest mandate and so could take the lead.

A member inquired as to the status of the NRC study. This was commissioned last December; the terms of reference need to be developed by NOAA. It was further noted that Magnuson-Stevens requires NOAA to fund the study, but that this is not yet specifically in the FY07 or FY08 budgets.

A NOAA representative asked why CaCO₃ saturation depths varied across oceans. Dr. Feely replied that this is part of the natural carbon and ocean circulation cycles: the oldest and most CO₂-laden waters are found in the Pacific and Indian Oceans. Changes in these patterns are being examined in conjunction with biological surveys. Deep corals will be considered for monitoring in addition to shallow corals; NOAA is developing criteria for selecting the best sites for this. The agency plans to develop a methodology for shallow ecosystems and then move into deeper waters. PMEL is working with the NESDIS group developing a warning system for coral stress due to ocean heating because a similar approach may be useful here.

Given the great consequences of ocean acidification, it is necessary to define the observation system needed to understand these long-term processes. A member of the SAB asked if there are other key chemical reactions and if any of these are restorative. The member also asked how the extrapolations over time presented in the briefing were done. The extrapolations were determined using global circulation models containing biogeochemical components. A primary restorative reaction is the release of calcium from ocean sediments, however it takes tens of thousands of years for this to be released and circulate back to the surface sufficient calcium to restore the normal chemical processes.

Regarding NOAA's investment in this topic, a member stated that the key to determining research investments should be how to best provide information to policy makers, which is different than simply supporting research. Potentially through the NRC study, the activities required to provide a compelling case that supports appropriate policy decisions need to be determined. Because this is a large topic, the terms of reference for the NRC study must be carefully drafted, focusing on a set of policy-related questions, implications for the country and for NOAA, and on NOAA's stewardship role for marine sanctuaries. An upcoming set of policy questions may be scenario analyses of the lag time between actions and ecological effects, including how fast the effects clear out.

A member asked what factors regulate carbon saturation levels in the ocean's mixed layer, and whether different states exist in different oceans. Dr. Feely stated that these factors include carbonate concentration, temperature, pressure, and salinity. Current models do not accommodate changes in salinity, but these effects are not as strong as others. Because this involves whole-system modeling, Dr. Feely was asked to comment on the current computational ability to store the masses of ocean data and run useful tests. Dr. Feely noted that there have been great improvements in modeling and that scientists are developing ways to look at the ratio between calcifying and non-calcifying organisms, which drives the carbon feedback to the atmosphere.

It was noted that the ocean acidification issue is less mature than the understanding of atmospheric global warming. This shows the wisdom of NOAA's research reorganization based on the report of the Research Review Team. It allows examination of changes in the ocean in combination with effects on carbon levels and ocean life. This is similar to research on climate effects on vegetation and permafrost at high latitudes in the Northern Hemisphere. NOAA's Earth System Research Laboratory is beginning to address such earth system observations and identify ways to work on complex holistic models.

A member noted that ocean acidification connects personally to people through their food, which can help raise awareness and increase NOAA research funding in the area. The member asked if NOAA effectively communicates this and other such examples of good research or if it needs to improve its outreach methods. Outreach issues were addressed later in the meeting.

A member proposed four things that the SAB could recommend: 1) agreeing that NOAA is only agency with the capacity to develop and deploy the proper observing systems; 2) agreeing that NOAA should involve other interested agencies soon and potentially share the costs of the program; 3) noting that there is an international component to include; and 4) agreeing that the NRC study needs to move forward expeditiously but that the terms of reference need to be developed carefully to focus the group on the greatest needs.

Action:

- Further consider ocean acidification research and, if necessary, provide recommendations to NOAA on its related research programs. Recommendations could include:
 - a) NOAA as the primary agency for ocean observations;
 - b) NOAA coordinate its research with other agencies;
 - c) NOAA coordinate its research with the international research community;
 - d) NOAA move ahead quickly with a National Research Council study of this issue, but scope it out carefully to ensure policy relevance;
 - e) Include in research program studies on feedback loops, both positive and negative.

Report on the Review of the Cooperative Institute for Oceanographic Satellite Studies - *Otis Brown – Chair, CIOSS Review Team and Dean, Rosenstiel School of Marine & Atmospheric Science, University of Miami*

The purpose of the briefing was to summarize the results of the SAB review of the Cooperative Institute for Oceanographic Satellite Studies (CIOSS) at Oregon State University (OSU). The review gave CIOSS an “Outstanding” evaluation. Review findings were discussed; noting that CIOSS’ vision includes a good mix of research and outreach and that the Cooperative Institute (CI) has made good progress towards achieving its long term goals. CIOSS was found to provide NOAA and NESDIS a flexible way to respond to challenges associated with emerging programmatic needs, and to conduct quality and timely research supporting NESDIS’ mission. CIOSS has strong connections to NOAA and collaborates with others, including other CIs. CIOSS’ work with an Oregon State University K-12 outreach program was noted as an impressive potential model for others. The reviewers also felt that the CI timelines for mandated review and competition dates was detrimental to CIOSS and NESDIS, and proposed extension of the timeline in the future.

The review recommended CIOSS should continue working closely with NESDIS and increase its collaboration with other NOAA CIs and laboratories, and that it should continue its educational outreach activities. It also recommended that the analysis of the Coastal Ocean Applications and Science Team (COAST) ocean color dataset continue as new sensors for monitoring marine ecosystems become available. The SAB was asked to approve the external review and consider the recommendation to extend CIOSS’ term.

Discussion:

A member of the SAB inquired after CIOSS’ efforts in graduate education, diversity, and future workforce issues. Some information was in the written report, but there is much more that the CI could do. Unique opportunities exist to involve Native American communities and CIOSS is working on that area. It was asked how much NOAA funding went towards the K-12 educational outreach. The CIOSS Director Ted Strub noted that the CI provides approximately \$40,000 a year, which supports after-school activities, workshops for teachers, and a high school challenge event. Dr. Brown added that funds from the Dept. of Public Health and NASA also support the education program. He

further noted diversity recruitment efforts for higher education using leveraged NOAA funds, and that CIOSS is active in fostering collaborating between the education and geosciences fields. Another member observed that the K-12 educational effort was an excellent addition that is not always included, because it is not typically in the scope of the NOAA requests to CIs. This is relevant to the SAB Extension, Outreach and Education Working Group efforts, and may be useful to include as an eligible work task element for the CIs in the future. CIOSS made use of an existing OSU program that would have taken years to develop independently, but this concept is becoming more common at universities.

Regarding timing of reviews, a clarification was requested as to whether the three-year horizon was an issue for other CIs. This became a concern for CIOSS due to some start-up issues. Although the CI award was made four years ago and the review comes at the four-year mark, CIOSS has effectively only been operating for three years. In addition, CIOSS has been working with NOAA on other self-corrections built into the CI process, but it was too early for the current review to see the results of those. As the overall Cooperative Institute program shifts to a competitive model, other CIs may encounter the same problem.

