

Meeting of the NOAA Science Advisory Board
Teleconference
February 27, 2019
1 PM to 4 PM Eastern Daylight Time

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

SAB members in attendance:

Ms. P. Lynn Scarlett, VP Policy and Government Relations, The Nature Conservancy (Chair); Dr. Michael Donahue, Vice President and Director, AECOM, Dr. Eugenia Kalnay, Professor; Dr. Stephen Polasky, Professor, Oregon State University; Dr. Denise Reed, Professor, University of New Orleans; Dr. Martin Storksdieck, Oregon State University, Mr. Robert S. Winokur, Consultant (ret. NOAA, Navy).

NOAA senior management and Line Office representatives in attendance: Dr. Neil Jacobs, Assistant Secretary of Commerce for Environmental Observation and Prediction, Performing the duties of Under Secretary of Commerce for Oceans and Atmosphere, Timothy Gallaudet, Ph.D., Rear Admiral, U.S. Navy (Ret.) Assistant Secretary of Commerce for Oceans and Atmosphere / Deputy NOAA Administrator, Dr. Gary Matlock, Deputy Assistant Administrator for Science, Oceanic and Atmospheric Research (OAR), Mary Erickson, Deputy Director, National Weather Service (NWS), Dr. Mark Paese, Deputy Assistant Administrator, National Environmental Satellite, Data, and Information Service (NESDIS); Dr. Francisco Werner, Chief Science Advisor & Director of Scientific Programs, NOAA Fisheries (NMFS).

Staff for the Science Advisory Board in attendance:

Dr. Cynthia Decker, Executive Director and Designated Federal Officer; Ms. Elizabeth Akede; and Ms. Caren Madsen

Call to Order and the NOAA Update

Lynn Scarlett, Chair, Dr. Neil Jacobs

Lynn Scarlett, Chair of the Science Advisory Board, called the meeting to order and called the roll to determine who was present on the webinar and in the room. She invited Dr. Neil Jacobs to make an opening statement. Dr. Jacobs has recently become the Acting Administrator of NOAA. Dr. Jacobs noted that the NOAA leadership changes should not be perceived as indications of changes in priorities or initiatives. Tim Gallaudet was on the line and echoed what Dr. Jacobs said. The two agreed that the change would allow Adm. Gallaudet to focus more on weather and seafood initiatives related to the Blue Economy. Chair Scarlett thanked RDML Gallaudet for his time in the position and thanked Dr. Jacobs for taking on the challenge the duties and functions of Under Secretary and NOAA Administrator.

SAB Consent Calendar

Lynn Scarlett, Chair

There was a motion to approve by Mr. Winokur, a second, then a unanimous vote of approval.

Discussion of the NOAA Research and Development Plan

Eric Bayler, NESDIS Center for Satellite Applications and Research and Vice Chair, Research and Development Enterprise Committee of the NOAA Research Council

Summary

Dr. Bayler outlined the topics for the R&D plan and the process involved. The public comment period ended February 8. He noted that the federal shutdown likely affected the number of comments received. Comments were solicited via a Federal Register Notice, town hall presentation at the American Geophysical Union Fall meeting, meetings with NOAA councils, social media posts, and internal and constituents emails. There were 67 comments received: 41 internal, 23 external, and 3 from unknown affiliations.

Dr. Bayler said this is the fourth R&D plan to be developed, and that the plan had evolved from a three-year plan to a five-year plan. The current plan is for seven years.

The vision areas in the R&D plan outline include:

- Vision Area 1: Reduced Societal Impacts from Severe Weather and Other Environmental Phenomena
- Vision Area 2: Sustainable Use of Ocean and Coastal Resources
- Vision Area 3: A Robust and Effective Research, Development, and Transition Enterprise

He said comments were grouped and addressed by vision area and vision areas align with the Blue Economy. He mentioned other types of comments from data scientists and social scientists. He gave a brief summary of the other comments which included:

- Bring in more data scientists and social scientists and provide greater job security through federal positions. Train existing workforce to adopt new technologies
- Share data and expertise. Specific mentions of industry, private-public partnerships, the academic community, and support for NOAA laboratories
- Seek stronger connections with the emergency management community on the research, development, and strategic use of unmanned aircraft systems (UAS)
- Create strategy for sustainable funding of long-term records
 - Fund NOAA long-range research projects and encourage innovation
- Suggestions to change vision areas
 - Include a new vision area regarding societal responses and have the third vision area listed outside the new vision areas
 - Include human activities in the first vision statement
 - Change first vision area to “Reduced societal impacts from severe atmospheric-oceanic events and other environmental phenomena”

- Change third vision area to “An innovative and effective research, development, and transition enterprise

The R&D plan developers are seeking NOAA SAB consensus feedback at the April 23-24 SAB meeting to address:

- R&D Plan Outline
- Comments on framework gaps and areas needing emphasis/de-emphasis
- Recommended NOAA R&D priorities

Dr. Bayler ended with the timeline for the project.

Discussion

Chair Scarlett reminded the SAB that the plan development is on a very short time frame. A clarifying question was: Is the plan focused on wholly substantive topic research areas or does the plan expect to go into the “how”?

Dr. Bayler said that in addition to the substance, all of it is set within the context of the NOAA R&D enterprise. How to achieve this is definitely part of the plan. Dr. Martin Storksdieck asked if, at the April meeting of the SAB, the group should plan to provide its final consensus advice on the outline. Dr. Bayler said yes. Dr. Storksdieck suggested a working group or subcommittee to draft the advice but suggested this could be based on independent input from the members.

Dr. Denise Reed noted the tight timeline. She said that if the SAB is interested in areas of emphasis or de-emphasis, or in working in individual groups. She said input from the SAB could be collected, but the members could also identify areas where there is consensus or disagreement. Rather than having a subcommittee, each SAB members could look at the outline, provide comments and then consider a summary of these. She asked if the SAB needs to go into the next meeting with a written draft document. .

Chair Scarlett asked if the SAB could go to the April meeting with comments on the R&D plan with consensus as an agenda item for the meeting. Mr. Winokur asked, “How do we know what [R&D] NOAA has invested in? Do we go back to the previous R&D plan?” He noted that there was a possibility of working in a vacuum and not knowing what the gaps in R&D are. He asked how an R&D plan could be developed without all of the information needed.

RDML Galludet said that the point was well-taken and noted that, within funding for FY19, there is the ability to provide input to the R&D budget. He said the FY20 budget will be out shortly and could provide additional data points. Chair Scarlett asked if it was still possible to look at the budget and also the content in terms of what is deemed as less important. She said that the SAB discussion of a new R&D plan could benefit from getting a summary of the previous plan to see what has been moving forward from that plan. She said continuities and consistencies could be helpful too. She asked if the SAB could get another set of information.

Dr. Gary Matlock affirmed that the additional information could be provided to the SAB. He said a recent report of NOAA accomplishments could also be provided in addition to variations of the Chief Scientist report. He said all documents are publicly available. He said the President's budget request is another source of information; there is proposed and then the enacted budget from the current fiscal year. He said documents could be made available to the SAB.

He noted that we never know what the President's Budget Request will be compared to the enacted, but said the R&D plan is not being developed based on the anticipated budget. It will be based instead on what NOAA thinks the R&D activities will be.

Chair Scarlett summarized the discussion. As the SAB looks at the outline, the board can do so with NOAA providing the previous R&D plans, yearly science reports, FY19 enacted budget, and the current R&D outline. She asked Mr. Winokur if this would give him the information he needs. He said he was not sure. He said if the R&D plan ended up representing an unconstrained budget plan, then it could read like a wish list. He said the SAB could have 1-2 teleconference calls to summarize what Dr. Matlock said. He added that otherwise, the SAB could set up their own priorities. Either way, he said, there should be opportunities for discussion.

Chair Scarlett proposed that time constraints could make this difficult. Dr. Storksdieck noted that the SAB has not discussed that the conversation will be at the next SAB meeting; it's an outline the SAB is commenting on. Dr. Reed said it comes back to "what we have going into the meeting versus what we'll have going out of the meeting."

Dr. Matlock said that there is an expectation that the discussion with the SAB would occur when the SAB gets the first draft of the plan (April-June). He said other opportunities for discussion can always be scheduled.

