SAB comments on research plan outline summarized

## General Comments

1. *Overall Direction for NOAA:*
   a. Urge NOAA to maintain a strong and well-articulated focus on the health, diversity, productivity and sustainability of the nation's marine and coastal ecosystems.
   b. Did not see reference to the two NOAA high-level priorities; namely (1) produce the best weather system in the world and (2) grow the American economy through the sustainable management of marine resources, or the "Blue Economy." Those should be referenced up front.
2. *Machine learning, big data, etc.*
   a. In each of the priority areas use of deep learning, AI, machine learning, big data, cloud computing terms are included. While this isn't a very descriptive document, it is somewhat surprising that open source software (OSS) is not highlighted as a priority, especially since all of these computing advances rely so heavily on open source libraries and many of the active researchers work within an open source framework. It seems that OSS should be mentioned alongside these high-level priorities for NOAA. It seems like this would also respond to OMB m-16-21. Developing the capabilities for these new types of analysis and model development could be more easily enabled through code efficiencies developed through OSS algorithms for data processing, essentially developing OSS enterprise solutions. Using AI, DL, DNN, ML, etc. all require large training datasets and accurate uncertainty estimates. The development of open matchup datasets for satellite and in situ / model data is a critical first step that I don't see mentioned. ESA has already funded a number of these through their CCI program, it would be useful (and collaborative) for NOAA to contribute to this effort for the NOAA satellites, which would also move NOAA closer to advancing some of the advanced computing the NOAA is prioritizing.

3. *About the nature of the "report" itself*
   a. Wonder if this should be called a "plan" per se. A plan generally includes milestones, budget, priorities and other relevant benchmarks against which one can measure progress. I believe the previous document was called "Research and Development at NOAA." This plan could be an update to that or called something like NOAA Research and Development Strategy or Priority Areas.
   b. It's not clear who the audience of the R&D Strategic Plan is? Is it for the NOAA administration to help strategic choices or is to the science community, the media, the public, etc.?
   c. What's the time period? A real strategic plan needs to define the scope. Are we looking for the strategy for the next year, next 5 years, next 10 years?
   d. A strategic plan is basically about meeting goals with specific strategies, establishing priorities and the resources to meet those priorities. Don't see any of that.
   e. In contrast to above: Overall there is much to like about the outline.
      - It's rooted in the framework of higher-level NOAA, DoC, and executive branch planning, and Congressional legislation
      - It's focused on a few key, broad questions
      - It aims at improving the services across NOAA's product line/portfolio
      - It addresses R2S transition issues
      - It emphasizes evaluation

Suggest each of the "vision areas" be relabeled" as goals.  There is an overarching vision for the document and the three areas are really goals to attain the vision in my opinion.

f.  Suggest rewording each of the highlighted questions under each vision/goal to be a positive statement rather than a question.  For example, "How can forecasts and warnings for severe weather and other environment phenomena be improved" to "Improve forecasts and warnings for severe weather and other environment phenomena" or even something like "Reduce impacts of severe weather and environment phenomena (natural disasters)."

g.  Each of the highlighted questions could be labeled as objectives under each goal.

h.  Hard to tell if each bullet is a separate R&D area or whether they are just factors to be considered under each question, but that is a detail to be sorted out in the plan.

i.  As indicated in the outline, it is hard to find key areas of emphasis, such as Polar Science, Water Prediction, Observations and Data Management, and Decision and Social Science Assessments.  These areas of emphasis are buried in the long list of research areas.

j.  Overall, believe the key elements are included in the outline, along with the public comments that were solicited.

k.  Whatever the plan is called, it cannot appear as an unconstrained list and in some way needs to relate to the budget.  Not suggesting including the budget, but the "plan" has to have budget realism for implementation and to be relevant.

4.  *Social Sciences:* The NOAA R & D plan outline identifies three important vision areas for future research. They identify a number of weather and climate science initiatives, but particularly under vision areas number one and number two, the outlined research agenda does not clearly articulate a significant role for social science in bridging the gap between scientists and potential forecast and warning users.  Reviewer recognizes that this is only brief outline and perhaps the issues raised below were thought to be implied, but it would be useful in the next version to make the vision clearer.  Bringing in more complementary social science and co-production activities with decision makers that obviously is integrated throughout the research process offers important opportunities for NOAA to address concerns about public safety and economic impacts. Doing this is not simply a matter of more communication or evaluation on the back end; it is understanding decision frameworks, decision calendars (how much lead time do various decisions need for forecasts to be useable and useful), what is the relative significance of various types of uncertainty (whether that be social, economic, regulatory, or forecast related) in determining what makes information useful and usable.  Using social science to refine a project at the beginning can bring efficiencies to the total path of product design and version development.

**Introduction**

1.  Enabling Elements for R&D could reference the need for garnering political support and integration (using a systems framework).
2.  There seems to be a stronger focus on research/science than on development.
3.  Since NOAA infrastructure is extensive and critical, it might be useful to discuss it separately from partnerships.