The SAB unanimously agreed to accept the CIOSS Review Final Report with no additional discussion. There was a motion to consider extension of the review process as part of discussion on the new competitive CI process. This was unanimously approved, and will be a future SAB agenda item. Regarding the review process, a member of the SAB recommended that Dr. Brown provide any suggestions to John Cortinas, the Cooperative Institutes Program Manager.

Action:

- Transmit Final Review Report for the Cooperative Institute for Ocean Satellite Studies (CIOSS) to NOAA.
- As part of new Joint Institute/Cooperative Institute review policy, consider recommendations on the timing of SAB reviews (award date vs. funding date).

Updates on SAB Working Groups

Extension, Outreach and Education Working Group (EOEWG) - Frank Kudrna - Kudrna & Associates, Inc. and Chair, EOEWG; Gerry Wheeler - Executive Director, National Science Teachers Association and Vice-Chair, EOEWG

The presentation updated the SAB on the working group charge and membership, summarized the first meeting and data collected thus far, and discussed future plans. The EOEWG was charged to “explore opportunities to enhance the impact of NOAA’s education, outreach and extension (EOE) activities with its constituents” through various means. Mr. Kudrna noted that the preceding discussion of opportunities in regional collaboration links well with the EOEWG’s outreach focus. The group met for the first time in January and has subsequent meetings planned for May, July, and October. The group plans to produce a draft report for presentation to the SAB by November 2007 and

a final report by March 2008. Mr. Kudrna further noted that the members of the working group represent broad experience in extension, outreach, and education areas.

Discussion:

An issue raised was whether the EOEWG would be able to conduct a survey examining the public perception and recognition of NOAA. NOAA branding issues were also discussed, including views on the NOAA logo.

It was asked if there had been discussion on climate applications for EOE. Though the group is not far into their study, climate can have significant influence on coastal issues and should be linked. Discussions with the U.S. Department of Agriculture (USDA) addressed this; it often partners with Sea Grant on agricultural land and water issues. This is a good opportunity to link efforts across the country to coastal areas. An SAB member noted that the climate program sponsored a workshop on applied climate issues, expecting 300 abstracts. It received approximately 700 abstracts so clearly there is a great deal of interest in the subject. On critical topics such as climate more outreach is needed; many interesting cross-cuts exist between this and various fields, including regional planning and coastal management.

Data Archiving and Access Requirements Working Group (DAARWG) - Ferris Webster – Executive Director, World Data Center, University of Delaware and Chair, DAARWG

The DAARWG is charged to help the SAB “provide scientific advice and broad direction to NOAA regarding the wide range of data, information, and products that NOAA should archive and how NOAA can best provide access to this information.” This includes all of NOAA’s observing systems and computational models as well as non-NOAA information. Working group members were identified; their expertise addresses all NOAA components. The DAARWG is coordinating with a similar National Research Council study due to produce its final report later this year. The DAARWG held its first meeting in December of 2006; it was primarily informational but decided on three key issues for further evaluation. These are: 1) the Global Earth Observation Integrated Data Environment (GEO-IDE) and getting NOAA’s legacy systems to interact; 2) the Comprehensive Large-Array Stewardship System (CLASS) and the clarity of its aims; and 3) integration of data systems from various sources to solve environmental problems. The group will meet again in May and hopes to present a draft report to the SAB in August 2007.

Discussion:

A member of the SAB asked if, for example, fisheries and satellite data are too different for integration into a single system. The DAARWG notes that since one cannot anticipate how people will have to access and combine data to address issues, there should be no separation between the disparate data types. If a case exists demonstrating that users need various data systems integrated, then the systems should be integrated. For example, the CoastWatch node for Pacific Grove, California needs to integrate fish

catch and larval fish maps with temperature, current, salinity, and bathymetry maps. Common elements of all of these systems are space and time, which allow the other elements to be produced and displayed in a geographical system.

Climate Working Group (CWG) – Dr. Len Pietrafesa - Associate Dean for External Affairs, North Carolina State University and SAB Member

The CWG will meet at NOAA's National Climatic Data Center (NCDC) in Asheville, North Carolina on April 11-13 to conduct a program review of the Climate Observations and Analysis Program within the Climate Goal. The review will be divided into several topics: 1) data ingest, access, and archive; 2) *in-situ* observing systems and data management including stewardship; 3) analysis including reanalysis, observing system simulation experiments (OSSEs), observing system experiments (OSEs), and related research; 4) climate services and product development; 5) user communities; 6) understanding the state of the climate (including data assimilation) and monitoring; 7) detection and attribution; and 8) space-based observing systems and related data stewardship. Other discussions will also take place during the review.

Discussion:

The CWG is a very active working group and its recommendations to the SAB are integrated into the Climate Goal's planning process. The Climate Goal is examining whether NOAA is addressing climate resources adequately. One focus is climate applications and services, which has limited assets. The upcoming meeting will look at all of the resources in Climate Observations and Analysis. Climate is placing significant emphasis this year on how to better meet national challenges and move beyond its strong research focus to combining research with outreach and products for decision-makers.

An SAB member noted that the NCDC stakeholders' annual meeting is very well attended each year, showing the needs of other agencies and private industry for NOAA's data and information. Many of the panel discussions focus on issues that NCDC addresses routinely. With climate's current high profile, this is a Sputnik-like opportunity for NOAA to provide information and services, bringing recognition with the general public.

Fire Weather Research Review Working Group (FWRWG) - John Snow - Dean, College of Atmospheric and Geographic Sciences, University of Oklahoma and SAB Member; David Fluharty, Wakefield Professor of Ocean and Fishery Sciences, School of Marine Affairs, University of Washington and Chair, NOAA Science Advisory Board

The FWRWG Terms of Reference (ToR) have been developed based on a Fire Weather Research presentation at the December 2006 SAB meeting. The ToR and associated list of candidates for the group balances the NOAA and SAB interests in the field, including basic and applied research as well as the user community. A formal SAB decision on whether to establish the FWRWG and approval of this ToR was requested. It was noted

that some of the categories within the candidate list remained open; recommendations were welcomed. Dr. Snow desires to finalize the ToR this month and hold a first meeting in the summer.

Discussion:

One member noted that this topic is especially important in the West and Alaska and fits into the President's forest fire initiatives. Though some of the incident response for fire weather research connects to homeland security and other areas, maintaining a tighter focus on fire was seen as providing the most benefit. However, findings in this report could be a model for such related topics.

Dr. Snow moved to establish the working group as per the Terms of Reference; it was so moved, seconded, and approved by unanimous voice vote. Dr. Snow will serve as Chair of the working group.

Action:

- Establish a Fire Weather Research Working Group.

Other Working Groups - David Fluharty - Wakefield Professor of Ocean and Fishery Sciences, School of Marine Affairs, University of Washington and Chair, NOAA Science Advisory Board

Dr. Fluharty discussed progress in other working groups. The Partnerships Working Group (PWG), to be chaired by Michael Keebaugh, has developed a draft Terms of Reference and has set a tentative date in May to meet pending the group's formation. The Social Science Working Group (SSWG), to be chaired by Susan Hanna, is also being established but does not yet have a tentative first meeting scheduled. The person in process of filling Dr. Hanna's seat on the SAB will likely be involved with the SSWG.