Chair Scarlett said she was hearing that the SAB is being asked to comment on an outline. She said individually the SAB can submit their individual feedback to Dr. Decker and the SAB staff. A summary can then be sent to the SAB before the April in-person meeting. Then the SAB can discuss this more fully at the April meeting.

She said the goal at the end of the SAB April discussion would be to have consensus on the input to the outline, and that will allow for robust discussion among the members. Dr. Decker added at this point that the SAB has the ability to have working meetings as long as there is no consensus reached in those meetings; those meetings will allow the SAB to clarify input from individual members.

Chair Scarlett said if there could be a deadline of perhaps the third week of March and then set up a discussion to clarify any differences of opinion. She said the question is if the SAB will have the outline and materials soon enough and if that is logistically feasible. Mr. Winokur pointed out that the outline is now posted on the SAB website. The Chair said the SAB could aim for the third week of March, then have a working group meeting. Dr. Reed offered a friendly amendment: a request that the SAB office provide guidance as to what's needed in terms

of priorities, gaps and justification. Chair Scarlett said they would need to be able to structure their response. Dr. Decker affirmed that the SAB office could provide this assistance and that the office can set up an information resource that will be easily accessible on the SAB website.

Action 1: The Science Advisory Board (SAB) agreed to provide input to NOAA on the draft Research and Development Plan Outline that has been circulated publicly. The members will provide individual comments on the Outline to the SAB Office by Friday, March 22. These will be collated for discussion at a working meeting to be held virtually prior to the April 23-24 SAB in-person meeting. At that meeting, the SAB will discuss and agree on its consensus input to NOAA on the Outline.

Responsible Entity: NOAA Science Advisory Board
Points of Contact: Lynn Scarlett (with assistance from SAB Exec Director C. Decker)
Due Date: Comments 22 March; draft summary early April; final product April 2019 SAB meeting

Action 2: In support of Action 1, NOAA will provide the SAB members with supplementary materials regarding NOAA R&D, including the past three 5-Year R&D Plans, the Science Reports published the last three years, the NOAA FY19 R*D budget enacted and the FY20 R&D President's proposed budget (when released).

Responsible Entity: NOAA Research Council Research and Development Enterprise Committee (RDEC)
Points of Contact: Gary Matlock, Gina Digiantonio
Due Date: March 8, 2019

Action 3: NOAA will provide to the SAB specific guidance on what kind of advice on the NOAA R&D Plan Outline would be most useful, e.g. the vision, the themes, the bullets under the themes, the scope, the public comments, etc. This will enable the SAB to focus its efforts in the short amount of time that is available.

Responsible Entity: NOAA Research Council
Points of Contact: Craig McLean, Cisco Werner
Due Date: After 12 March Research Council meeting

Climate Working Group Review of the Climate Program Office Climate and Global Change Post-Doctoral Program

Dr. Joellen Russell, University of Arizona, CWG Member, and Chair of the Review Panel

Summary

Chair Scarlett pointed out that the issue that prompted the review was an FY18 budget decision that had reduced the number of postdoctoral (postdoc) fellows in the program. She said the action requested by the SAB Climate Working Group was for the SAB to review the report from the review team, approve it and then transmit it to NOAA.

Dr. Paul Knight, co-Chair of the Climate Working Group, introduced Dr. Joellen Russell, member of the CWG and chair of the review team. He noted that Dr. Russell is not only on the

CWG but is also a member of the board of the postdoctoral program, making her uniquely qualified to chair the review.

Dr. Russell noted that the response to the review report was overwhelming and that it is clear that NOAA has a profound impact on global climate science. She said the goal of the program was to provide a cohort of experts in global change prediction and address the need to grow excellence in that area. She provided a history of the post-doctoral program which dates back to 1990.

She said the C&GC Postdoctoral Program has faced increasingly tighter budget constraints. Over the past two years, the NOAA Climate Program Office (CPO), in light of Executive Branch budget proposals calling for significant cuts in the “climate competitive research” budget line, was only able to fund four instead of the typical eight postdocs. As a result, CPO requested the CWG to review the program. A panel composed of a diverse field of experts in climate and global change met on October 5, 2018 to hear reports on the history and the status of the Climate & Global Change (C&GC) Program and to make recommendations. She said the panel charge was to address

- 1) The communication of the Program’s effectiveness and impact to date, and
- 2) Potential alternate funding options that NOAA could consider to maintain the long-term viability of the Program.