# Vision Area 1

1. *Including elements of social science research and addressing human impact*
   a. Reducing societal impacts is not possible without studying how society responds dynamically to threats. It is not sufficient to put all of social science research into one bullet under Vision Area 3.
   b. How can improved forecasts be used for better responses to save life and property? Address how system, community and individual responses can avoid climate change and mitigate its impact.
   c. Section only tangentially addresses societal impacts, with general terms for subtopics (decision support, risk communication). Human activities are missing in this vision statement. Recommendation: Incorporate the vision from the 2018 NASEM report "Integrating Social and Behavioral Sciences within the Weather Enterprise" throughout Vision Area 1.
   d. Forecasts and warnings may be made more useful by understanding and addressing the socioeconomic issues that influence whether and under what conditions people hear or heed these warnings.
   e. Add research on risk perception, trusted sources, the role of experience in judging threats, as well as further research on risk communication. Harness potential for complementary social science to allow NOAA to more fully achieve its goal.

2. *Weather*
   a. Outside the Weather Bill, major changes in technology, science, and involvement of the private sector in the weather enterprise need to be captured. Many other agencies provide data, models, and science that enable NOAA's weather enterprise (e.g., NASA, DoE, DOI, NSF, etc.). NOAA should be expanding into other areas—e.g., better air quality forecasting, wildfire smoke forecasting, etc. Therefore, NOAA should take a leadership role in bringing together all the players—academia, other agencies, private sector, and NGOs—to help design the NOAA weather enterprise for the next decades.
   b. Use of atmospheric chemistry to understand and better predict weather and climate is crucial: example, boundary layer.

3. *Climate Change*
   a. The only topics related even vaguely to climate change are in Vision Area 1. Climate change research is an important component of the NOAA mission and deserves more prominent discussion.
   b. It is encouraging to see state of the Climate included. However, the outline blurs/blends together elements on climate change impacts and existing observed changes with elements relevant to modeling and projections of change. These should be more clearly distinguished and delineated.

4. *Other Comments*
   a. These are good questions but expect to see in a strategic plan "strategies", which include actions, trade-offs and establishing of priorities.
   b. Question 3 implies that the current services are sub-standard. Should it be more focused on enhancing utility of space weather products and services?
   c. Add "integrated framework" to the high precision GHG monitoring

**Vision Area 2**

1. *Integrating Social Sciences*
   a. Integrate social, behavioral, physical and data sciences to design and achieve an effective R&D enterprise that moves research into practice in partnership with the diverse communities NOAA serves.
   b. Beyond (useful) economic dimensions, there is social science research on what decision-makers need to support decision-making as well as what they don't need and the barriers to adaptation that are most significant. That type of insight would be very valuable to inform the development of adaptation methods and manuals.
   c. Recommendations from the 2018 NASEM report apply: social and behavioral science leadership, capacity, and focused expertise and efforts are critical to achieve progress in this vision area.
   d. NOAA should explicitly include in its strategic plan the development of local, national and international partnerships and engagement strategies to assure that research efforts are strategic and synergistic with those of other agencies as well as communities and nations.

2. *Addressing ecosystems*
   a. Specific research topics under each heading appear to give little emphasis to sustainability and the role of coastal and marine ecosystems. It is impossible to understand the "sustainable use of ocean and coastal resources" without an understanding of ecosystem functions and interactions (including an understanding of interactions between humans and natural ecosystems). There are a few topics that address ecosystem outcomes (e.g., combined effects of environmental changes on species and ecosystems; model, monitor, and forecast events that degrade coastal habitats; evaluate impacts and economic tradeoffs of ocean acidification, sea level rise, and harmful algal blooms).  However, for the most part, research to understand aquatic ecosystems is given minimal emphasis.
   b. There seems to be a disconnect between topic headings that imply research on issues such as sustainability and healthy ecosystems, and a lack of specific and well-articulated research topics in these areas. Similarly, Section 1 (addressing sustainable aquaculture) does not appear to include topics covering ecosystem impacts and interactions (except to the extent covered by disease transfers and space-conflicts).
   c. Notably absent is any reference to ecosystem "services" (whether using that language or other terminology).
   d. The section understandably has a discussion of ecosystems (and a traditional juxtaposition of ecosystems and ecosystem protection vs extraction/use/development). While this is relevant, it overlooks a focus on ecosystems AS infrastructure and as linked to economic outcomes, coastal resilience, etc.

3. *Value of long-term research*
   a. In each of the vision areas, recognize explicitly that NOAA long-term research on the state of the oceans, atmosphere, and their interactions provides critical baseline

information for understanding impacts and shorter-term developments.