Approach for Responding to the Hurricane Intensity Research Working Group (HIRWG) Reports - *Greg Mandt – NOAA Research Council and National Weather Service*

Greg Mandt presented a briefing on behalf of the NOAA Research Council to inform the SAB about NOAA's approach for responding to the Majority and Minority Reports of the SAB Hurricane Intensity Research Working Group (HIRWG). The Research Council will provide the final written and verbal response at the Fall 2007 SAB meeting. The NOAA response will build on existing documents to encompass the scope of the HIRWG recommendations and identify where the agency can act best implement them in the short and long term. One such existing document is the Weather and Water Goal's Hurricane Inundation Plan, which encompasses roughly 70-80% of the HIRWG recommendations. The presentation noted that the HIRWG goal to "... reduce error in 48-hour intensity forecasts for hurricane-strength storms by at least 10 kt (approximately one half of a Saffir-Simpson category) within five years, with an emphasis on improved forecasting of rapid intensification and decay, and decay and reintensification cycles" was very

ambitious, and that even a more modest goal to improve intensity forecasting would require more resources than currently available. It was noted that the rate of improvement required may be beyond NOAA's capacity. Funding prioritization is required to determine how best to invest for the greatest impact. Another consideration is how to couple the NOAA response to the HIRWG reports with a response to a related National Science Board (NSB) report ("Hurricane Warning: The Critical Need for a National Hurricane Research Initiative" NSB 2006) and work with the National Science Foundation (NSF) on a national approach to hurricane research. The agencies are well poised to start moving forward more aggressively with coupled resources into the field of hurricane intensity.

NOAA has grouped the 37 HIRWG recommendations into four major areas and correlated these recommendations with existing plans. The four areas are: 1) advanced numerical weather prediction systems and data assimilation; 2) improved observations of the hurricane and its environment; 3) organizational changes to achieve a critical mass; and 4) accelerated research and development and transition to operations. NOAA has planned and programmed activities in three of the broad areas, but the scale of investment differs from that needed to address the HIRWG recommendations; further consideration is required in 3) on organizational changes. The status of current activities and significant funding gaps in the three other categories were discussed. An issue is that operational models have ten year lifetimes, whereas the HIRWG goal is for improvement in five years. As such, improvements will occur by using Hurricane Weather Research and Forecasting (HWRF); the support capacity for research must be augmented for HWRF at the Developmental Test Center (DTC) so that external researchers can use and improve the operational model faster. The DTC and the Joint Hurricane Test Bed are both important features of transitioning research into NOAA operations. There are many ideas for research and for improving operations; to determine where NOAA investments should be made the agency needs to examine which ideas have the greatest benefit/cost ratio. Longer term items for consideration include investments in modeling and observations, tradeoffs and cost-benefit analyses, research on the best approach to operational numerical model research, and how to address the HIRWG recommendations that fall outside of current NOAA plans. Related funding priorities for FY 2009 were listed; considerations include how to move forward aggressively in the near term and how much national investment is likely.

Recommendations from the NSB report were discussed, noting that NOAA and NSF should cooperate on a national investment strategy. There is some overlap between the HIRWG and NSB reports, but the NSB report requires a broader assessment of NOAA roles and activities. Recommendations from the SAB were welcomed.

Discussion:

A member asked whether there are fundamental problems with the existing models or if they could run accurately given perfect initial conditions. Both initial conditions and the models themselves are concerns because of the many unknown factors in intensity forecasting. Work on the HWRF model could help. It was noted that there are models

with very fine resolution but researchers need experience with the models to ensure that they run correctly before being able to make predictions.

A member noted that the HIRWG was aware of the NSB hurricane research task force and that, therefore, the HIRWG focused on the specific NOAA investments in hurricane research. The group presumed that the NSB would make very broad recommendations and expects NOAA to utilize the NSB report to justify additional funding. NOAA investments alone present more of a challenge, requiring examination of key investments. For example, making NOAA datasets more broadly available to researchers could engender extensive external research, which could be funded by NSF grants. There are such places where NOAA could make relatively small investments and leverage much larger investments through external research. Out-of-the-box thinking is also required, such as running probabilistic and other models on non-NOAA computers. Such ideas are in the works, especially in climate areas, but progress is slow. It was noted that gathering hurricane data from international satellites might also be useful, and alternatives for collecting *in situ* observations, such as airplanes, balloons, and unmanned aerial vehicles, would be useful in the next few years.

A member encouraged caution on selecting investment priorities, highlighting a need to advance the underlying science. Preparing a specific “straw man” investment strategy on what appears to be the most productive track while keeping an open mind to adjustments as needed was encouraged. This will promote a more flexible approach to the problem resulting in all the pieces needed to develop the boundary and initial conditions and other parameters for a model. A summary of how all of the research pieces fit together would allow people to understand better the overall prioritization of funds. Without such a broad view of the priorities and multiple resources needed, ensuring that the data gathered matches the data needed is difficult and investment in the wrong areas could result.

Documentation of the return on investment for this national priority research is also needed to improve funding in a flat budget environment; the benefits of research investment such as lives saved and reduced disruption of commerce should be highlighted. Return on investments also includes identification of societal and related monetary benefits, such as ensuring that emergency responders and other citizens are not caught off-guard. If research investments lead to operational systems that allow improved and better targeted evacuation decisions, much money and effort can be saved. This problem is illustrated by hurricane false alarms as well as history of money not producing needed research results. However, it seems that hurricane intensity may be at the stage where it can move forward quickly through significant investments in key areas, as long as these areas are correctly specified and are ensured to be useful. Having a scientific strategy to answer key questions such as how the hurricane interacts and modifies steering currents is necessary. This approach to the response is designed to address such questions.

A member of the SAB noted that this is an excellent test case for formulating a coherent plan within NOAA, because many parts of the organization contribute and must agree on

a path forward and the lead. Investments are currently fragmented, making it difficult to fight for large-scale resources. All of these pieces must be assembled into an overarching investment strategy for hurricane forecasting so that NOAA can stand with a single message and clearly state the benefits of the plan. This plan can be evaluated and altered as needed. It must also remain open to all options suggested by the HIRWG reports even though it might state a preferred track.

A member of the SAB summarized the key issues discussed: 1) Emphasis on the need to show the impacts of further research funding, particularly to those in Congress currently working on the budget. This impact statement needs to focus on key areas bringing greatest payoff rather than spread across many areas; 2) determination of whether NOAA Oceanic and Atmospheric Research (OAR) or the NOAA National Weather Service (NWS) has the lead and how research efforts will be organized; 3) determination of how best to invest FY 2008 funds. SAB advice is welcome in this area, which is also a good topic for Research Council consideration in coordination with BGEN Kelly and NWS; 4) funding and use of the Joint Hurricane Testbed. The SAB agreed to continue this discussion during the joint meeting with the NOAA Research Council.

A member noted that similar questions may be raised with the SAB Fire Weather Research Working Group. Many phenomena such as hurricane intensity and fire weather require very high resolution observations, which will require filling observational gaps as well as developing high-resolution computational models.