Dr. Russell covered the Review Panel Findings as follows:

- 1. Excellent program.** This excellent Program promotes NOAA’s mission and prestige both nationally and internationally, as demonstrated by Fellow and Alumni scientific achievements, citations, innovations, prestigious appointments, and leadership roles.
- 2. Serving the nation and society.** In service to the nation and society, the Program supports improving and expanding prediction within the earth system; combining observation and modeling; developing new tools and techniques and identifying and quantifying new interactions in weather, water and climate; and enabling nationwide communication of resilience and adaptation strategies.
- 3. Fostering and developing the next generation.** The Program fosters and develops the next generation of earth system and climate science leaders by supporting independent scientists and emerging leaders who build the new and transformational tools, technologies, understanding, and innovations.
- 4. Building the nimble and interdisciplinary community.** The Program builds the nimble and interdisciplinary community required to address emerging issues in weather, water, and climate.

The panel recommendations were also presented:

1. Funding at least 10 postdoctoral fellows per cohort.
2. Improving Fellow interaction with NOAA.
3. Enhancing diversity and inclusion.

4. Incorporating ongoing and well-maintained metrics.

Dr. Reed noted that the panel members did not comment on alternate funding. She talked about the four criteria for satisfaction relative to alternate funding strategies:

(1) The Program requires a single home and point of coordination that serves the Fellows, the hosts, the host institutions, and the overall research.

(2) The Program requires overarching accountability, which the Climate Program Office has expertly provided for decades.

(3) To preserve the independence, leadership, and innovation of the Fellows, consideration of split-funding with specific already-funded projects should be precluded; however, other funding sources that are contributing without expectation or agenda could be considered.

(4) NOAA must be entrepreneurial in approach to simultaneously honor the promise of the past and the purpose for the future.

Discussion

Dr. Russell said that in interviewing cohorts, the independence of the program allowed them to develop research better than they would be able to develop otherwise. Dr. Kalnay asked if there is a possibility for a time extension for individual postdocs to complete their research, if needed. Dr. Russell responded that UCAR [the organization that runs the program on behalf of NOAA] would need to answer that question. Hanne Mauriello from UCAR was present. She said that, historically, the post doc program had been a two-year program and no extensions are needed.

Mr. Winokur opened the discussion by suggestion that the report be reworded to say that the “target should be 10 post docs.” Chair Scarlett added that perhaps the text should be reworded so that it does not suggest that if there are not 10 post docs, the program is not worth pursuing, i.e., what happens if 10 post docs are not put in place?

Lynn Scarlett referred to her experience as a budget officer for the Department of the Interior at one point in her career. She said she has a concern about a recommendation to NOAA from an external group asking for 10 post docs to be funded could force a decision that could jeopardize funding for other programs. She said the suggestion that changing the language to say that 10 post docs should be a target number is a strong sign of support but not an outright imperative for funding.

Dr. Russell said that the recommended number of 10 was a significant part of the panel’s discussion before completing their recommendations. She said that, while she appreciates how tough the budget situation has been for NOAA, the decision by the panel to recommend a total of 10 postdoc fellows was not taken lightly. She said she feels strongly that NOAA should hear the need for the higher number of postdocs and argued that 10 young people doing the work is vital to the research. She added that diversity and inclusion in the program is difficult to reach when there are only four postdoc fellows in the program.

Chair Scarlett said that, for budgeters, there are slight nuances in language and expressed concern that saying that 10 postdocs should be funded might suggest a “10 vs. target funding for 10” could lead to no funding. Dr. Decker suggested noting the target number of 10 in a cover

letter to accompany the panel's report. She said the SAB has the right to change the report language but said a cover letter addressing the issue might be best. Chair Scarlett suggested that the SAB accept the report with a cover letter to address the target number of 10 so that NOAA would not be placed in a difficult position with respect to a funding decision. She called for a motion to accept the report and cover letter suggestion. Dr. Storksdieck made the motion. It was seconded and there was a unanimous vote to approve the report and cover letter recommendation. The SAB office will draft a cover letter for the report.