Public Comment Period

No public comments were received.

Wednesday, March 7, 2007

Official Call to Order and Review of Meeting Format - *Cynthia Decker - Executive Director, NOAA Science Advisory Board*

The SAB meeting was officially called to order for the day; Dr. Decker reviewed the meeting's format and procedures.

Monitoring Performance of Research in NOAA - *Al Powell – National Environmental Satellite, Data and Information Service*

This presentation on behalf of the NOAA Research Council described an approach to monitoring research in NOAA in order to improve achievements, outcomes, cost, and performance. Dr. Powell asked the SAB for comments on the proposed approach as well as invited the SAB to participate in evaluating NOAA's research by benchmarking it against other federal agencies and international research organizations. This effort to better monitor research would help NOAA to validate its research with the Department of Commerce, the Office of Management and Budget (OMB) and Congress. Research in

NOAA has previously been monitored by Line Offices and Goal Teams on an *ad-hoc*, independent basis. As these reviews are not consistent across the agency, the current effort strives for more consistency and to develop a tracking system illustrating the research funds, products, and benefits derived from the organization. It was noted that in general, guidance on outcomes flows down from the top of the organization, while metrics roll up from the specific to corporate levels. Outcomes and metrics should feed back on each other to allow assessment for correct priorities, to ensure the outcomes are as intended, and to guarantee that research activities link to the highest priority outcomes.

Cornerstones to monitoring research in NOAA were listed; these include to: 1) consistently link milestones to outcomes as well as link milestones and outcomes to NOAA's plans; 2) systematically evaluate the progress, quality, relevance, and value of research in NOAA; 3) provide financial reporting of research activities across NOAA; and 4) emphasize societal benefits when reporting accomplishments in science. Forming a database of milestones and outcomes and linking them to plans is necessary because NOAA often gets questions regarding its research activities in specific topics or locations. Individual progress must combine into collective outcomes that are of benefit to society in particular areas. Details of external evaluation processes were discussed; recommendations included peer reviews, relevance reviews, and benchmark reviews identifying best practices. The SAB, if amenable, would be involved in the benchmarking review. Such a review would occur every four years, timed to provide information during potential institutional and leadership changes. Financial reporting of research will require a combination of the current financial and planning databases, including the ability to query the combined database. The Research Council is forming a permanent committee on monitoring research to develop methods to implement this proposal. The SAB was asked if it was willing to evaluate NOAA's research enterprise in a benchmark comparison with other research-oriented agencies and with research done by international bodies, as well as to assess NOAA's internal evaluation of research.

Discussion:

A member noted that the research milestones and outcomes database fits well with regional collaboration efforts, as information on local impacts is necessary when speaking with regional leaders and federal legislators.

A member of the SAB asked how the evaluation process would address the "disruptive" part of the research portfolio, which consists of new and potentially valuable research areas and priorities. Such transformational elements can be included by careful selection of review criteria and looking to external changes as guides. NOAA's research cannot yet be characterized into high risk or sustaining categories; the agency is striving to get the information to ask such questions. It was asked how much research was "projectized," i.e. if research combined from multiple pathways and pieces towards a set goal delivering an integrated capability. NOAA is learning to do this through PPBES and its Goal structure, which collectively integrate various pieces into a whole. A framework stressing outcomes is good; the clearer such outcomes are in planning the better they can drive projects in research and operations and link the two. An example would be the

outcomes of protecting people and avoiding storm damage via hurricane research. Such “projectized” directions allow Goals to suggest broad outcomes with the flexibility to encompass new work.

A best practice noted in industrial research organizations is the early termination of non-productive work. NOAA needs to be more effective at this, using such data to illustrate for the Hill when projects should end. This is necessary for course corrections and should provide good guidance to strategically redirect paths over time. A member noted that some corporations end 20% of projects per year to allow for fresh ideas. It was asked if new research proposals include estimates of anticipated societal benefits and potential return on investment. These outcomes are articulated in the program plans. As an example, the interagency climate change program has an annual program review focused on research applications; it strives to identify 6% of its budget for new research projects. To take up such new things, something else must be end; this reduces underperforming projects and allows space for new ideas. Similarly, NOAA should be starting more than it can finish and needs to work towards support for this strategy on the Hill. Varying review standards were noted for certain research sections in NOAA; these would be included in the broader NOAA review system.

As with ocean acidification, it was asked if NOAA was properly communicating the value of its research to others and whether there was a plan to distribute such information. To do this, individual research teams must alert others in NOAA to their successes and how they fit into the overall goals of the organization; the independent pieces must be able to be linked up to demonstrate as a whole how they address a broader priority.

Discussions were raised about the request for the SAB to conduct the benchmark review. The SAB could reasonably expect significant information to be provided regarding NOAA, but it was not clear how to compare these data to other agencies. On suggestion was that the benchmarking could be against research performance in specific areas that are similar to those supported by other agencies, examining how the different research programs compare and providing feedback on how NOAA could improve. The international programs are a good candidate for this. This benchmarking would likely require coordination with SABs at other agencies. This activity could be accomplished by inviting suitable experts to participate in a peer group rather than having the SAB itself conduct the entire review. Before this can happen, however, a process to obtain both external and internal information must exist. This could lead to an overly extensive process, however, creating too much effort for SAB members involved. The SAB and the Research Council would have to work together during the internal NOAA review to ensure that the SAB has adequate information for its review. How to best set up this internal tracking is important, because NOAA and the SAB both need to clearly understand activities within the agency prior to comparing them with those of other agencies. Because the aim is to time the review to coincide with potential changes in leadership (i.e. Administration), this first benchmark review would have to commence within the next year. To make the process more efficient, it was suggested that the SAB develop a matrix of relevant organizations and note with which of these organizations the SAB members are involved. This would identify where gaps in the review exist to be

filled by others. The scope of the topic needs further identification; the review could examine research selection and investment and whether it allows flexibility for regional focus, or the review could simply evaluate scientific research. Dr. Powell responded that the SAB would not have to assess research at the individual project level, but rather examine whether NOAA's overall portfolio places the right emphasis on different priorities and if the agency is heading in the right direction as compared to other agencies and with national priorities. It was noted that the SAB may not be able to address everything and would have to focus on large items or transformational research topics in order for this first review to be completed in the appropriate timeframe and have a significant impact.

A member of the SAB noted some discomfort at seeing peer review as a main focus of the research-monitoring effort. Though peer review is important, it should be adjunct to the main effort pushing for NOAA's research direction, outcomes, goals, and priorities as a mission agency. More focus on a measurable list of goals and how to attain them was encouraged; this would be more critical than the assurance of peer review or a comparison with other agencies, as it would address whether NOAA is being a wise steward of its funding allocation. In response, Dr. Powell noted that setting priorities is critical, but that this occurs more on the front end of the process through NOAA Planning, Programming, Budgeting and Execution System (PPBES). The emphasis here is on providing feedback into such critical prioritization activities. It may be important to discuss the relationship between the Research Council Relevance Review and the SAB Benchmark Evaluations. The SAB review may have a relevance component as well, providing a beneficial external look at priorities and relevance. Connecting monitoring research with reaching outcomes is a part of a larger process. The full process should monitor research and its relevance, transition processes between research and operations, operational research, sustaining research, and the socioeconomic impacts of research.

It was asked whether the three existing financial and planning databases capture all of NOAA's research. Dr. Powell estimated that they capture 85-90%, but do not discern specific topics. The goal is to be able to query a database rather than continually request information from NOAA staff. Because consolidated financial information will play a significant role in evaluations, it was asked if the end-to-end system would be available to extract the required data in time for a review next year. Planning for this combined system is in process, including decisions about which questions should be able to be answered by the database. Improvements will be iterative, but the draft system should be available in a year or two for data extraction. This time lag may be a challenge if the first Benchmark Review is to occur next year. The SAB needs more conversation with the Research Council to consider how best to move ahead on a useful review. The initial review need not be perfect, and the SAB may instead be able to examine a subset of the research rather than the full research portfolio.

Science Advisory Board and NOAA Research Council Joint Meeting

Opening Remarks

Dr. Fluharty and Dr. Spinrad provided introductory comments as respective chairs of the SAB and NOAA Research Council (RC). Dr. Fluharty noted that both groups provide advice on research in NOAA; the purpose of this discussion was for the two to exchange perspectives. Dr. Spinrad noted that this joint meeting was a unique opportunity, as recent interactions have been *ad hoc* presentations and responses to SAB recommendations. The discussions at the meetings are excellent but the intercessions lend a discontinuous nature to the exchanges; this should be addressed. The SAB advises NOAA as a whole; in parallel the RC represents internal research capabilities across NOAA. The SAB and RC could discuss how best to work together in providing NOAA advice on steering its research. Four key areas are at issue: 1) policy, including legislative mandates and other drivers such as the Ocean Research Priorities Plan (ORPP); 2) changing perspectives, including climate change, natural hazards, and the economic value of environmental stewardship; 3) practices, including regional collaborations and other interactive mechanisms that may lead to new relationships; and 4) new strategic programs, including the Integrated Ocean Observing System (IOOS) and tsunami activities.

The Chairs listed several categories for discussion at this meeting, including NOAA research issues and goals, the implementation of regional collaborations, the relationship between NOAA and the ORPP, future interactions between the SAB and RC, and additional discussion of the HIRWG response. Areas for consideration across these broader topics are how NOAA can best prepare for and provide the best information to new federal leadership following the 2008 elections. Demonstrating that NOAA consistently conducts research in the public interest would highlight the importance of strong science in NOAA.

Transformational Research

The willingness to invest in transformational research was discussed because there is an apparent mandate from the government to invest in such high risk/high reward research. Though mentioned in the NOAA 5-Year Research Plan, it is a significant step from the statement of support to proposing, justifying, and funding such projects. The question is how best to make this leap and ensure institutional and federal support. NOAA is a mission-oriented and operational agency, so budget tolerance for risk tends to be low. Therefore, NOAA leadership must be committed to defending the benefits of transformational research. In addition, high risk research requires the existence of people willing to take the risks and present these ideas in an inspiring, saleable way to those who control resources. Successful transformational research requires discretionary funding and the infrastructure to conduct it, as well as a management structure that can set goals that may not be immediately achievable and encourage scientists to develop risky ideas. The overarching HIRWG recommendation may be such a goal; it can spur people forward to great advancements worth the investment even if the high goal is not met. A member noted that the Defense Science Board is developing criteria for transformational research, including the need for senior leadership support and a small, committed research and development team. The risk of transformational research should be evaluated against the outcome of a 100% successful project. The investment should be

perhaps a 5% budget wedge for which people could compete. The value of this research should include the concept of “no surprises.” For example, the Navy funded studies on phytoplankton iron limitation in the 1980s to address concerns that submarines may be traceable by blooms. Similarly, NOAA could look to ensure no surprises in climate areas. Addressing grand challenges is another reason to forward transformational research. An original intent of the Research Council was to advocate for grand challenges and new ideas at a high level. There is, however, a difference between grand challenges, which must be planned, developed into projects, and publicized, and transformational research, which by nature cannot make commitments and works best with a low profile until successful, allowing for failure.

Scientists within NOAA are prepared to conduct transformational research; universities are also good idea sources, as potentially is the Small Business Innovation Research (SBIR) program.

In a mission-oriented agency, transformational research can be carried out at a low level without countering the mission focus. For example, much of the ocean acidification research began as side projects and is now proving to be increasingly significant. Companies with such “phantom” activities have found that tight controls and performance measures on progress may smother the intent of the research. Such projects must be evaluated differently and run with looser oversight. These projects can be very effective at producing innovation towards clearly defined goals with appropriate structure and effective people, or can fail due to a lack of sufficient process. More functional oversight is needed to integrate transformational research with more functional projects. A balance between freedom and process is required, including identification of a narrow mission-critical focus for the scope of the activities while allowing creative failure. This would attract people who are drawn to risky projects and may bring additional creative ideas into the program and strive to deliver on them. Because some research must fail to remain on the cutting edge, it is best to sponsor multiple approaches by multiple groups. An open innovation forum was proposed where people could present their ideas and the most interesting ones would receive further discussion.

The definition of success in transformational research was discussed. It could be making progress on or achieving some of the ambitious goals set. Success could be temporal, for example achieving a result in one year instead of five. Enhanced ability to recruit high quality researchers is also a measure. However, an issue is NOAA’s accountability to many performance measures and the need to develop a tolerance for failure and resource support for transformational projects. The theme of “no surprises” was restated; it could garner support by highlighting the need to ensure that natural events such as hurricanes do not surprise NOAA’s customers.

Separation of transformational research and development (R&D) from risk and innovation was suggested. Transformational research should be a part of the corporate research portfolio and should look to develop a robust set of R&D capabilities as core NOAA mission roles. Risk is not managing a portfolio but is instead the practice of encouraging an entrepreneurial and innovative culture across the R&D spectrum. NASA

accomplished this by including some extra funding in Primary Investigator's (PI) budgets to enable exploration of ideas. Successful PIs can use these funds to make great strides without the divisiveness that can happen during open competitions across an agency.

Action:

- Distribute Defense Science Board (DSB) criteria for transformational research to SAB/Research Council members, when available.

Regional Collaboration

The Science Advisory Board and the NOAA Research Council discussed regional collaboration efforts in NOAA and the appropriate related stance for NOAA's research. Dr. Spinrad noted that, though research labs may be located in particular regions, their activities can extend much more broadly. However, there are also some inherently regional NOAA activities, including research, in other Line Offices such as NWS and NMFS. Regionally-focused research is appropriate, but the agency is still defining its role.

It is important to avoid unrealistic expectations during stakeholder engagement as the regional efforts are developed. Collaboration is a two-way street; once stakeholders are engaged they will have expectations and influence the research agenda. Key target audiences for the regional efforts will be state governors and other influential leaders who can help support regional work. Distinct social and economic regions of the country have different needs; characterizing the needs these areas and aligning that information with research capabilities and applications in NOAA will provide information on the benefits of NOAA's research to individual states. This communication could result in greater agency recognition and support. For example, USACE's annual meetings with states build strong support; dedicated regional NOAA representatives could develop similar connections. NOAA also should enhance the awareness of all its field personnel of the full spectrum of research in NOAA and the advanced capabilities in development. This would allow them to better provide support to NOAA's ongoing and developing research capabilities.