A summary of the action from this agenda item follows:

Action 4: The SAB accepted the Report on the Review of the NOAA Climate and Global Change Postdoctoral Program conducted under the Climate Working Group. However, there was some concern about the possible interpretation of the language regarding Recommendation 1 "Funding at least 10 postdoctoral fellows per cohort." The SAB noted that future leaders could determine that the sense of this is binary, i.e. if NOAA cannot fund 10, then none should be funded. The SAB believes the correct interpretation of this is that 10 should be the optimal target, recognizing that there may be problems in the future for funding. The SAB will add a cover letter to the report when it is transmitted to NOAA that articulates this belief and support of the report.

Responsible Entity: SAB
Points of Contact: Lynn Scarlett
Due Date: 29 March 2019

Environmental Information Services Working Group Update on SAB Work Plan Topic 2 Use of Observing System Simulation Experiments (OSSEs)

Dr. Brad Colman, The Climate Corporation and EISWG Co-Chair

Summary

Dr. Brad Colman, Co-Chair of the EISWG, presented an update on the status of the Environmental Information Services Working Group (EISWG) white paper on the use of observing system simulation experiments (OSSEs) in NOAA. Since the last update in November of 2018, the OSSE writing team was finalized. Also, due to the competing schedules and the lapse in appreciation for NOAA, the writing group's timeline was modified to have the finalization date of the white paper moved from February 2019 to April 2019. EISWG member Xubin Zeng is leading the group. Dr. Kalnay is the SAB champion for this topic. The group also consists of three EISWG members: 1) Dr. Bob Weller, provided information on ocean and/or climate OSSE capabilities; 2) Dr. Ron Birk, provided information on OSSE capabilities within the private sector; and 3) Dr. Bill Hooke, provided general information on OSSE-related issues. Climate Working Group member Dr. Fuqing Zhang provided inputs on OSSE capabilities within the academic community and Dr. Joellen Russell contributed on ocean OSSE capabilities. Other government agency representatives contributed as well; Dr. Derek Posselt provided information on OSSE use and capabilities at the National Aeronautics and Space Administration (NASA) and Dr. Dan Tyndall provided information on how OSSEs are utilized at the Naval Research Laboratory (NRL). Dr. Lidia Cucurull and Dr. Bob Atlas provided information on NOAA's current use of OSSEs. Lastly, domain expert Dr. Fred Carr also provided information on OSSE capabilities within the National Weather Service. The white paper is broken up into three

sections. Section one focuses on current OSSE capability and practices in NOAA and other sectors. Section two focus on when, on what decision, and with what approach are OSSEs useful or limited? Section 3 focuses on the recommendation to NOAA on what may be done with OSSE in the near future. Some initial thoughts from the group is that NOAA should develop OSSEs for earth system models and to ex10d OSSEs to address societal impacts. A draft version is currently being circulated within the writing team before a draft is sent to the full EISWG for their review, comment, and approval which will take place at the EISWG's meeting April 2-3, 2019.

Dr. Colman asked SAB member D. Kalnay to provide comments. Dr. Kalnay expressed her enthusiasm for the report and emphasized the contribution that comes with coupling Ensemble Forecast Sensitivity Observations (EFSOs) with OSSEs.

Discussion

Chair Scarlett thanked Dr. Colman for his presentation and asked if there are any comments from SAB members.

Dr. Storksdieck commended Dr. Colman on the presentation and had no comments to add.

Chair Scarlett stated that the lack of objections and concerns from the SAB members on the call is an indication that the group approves the direction of the OSSE white paper that was presented. Dr. Jacobs also commented with appreciation for what is in the report. The structuring of observing system experiments (OSEs) and OSSEs is very important. The NOAA Observing Systems Council (NOSC) is trying to determine a formalized protocol to conducting OSEs and OSSEs. He also expressed his enthusiasm for Forecast Sensitivity Observations (FSO) tests and is for the implementation of the use FSOs and EFSOs in NOAA.