The development of better information and outreach on NOAA's services that are available to meet regional needs would be useful and is under consideration. This is a challenge because NOAA is a distributed organization with fragmented information on assets and research. A potential model for this could be NOAA's matrix management system, using the region as the matrix program whose manager brings assets and priorities to the national level. This idea resonated with both groups. Two issues were noted: 1) available research capabilities available that could be used to increase NOAA involvement in emerging concerns; and 2) shared stewardship roles between states and NOAA.

One problem is that success is measured on regional outcomes, but there are insufficient resources to address all problems in every region all at once. This requires solutions that are developed for one region but can be applied elsewhere. An additional challenge is

how to build on the benefits of state-oriented programs such as Sea Grant in a regional context and express progress in terms of the regions. State input is important; joint work with the federal government must determine what is fair and equitable in the relationship. For example, California is prioritizing funding for activities in its ports, which the federal government could not effectively do. States hold this important role of ensuring equity in capitalization activities within their borders. Optimizing results for both regional and national problems is critical. A nested model of regional to global needs must be maintained to track this. For example, NMFS is trying to have a more national perspective on inherently regional work. It is a challenge to maintain that product utility across many levels.

A challenge for the climate research and modeling community is forecasting changes and impacts at the regional level. People at the state and local levels are concerned that the world is changing, and there is a dearth of credible information reaching them. This includes both predictions and the record over past decades. Computing and other resources are barriers to adequately answering regional climate questions. Finer-scale observations and model resolution will be needed, but the climate community lacks agreement on how fine a resolution is necessary. Much debate exists in the climate research community on the value of downscaling model grid size versus conducting high resolution models. NOAA should lead in this area because regional needs driven by climate research capabilities will precipitate questions on operational climate research and what can feasibly become available for regional use.

The Ocean Research Priorities Plan and NOAA

The Ocean Research Priorities Plan (ORPP), *Charting the Course for Ocean Science in the United States for the Next Decade*, is the first national plan that establishes common goals for federal agencies and their partners. It was produced by the interagency Joint Subcommittee on Ocean Science and Technology (JSOST) as part of the President's Ocean Action Plan and represents the work of 22 federal agencies, partners, and the public. It has an integrative focus on societal benefits, which is different from the more traditional organization by scientific disciplines. The JSOST identified four near-term priorities, which include: 1) forecasting the response of coastal ecosystems to persistent forcing and extreme events, 2) comparative analysis of marine ecosystem organization, 3) sensors for marine ecosystems, and 4) assessment of meridional overturning circulation variability and implications for rapid climate change. The result of this is \$40 million of new money proposed in the President's Fiscal Year 2008 budget. Half of this would be in the NOAA budget and the rest in NSF and USGS. A NOAA-wide approach to coordination with NSF and USGS will be necessary to implement this.

NOAA must position itself to address the ORPP longer-term priorities while executing the near-term research priorities when FY 2008 begins in October. This will be a significant challenge. Arguably, the \$40M for the near-term priorities is seed money, insufficient for these issues to be fully resolved. The Global Ocean Ecosystems Dynamics research program (GLOBEC) may be a useful model for using the seed money in a coordinated, interagency way that the research community will appreciate. NOAA

must show that it is executing the community's broader plan. A first step would be to immediately develop a working group of all constituents involved, including other agencies, academia, and the private sector, and form a plan over six months and 2-3 meetings. This sends the message that NOAA has the lead but wants all parties involved. It would also develop visibility and support for these efforts, as well as a partner network.

A few criteria for selecting among the longer-term ORPP priorities may include: 1) identification of roles unique to NOAA, for example its current support of the Census of Marine Life; 2) identification of activities that lay a foundation for future work and enhanced capability over time regardless of continued funding; 3) identification of projects that involve other federal partners while establishing NOAA leadership; and 4) furthering the idea of "no surprises" research. NOAA should examine successful partnering models such as the Gulf of Mexico Alliance for how to include societal benefits. Responding to the ORPP also provides opportunities for nontraditional partners, such as the Packard Foundation. Although the funds available from Packard are insufficient to support major efforts, working with them as partners shows promise in a broader context. This may be a good topic for continued discussion at a later meeting.

All the ORPP activities require a fast and effective start. The Ocean Action Plan and all related efforts began with an Executive Order from the current Administration. Demonstrating success to a new Administration is critical to preserving these efforts.

Congress may attempt to pass the FY 2008 budget by October. If so, it may be good to start the process of promoting and planning for funding ahead of time. Chairman James Connaughton of the White House Council on Environmental Quality (CEQ) may be a good partner on this; perhaps serving as a keynote speaker at a kickoff meeting to develop ideas in anticipation of the budget so that activities can begin immediately. Similarly, the flexibility provided in the FY 2007 joint resolution can build some initial funding for anticipated research. These efforts would also grow a community of people that can talk to the Hill about the value of ORPP activities.

Monitoring Performance of Research in NOAA

The SAB and RC returned to discussion of monitoring the performance of research in NOAA and the SAB Benchmark Review. The groups discussed how to conduct this first review within the next two years in order to match up with the electoral cycle. In terms of NOAA's immediate fiscal situation as well as the broader relevance of its research, the SAB is uniquely positioned to evaluate the assets that NOAA brings to national research capabilities as well as their integration and relevance as to the broader arena. The SAB is able to connect where NOAA cannot, for example with other agencies' SABs, to put NOAA's research in context with the health and direction of the federal government's overall earth science portfolio.

An SAB member was struck by how much NOAA accomplishes with limited resources. He asked if the SAB could help establish and communicate the societal benefits of NOAA's research on specific activities, potentially to help guide the research program.

For example, the Research Council may be able to advocate for annual focal topics for the Small Business Innovative Research (SBIR) program rather than have those resources spread across many topics. This pertains to monitoring research and innovation more effectively throughout the agency. The SAB could consider how NOAA's SBIR program is managed and leverages the community as compared to other agencies, and how to maximize the value of such programs in combination with other opportunities and other agencies' SBIR programs.

It was suggested that the SAB and RC jointly develop a Terms of Reference and plan for this evaluation, with the aim to complete these in time for review and action at the next SAB meeting. An internal NOAA group proved helpful for quickly gathering data during the External Review of NOAA's Ecosystem Research and Science Enterprise; a similar team was recommended for this effort. The definition of the SAB's involvement could be fairly open initially; this is an evolving process and the SAB should not be unnecessarily constrained at this point. This activity was compared to the OMB Program Assessment Rating Tool (PART); some sections of PART, such as its research questions, may prove useful here. Though this exercise is different, it will help with the research-oriented PART reviews. An SAB assessment delineating the scope and the goal of this first review is essential. Conducting a useful NOAA-wide review in six months may not be feasible. Instead, conducting benchmark reviews on a few representative topics identified in earlier reviews may be a better idea. Actively observing the Research Council's review phase may be necessary to develop appropriate information. Focusing on areas with the highest political value might be most useful, and conducting a test case would demonstrate the effort needed and allow for procedural adjustments. This could have great impact on the Hill and with OMB. Example test cases are ocean, climate, or weather and air quality research, but one must be aware of potential unintended consequences of selecting one category over another. Ocean research was recommended since it is currently a major issue. It will be beneficial to recall NOAA's applied and operational role in conjunction with its research, allowing comparison with other mission-oriented agencies and highlighting where NOAA plays a unique role with its partners in conducting longer-term research with a mission focus.