Update on NOAA Weather Programs

Dr. Neil Jacobs, Assistant Secretary for Environmental Observations and Modelling, performing the nonexclusive duties and functions of Under Secretary and NOAA Administrator

Summary

Dr. Jacobs, NOAA Acting Administrator, presented an update on NOAA Weather programs and highlighted different sections of the National Integrated Drought Information System (NIDIS) Reauthorization Act of 2018.

Improving Forecast Skill and Performance

The results of a transplant experiment depicting a European Medium-Range Weather Forecast (ECMWF) Model anomaly correlation showing the relationship between forecast accuracy and time was presented. The further steps (time) the time scale the less accurate a forecast is. Data assimilation systems use this model in the short term because the accuracy of the forecasts is higher. The skill of the dynamic core in the model is good but what is lagging and needing to be improved is the data assimilation.

Inherent Barriers with the Status Quo

Dr. Jacobs stated, in no particular order of severity, current barriers to NOAA's ability to improve its operational numerical guidance and forecast skill.

- Fractured internal strategy and mission creep
- Fractured external strategy across various agencies with different priorities
- Obtuse HPC procurement process (both hard iron and cloud)
- Security clearance procedures for visiting scientists
- Cultural (internal and external)
- Funding allocation process disincentivizes collaboration
- Risk aversion (incentive not to fail is greater than the incentive to improve)
- Too many committees with overlapping and conflicting input
- Lack of documented, supported, and portable community code – More focused on the Global modeling side.

Accelerate Research to Operations (R2O) and Operations to Research (O2R) Overview

High Level Overview of NOAA's Current end-to-end Product and Data Management

NOAA has different project scattered through the end-to-end product and data management process. The National Environmental Satellite, Data, and Information Service (NESDIS) has been doing experimental pilot projects using cloud products for some satellite data pre-processing; cloud distribution projects such as the NOAA Big Data Project have also been going on in the back-end; and there are also some new cloud based HPC projects being done. The aim moving forward is to understand how to align projects within the overall process instead of always doing ad-hoc projects.

End-to-end Community Model

The development of an end-to-end community model is required by the Weather Research and Forecast Innovation Act of 2017. A good example of an end-to-end community model currently accessible by NOAA is the Advanced Research Weather Research and Forecasting (WRF-ARW) Model. WRF is a state-of-the-art atmospheric modeling system designed for both meteorological research and numerical weather prediction. Users have access to the WRF portal where they can download and run codes within the system to inform development work. As a result of this, users are able to publish papers on the development work being done with the model. From the published papers, NOAA has the ability to crowd source on the model development being the users accessing and using the code. Currently, there are two barriers that inhibit other models from being end-to-end community models which are that the systems hosting these models are not user friendly and that the code is computationally expensive and hard coded to NOAA machines. Without access to NOAA machines, users are not able to access the code.

Virtual Machines (VM) for on-demand parallel "surge" development

By using the cloud for on-demand parallel surge development this enlarges the amount of HPC that's needed to do development work by NOAA. Currently, NOAA's research to operations compute ratio is 1: 1 while ECMWF is 5:1. The optimal balance for is 5-7:1

ratio. The problem with a 1:1 ratio is that NOAA scientists have long queues when running experiments. Currently, NOAA pays for nodes per hour for development work which limits the amount of work that can be done at one time because there is a finite number of nodes. Each NOAA researcher who wants to run an experiment has to line up to run their node which causes delays in research and increased costs. By switching to cloud-based computing NOAA is able to scale on demand whatever ratio to one that the agency needs. The node pool that cloud providers have are larger than what NOAA has access to. Research is accelerated because research is being done in parallel instead of one after the other.

Virtual machines and cloud High Performance Computing (HPC)

NOAA plans on moving to the use of virtual machines for parallel community development. In order to develop a parallel community NOAA will need to utilize a cloud HPC service that has remote direct memory access (RDMA) and fast interconnect speed. There is a NASA study running a General Circulation Model (GCM) in Amazon Web Services (AWS) that is typically cited as a reason to not use cloud HPC services. The study concluded that using AWS was not cost effective for their computing needs. The problem with the study was that at the time Amazon's interconnect speed was at 25 gigabyte. The effectiveness of a numerical modeling system is not dependent on the amount of nodes or processors available but the interconnect speed of processors. The typical HPC system has an interconnect speed of approximately 100 gigabytes. During the study, to make the gap up caused by the low interconnect speed, experiments had to be ran across multiple processors leading to higher costs. Since the study, AWS has upgraded to an interconnect speed of 100 gigabytes and Azure is at 400 which is 4x faster than NOAA's operational HPC.

Global model cloud pilot (GMCP)

NOAA wants to port and test Next Generation Global Prediction System (NGGPS) in cloud HPC and virtual machine (VM) environment. One issue that NOAA may encounter when switching to a cloud HPC and VM environment is the porting of code due to limited budgets. To find a solution to this problem NOAA reached out to the major cloud providers to see if any would be interested in taking on the task of porting NOAA code into the cloud using their own money and architecture. The argument made to the providers to port NOAA code with their own resources was that by doing so a large user base will come to their site to access said code. The cloud providers interested in this proposition were Amazon, Google, and Microsoft. NOAA provided the three companies raw data and source code and during the furlough these companies ported and started testing NOAA's code. The next step in the translation process is to conduct a "bake off" with 3rd party software engineering firms and cloud vendors. NOAA understands that these firms and vendors may not be able to numerically replicate outputs perfectly however success for the porting and testing of NOAA code is measured by a vendor or firm's ability to come close to what NOAA gets with its operational configurations and match or beat the production model run time. With Microsoft's cloud computing service Azure, it's been proven that as long as the code within the system is well documented vendors and firms in the "bake off" phase have been successful with the GMCP.

Visiting scientists and external expertise

NOAA plans on having an external commercial cloud vendor build the development “sandbox.” By having the interface built by a commercial cloud vendor NOAA is able to solve the scalability issues with limited nodes and solve security clearance issues for visiting scientists and external users. Although major issues can be resolved by using a commercial cloud vendor, NOAA will have to develop a secure ingest demilitarized zone (DMZ) for the external development “sandbox.”

Fast-Tracking Satellite Data Assimilation

Looking at the impact of observing systems in the global modeling system we see that the satellite radiance data is the most impactful in the model. The reason the ECMWF is doing better than the United States with the use of satellite data is because they can better assimilate the data with their systems. The chart provided depicted a cost-benefit ratio for investments made in satellites. Ideally the benefits will surpass the investments made. To reap benefits from a satellite the satellite must go to space, collect data, and NOAA must start extracting value from the data. The change that causes the benefits to outweigh the cost of the investment comes by optimizing the quality control and extraction of the value of data with the assimilation of the data and models. With machine learning and artificial intelligence, there are better ways of parsing out satellite data. An issue that is currently being tackled arises from the size of data files. These files are too big and have to be thinned out for being ran through models, which removes valuable information.

Agile/nimble “sandbox”

Development of a lab where people are encouraged to take risks is another thing being explored. Currently the United Kingdom (UK) Meteorology Office has such a lab for research and development. Many commercial organizations also have such labs where researchers are encouraged to innovate by developing disruptive solutions. The success rate of projects from these labs may be low, however, projects that are successful yield quantum leaps for the industry.

Accelerating Strategic Implementation Plan (SIP)

Progress is being made on the Strategic Implementation Plan and the Developmental Testbed Center (DTC), however the National Centers for Environmental Prediction (NCEP) is trying to build off the momentum from the SIP/DTC progress and improve the U.S. Operation Numerical Weather Prediction has to be made in parallel. One hindrance to progress is the negative branding around the U.S system. There is a need to overcome the image of the inferiority of the U.S Global Forecast System (GFS) to the European weather model ran by ECMWF. Historically the ECMWF model performed better than the GFS system but there are instances recently that the GFS beat the European model.

From the July 27th NOAA Executive Council (NEC) briefing

Dr. Jacobs relayed the status of items briefed at the NOAA Executive Council (NEC).

- Accelerate Strategic Implementation Plan (SIP)! (mainly R2O) – NOAA is still in the process of designing and implementing the SIP.