Dr. Fluharty and Dr. Spinrad brought the joint meeting of the Science Advisory Board and NOAA Research Council to a close, thanking the participants and noting that it was a productive meeting and that the dialogue should continue as needed during future SAB meetings.

Action:

- With respect to a Benchmark Review of Research in NOAA the SAB will:
 - a) develop a scope of work to consider in August;
 - b) continue dialogue with NOAA on needs; ensure clarity of purpose and type of response required from the SAB.

Report on the Review of the Cooperative Institute for Climate Applications and Research - Karl Turekian – Chair, CICAR Review Team and Professor, Dept. Geology & Geophysics, Yale University

Dr. Turekian presented the results of the review of the Cooperative Institute for Climate Applications and Research (CICAR) at Lamont-Doherty Earth Observatory (LDEO) of Columbia University, opening with the mission of CICAR. Research goals within CICAR are organized by three themes: 1) Earth system modeling; 2) modern and paleoclimate observations; and 3) climate variability and change application research. The review appreciated the level of activity in modeling and observations of the modern and paleoclimate, but was not as secure on CICAR's activities within climate applications research. The report rated CICAR as Outstanding, noting that the recommended adjustments could improve on the program.

Dr. Turekian summarized the review panel's recommendations. The Geophysical Fluid Dynamics Laboratory (GFDL) connects well with the modeling and data aspects of CICAR and is its primary NOAA partner. CICAR also coexists with and has a complementary mission to the NOAA-funded International Research Institute for Climate and Society (IRI). The reviewers recommended that existing interactions between the two should be enhanced via joint seminars or post-doctoral positions. Due to budget cuts at GFDL, the funding for CICAR was reduced, causing cancellation of the joint GFDL-CICAR Post Doctoral program. It was recommended that NOAA provide funds to continue this program as it provides a much-needed conduit between the institutions. The panel was concerned with the lack of diversity at CICAR and recommended that its project with the remote sensing group at the City College of New York be pursued with dedicated NOAA funds to build partnerships and train new researchers. CICAR was encouraged to seek out active research collaborations with the Center for Research on Environmental Decisions (CRED) and the Global Roundtable on Climate Change (GROCC) to enhance the social science aspect within the Climate Variability and Change Applications research theme. It was recommended that, for quality control of proposals, NOAA honor CICAR decisions regarding the relevancy of CICAR-related proposals submitted from LDEO, and if possible, by funding the proposals through CICAR. CICAR was encouraged to identify LDEO researchers active in Abrupt Climate Change Studies (ARCHES) and encourage them to seek funding through CICAR/ARCHES, as the two are intertwined. As ARCHES will soon come up for review; NOAA should evaluate the relative contribution of both ARCHES and CICAR. The review recommended that CICAR seek greater integration of the observational aspects of oceanic circulation in its research portfolio, especially in ways beneficial to modeling and proxy efforts.

Dr. Yochanan Kushnir, CICAR Director, commented by phone on the history of the relationship between CICAR, ARCHES, and IRI. The relationship between NOAA and ARCHES precedes CICAR; ARCHES was incorporated as an amendment to the CICAR portfolio at its inception. Abrupt climate change remains a focus, studying how it has occurred in the past in order to understand how it is happening today and in the future. CICAR itself is broader in scope in that its research agenda also addresses modern climate observations, modeling, and prediction. IRI also pre-dates CICAR; it is a separate operational organization that links with users in the field; particularly internationally. As CICAR and IRI both exist on the Columbia University campus, they

are seeking ways to interact more. CICAR aims to provide IRI support on new initiatives in theoretical research and climate science while each maintains its own specialties.

Discussion:

A member noted that the CI has resources for administration and graduate students in its Task 1 funding and that the rest is for research work with NOAA. It was asked why there was less funding in applications research, and whether this was addressed in the funding Tasks. Dr. Turekian replied that more funding should be placed explicitly in post-doctoral positions in that area through collaborative means, because much of the existing funding goes towards climatic research and operational areas. Because the post-doctoral program with GFDL was canceled, it was asked what other links exist with the laboratory. Many more links could be made; post-docs strengthen such connections, as would joint seminars.

CICAR, like CIOSS, was competitively awarded. Considering the CIOSS review's comment that a 3-year review period was too short, it was asked what the feeling was for CICAR. Dr. Turekian indicated that this was an issue of concern, but was not sufficient to try and delay the review.

The wording of the recommendation for funding proposals caused some confusion as to its intent and should be clarified in the final report. It was asked if the intent was for CICAR to have funding authority on projects being submitted to NOAA or if it should be a joint decision with NOAA. Dr. Turekian concurred with the former interpretation. With this authority, CICAR could provide NOAA information on whether a proposal may be worth consideration as an amendment to its portfolio. It was suggested that perhaps if proposals to NOAA from LDEO were accepted, CICAR could request that the money be routed through the CI rather than the university. Concern was raised that an independent researcher from the university applying directly to NOAA could be turned down by CICAR before the proposal reaches the agency; placing such barriers in front of researchers was not desirable. Dr. Kushnir clarified by phone that any researcher can apply on his or her own, but if the proposal falls under the CICAR mission it should fit with CICAR. In agreement with the researcher, a request for such action would be issued in a formal cover letter. Clarifying wording was recommended to note that NOAA should support Columbia's decisions regarding requests for funding successful proposals through the CICAR cooperative agreement.

The SAB proposed, seconded, and approved by unanimous vote to accept the report with the language change. Dr. Turekian, Dr. Kushnir, and others involved were thanked for their efforts and the SAB looks forward to continued good results from CICAR.

Actions:

- In the Final Review Report for the Cooperative Institute for Climate Applications and Research (CICAR), clarify the recommendation "NOAA should support CICAR in its task by honoring CICAR decisions regarding the relevancy of proposals submitted, and if possible, by funding the proposals through CICAR" by rephrasing to "NOAA

should support Columbia's decisions regarding requests for funding successful proposals through the CICAR cooperative agreement.”

- Transmit Final Review Report for the Cooperative Institute for Climate Applications and Research (CICAR) to NOAA.

Update on the NOAA Response to the External Review of NOAA’s Ecosystem Research and Science Enterprise - *Steve Murawski – NOAA Research Council, National Marine Fisheries Service and Ecosystem Goal Team Lead*

This briefing was to engage the SAB in a discussion on NOAA’s recent activities and future plans in response to the recommendations of the External Review of NOAA’s Ecosystem Research and Science Enterprise (eETT Report). The Research Council will provide the final written and verbal response at the Fall 2007 SAB meeting. This interim report reviews the recommendations themselves, NOAA progress on the recommendations, and parties responsible for implementing the actions. NOAA categorized the specific recommendations into four areas: 1) regionalization; 2) integrated ecosystem assessments; 3) ecosystem science and monitoring; and 4) organizational issues. These recommendations are being implemented in the context of many internal and external drivers including the NOAA regionalization effort and the reauthorization of the Magnuson-Stevens Act as well as FY 2008 Office of Management and Budget (OMB) guidance to look at coastal programs for linkages.

Dr. Murawski discussed the details of the recommendations and NOAA’s response for each area. Within regionalization, it was noted that the NOAA regions align fairly well with the Large Marine Ecosystem (LME) structure, but that the large United States Exclusive Economic Zone (EEZ) in the Caribbean could use greater attention from NOAA. Development of ecosystem science boards will be considered by the new regional teams. Representing broad ecosystem research in NOAA will be a significant responsibility and a way for regional entities to forward their priorities and represent science while advocating its use in regionally-specific products. NOAA’s Ecosystem Goal Team through activities in the Planning, Programming, Budgeting, and Execution System (PPBES) will continue to develop a vision for ecosystem science with a regional focus and how to best engage with partners.

In the area of integrated ecosystem assessments (IEA), much progress has been made in NOAA to lead identification of the issue and development of a vision that other agencies may adopt. An IEA can go beyond collating datasets to link drivers and pressures with ecosystem states and impacts. Preparation of IEAs will be funded via a competitive process involving responsible NOAA entities as well as external partners. There will be some funding in the FY 2009 plan for IEA pilot projects. The Integrated Ocean Observing System (IOOS) and IEAs can be joined together in the broad area of ecosystem science and monitoring; in the long term these will merge. The joint work must ensure that IOOS provides relevant ecosystem data, and the regional teams may be involved in maximizing the benefits of these collaborations. Social science is also becoming a greater influence in blending activities for stewardship responsibility; efforts are ongoing and include the initiation of a Social Science Committee under the NOAA

Research Council. The area of organizational issues include centers of specialized expertise and whether and how to best organize NOAA for efficient regional collaboration. This latter point touches on the OMB guidance to develop a joint vision for coastal programs, which needs to be addressed first.

Discussion:

A member noted that issues raised by the report included concerns on planning ship time and budgeting, and it appeared that these concerns were being addressed. Dr. Murawski responded that there was significant debate over scarce ship time and that the best methods to assign ship time varied by region. Supply versus demand remains an issue.

A member of the SAB asked who the customers were for IEAs. Dr. Murawski responded that many are specified by NOAA's regulatory responsibilities such as fisheries. Other customers could include collaborators with NOAA, and other agencies that could contribute to and use these products. Entraining agents of impact on the systems could occur through interagency work within the current ocean governance structure. Joint funding with other agencies may be possible, but all agencies involved must have a shared vision and each fund certain things in order to avoid the appearance that NOAA wants the lead in all areas. It is the plan to develop one voice in NOAA first so that additional collaborators can be brought in effectively. Some work, for example with the Environmental Protection Agency (EPA) has begun, but the key issues are more cross-cutting than current efforts. NOAA was encouraged to not go too far down the road before involving partners; Dr. Murawski agreed and noted that the interagency ocean governance structure was helpful with this. It was further noted that work with the Department of Agriculture (USDA) may be an easier starting point as USDA Cooperative Extension units and Sea Grant already work together on watershed issues.

A member noted that Sea Grant was discussed in the context of regionalization, though many would argue that little collaboration occurs between Sea Grant institutions and NOAA, though there is willingness in Sea Grant institutions to work more with NOAA. Dr. Murawski concurred that this image exists but engagement is increasing, for example by Sea Grant convening regional workshops for research priorities. The relationship between Sea Grant, other coastal programs, and NOAA needs to be improved to allow it all to fit a larger whole. Concern was raised that this is a near missed major opportunity with well-supported groups. Another member noted that the relationship between Sea Grant and NOAA has dramatically improved with increased NOAA support. Positive opportunities include the fact that Sea Grant is a matched funding program with much extension work. As this extension comes from local institutions, it lends further credibility to the science with people in that region. Building in activities for continued improvement would be beneficial. It was noted that Sea Grant institutions, Cooperative Institutes, and Coastal Zone Management partners were all interested in when they would be involved in the regional teams. They will be engaged at a later point, as the regional collaboration structure is intended to be highly interactive. Having a finite list of agreed-upon priorities can help with this.

NOAA was commended on the speed at which it is responding to the recommendations. The agency was encouraged to ensure that it is doing its best to inform external people of the process as well as engage them fully.

Recap of Meeting Decisions and Actions - *Cynthia Decker – Executive Director, NOAA Science Advisory Board*

Dr. Decker reviewed actions assigned during the SAB meeting. Actions were refined as per the requests of the Science Advisory Board members. Three actions were added:

Actions:

- Establish longer-term calendar for meetings and topics/activities to be considered at SAB meetings.
- Provide more information on SAB website regarding SAB working groups and other activities.
- Provide link from SAB Members website to Thomas website (Congressional)

Summary of Actions

- 1) Further consider ocean acidification research and, if necessary, provide recommendations to NOAA on its related research programs. Recommendations could include:
 - a) NOAA as the primary agency for ocean observations;
 - b) NOAA coordinate its research with other agencies;
 - c) NOAA coordinate its research with the international research community;
 - d) NOAA move ahead quickly with a National Research Council study of this issue, but scope it out carefully to ensure policy relevance;
 - e) Include in research program studies on feedback loops, both positive and negative.
- 2) Transmit Final Review Report for the Cooperative Institute for Ocean Satellite Studies (CIOSS) to NOAA.
- 3) As part of new Joint Institute/Cooperative Institute review policy, consider recommendations on the timing of SAB reviews (award date vs. funding date).
- 4) Establish a Fire Weather Research Working Group.
- 5) Distribute Defense Science Board (DSB) criteria for transformational research to SAB/Research Council members, when available.
- 6) With respect to a Benchmark Review of Research in NOAA, the SAB will:
 - a) develop a scope of work to consider in August;
 - b) continue dialogue with NOAA on needs; ensure clarity of purpose and type of response required from the SAB.
- 7) In the Final Review Report for the Cooperative Institute for Climate Applications and Research (CICAR), clarify the recommendation “NOAA should support CICAR in its task by honoring CICAR decisions regarding the relevancy of proposals submitted, and if possible, by funding the proposals through CICAR” by rephrasing to “NOAA should support Columbia's decisions regarding requests for funding successful proposals through the CICAR cooperative agreement.”

- 8) Transmit Final Review Report for the Cooperative Institute for Climate Applications and Research (CICAR) to NOAA.
- 9) Establish longer-term calendar for meetings and topics/activities to be considered at SAB meetings.
- 10) Provide more information on SAB website regarding SAB working groups and other activities.
- 11) Provide link from SAB Members website to Thomas website (Congressional)

The actions were approved by the SAB and the meeting was adjourned.