- USAF/Navy buy-in – NOAA is in a “wait and see” mode with this item. The USAF/Navy want to partner with NOAA in development work, however, due to the sensitivity of their work, a parallel secure environment may need to be created.
- NASA/DOE collaboration- NOAA is working to update the Memorandum of Agreement with these agencies to include the exploring and sharing of different computing architectures.

Joint Effort for Data assimilation Integration (JEDI) Update

This item is moving forward on Amazon Web Services.

Weather Research and Forecasting Innovation Act of 2017 (WRFIA) Reauthorization

NOAA noticed that the National Integrated Drought Information System (NIDIS) Reauthorization Act of 2018 would pass through both the U.S Senate and the U.S House of Representatives with bi-partisan support. Based on this knowledge NOAA provided input to the then bill which ended up passing the U.S Senate with unanimous consent and passing the U.S. House of Representatives with 300-to-6 votes. Section three of the NIDIS Act reauthorizes title two of the Weather Research and Forecast Innovation Act (WRFIA) of 2017 with authorization for appropriations language either at or above what was originally stated previously in the WRFIA.

EPIC and Community Modeling

Section four of the NIDIS calls for an Earth Prediction Innovation Center (EPIC). NOAA plans on making this a virtual center. To meet what is in the Act, a request for proposal may go out for an external party host the center. This section also emphasis the need to leverage the weather enterprise to have scientists focus on data assimilation techniques and outlines a way forward with the program.

HPC, Cloud, and Code

Section five of the NIDIS Act focuses on computing resources prioritization where instructions are given for NOAA to away move from its current practice of buying HPC to move towards a multi-year leasing agreement. Currently NOAA purchases HPC equipment by soliciting through a request for proposal (RFP) which doesn't typically go to HPC manufacturers but to contractors who have to purchase and custom build the equipment. A downside of this procurement process is that a large cancellation liability fee has to be set aside in the even that NOAA no longer wants or needs the HPC equipment being built by the contractor. NOAA is working with Congress to establish a way for the cancellation liability fee typically included in NOAA's current HPC procurement process.

Item seven in this section in the NIDIS Act calls out the need for NOAA to transition its programming language to one that is being used broadly by the coding community.

Satellite Architecture and OTA

Section six of the NIDIS Act calls for satellite architecture planning. Paragraph two, subsection (D) authorizes NOAA with the ability to create transaction agreements with commercial and academic sectors. This is something NOAA has been trying to get for a while. This authorization is set to terminate in 2023, however, it can be reauthorized without an expiration date if NOAA

is able to provide documentation showing that the transaction agreements are cost effective and beneficial to the nation.

Coastal and Ocean Observations

Section seven of the NIDIS Act authorizes the integration of ocean and coastal data from integrated ocean observing systems.

Cooperative Observer Program

Section eight of the NIDIS Act emphasis the need to expand and improve the Cooperative Observers Program. This program is valuable because of its ability to collect observation for initialization and verification. This is something that is needed to help improve the front end of NOAA's modeling.

Harmful Algal Blooms (HABs) and Hypoxia

Section nine of the NIDIS Act is broken into two main focus areas, research and development, and the establishment of HABs as national significance. With supplemental funding for development programs, the U.S. Congress is interested in coupling atmospheric models with hydrology models to evaluate where run off going. By having the atmospheric and hydrological models work with biologicals models researcher can determine where nitrogen, phosphate, and other harmful gasses may rise to trigger harmful algal blooms which creates hypoxia in the water which in turn harms biological life in both marine and freshwater environments. Designating HABs as events of national significance enables government to allocate financial resources in the case of very serious regional HABs.

Discussion

Chair Scarlett started by thanking Dr. Jacobs for his presentation. She noted that there was little time available for discussion and proceeded to open the line for questions.

Dr. Kalnay expressed gratitude and excitement for the presentation and the work being done to improve student and researcher access problems with HPC technology and code.

Dr. Jacobs appreciated the thanks from the SAB members. He stated that the past year has been spent working on the various projects presented. In his new role as Assistant Secretary for Environmental Observations and Modelling, performing the nonexclusive duties and functions of Under Secretary and NOAA Administrator, he will take on the roles and responsibilities that RDML Gallaudet had in the past year as the Acting NOAA Administrator freeing up time for RDML Gallaudet to work on projects covered in his own purview.