4. Specific Comments
   a. Question 1:
      i. Clarify "environmental phenomena", timescales for the phenomena of interest, and using "funnel approach" (from global to local) to ensure that the processes/linkages and interactions across space and time are captured.
      ii. Move the focus beyond precipitation and temperature only.
      iii. Bullet 1&2: Address new genomics tools to allow aquaculture to accelerate selective breeding efforts by utilizing marker assisted selective breeding...
      iv. Bullet 3: Address selective breeding efforts for shellfish as best hope of resolving disease impacts on aquaculture…
      v. Bullet 4:
         1. Address planning tools that enable decadal scale planning of coastal/estuarine conditions and how space-use conflicts will be influenced by climate/SLR
         2. If satellite images could be of sufficient resolution to identify that tracks of small boats in crowded waterways it might be possible to determine where recreational and commercial boats actually do traffic and where they don't, making arguments about multiple use conflicts fact based instead of subjective.
         3. This doesn't seem like a high priority – or it may need further explanation. What is needed are models that enable the interactions between development, and different fishing pressures to be better understood and to allow simulation of the effects. Should the role of MPAs be explicitly included here?
   b. Question 2:
      i. For each of these, an example area (or two) of potential application is needed. Also, which are studies/knowledge development, which are tools and which are technologies?
      ii. Address "Improved needs assessment and market analyses" and "Indicators for ecosystem sustainability"
      iii. This is an important research question for NOAA. However, the sub-bullets that define this topic do not appear to articulate research that addresses "healthy and diverse ecosystems" directly, but rather speak to (1) Next-generation species stock assessments, (2) Illegal, unreported, and unregulated fishing, (3) Bycatch, and (4) Indicators for coastal development and recreational fishing. All of these influence ecosystems in various ways, but there appears to be little emphasis given to research involving ecosystems themselves (unless this is somehow captured under "indicators for coastal development…").
      iv. Bullet 5: Do you mean what are the costs and benefits? And the distribution of those costs/benefits – who pays? Who gains?

   c. Question 3:
      i. Address ecosystem modeling here.

ii. Bullet 5: Unclear what is meant by this. It might mean improved planning tools to enable the derivation of greater system benefit from multiple smaller investments. That would be a useful addition.

d. Question 4:
   i. Address effects of improved training and professional development.
   ii. Bullet 3: Oil spill response technologies - This seems out of place here and would be better in knowledge tools and technologies above.

e. Question 6:
   i. Bullet 1: This has to be more than just events. We need to model, monitor and predict (maybe not forecast) the effects of different activities. Reframe this to focus on both chronic and acute stresses – and enable seeing one in the context of the other. Storm damage vs SLR?
   ii. Bullet 1: Model, monitor, and forecast events **and behaviors** that degrade coastal habitats.
   iii. Bullet 4: Clarify economic tradeoffs: Does this mean economic consequences? Who is suffering those consequences?

## Vision Area 3

1. *Question 1/5:*
   a. Address mechanism(s) by which **stakeholder input** is solicited and incorporated. This could involve existing frameworks such as State Climate Offices, Regional Climate Centers, Sea Grants, Extension Services OR creating new ones.

2. *Question 2:*
   a. **All forms of data**, platforms and analysis should be considered.
   b. Emphasize acquisition/sharing of private sector data networks, especially for model initialization. his would dovetail with remarks by NOAA acting Administrator for model changes (SAB meeting Feb 2019).
   c. Missing is better use of commercial products.

3. *Question 3:*
   a. **Embed social science throughout** in relevant research areas so it can work in concert with other research, i.e., better forecasts and how to communicate them, understanding indigenous fishing needs and pressures.
   b. Does Q3 refer to NOAA only or **linkages to the private sector** as well?
   c. Address issue of **next generation transdisciplinary experts**: what strategies exist in creating a new type of researcher?

4. *Question 4:*
   a. Implies a focus on having social science evaluate work once it is done rather than **having social science and social science collaborations with decision-makers inform how to shape a research** project from the beginning to meet needs. Bringing those insights into the beginning of a project formulation increases efficiencies by producing a product with the first version that is more closely aligned with stakeholder needs and less in need of revision. Would be useful to expand on the phrase "methodology for reaching target audiences" so that the needs and intent are more fully and clearly articulated.

b. Specify type of social science (psychology, sociology, anthropology, economics etc.) to better address the needs and gaps raised in the previous sub-questions.
c. Address **two-way communication with stakeholder** when addressing methodology for reaching targeted audiences.
d. Bullet 4: Address the modeling aspect – data modeling, not just data.

5. *Question 5:* Address research-to-practice or "bench-to-bedside" analyses.


***Other Specific Topics to Include:***
a. Growers could benefit from advances in labor saving devices – engineering solutions are needed to lessen the reliance on back-breaking, repetitive manual labor
b. NOAA could develop a competition to incentivize the development of approaches to shellfish farming that utilize areas with less conflicts such as deep-water sites on some of the larger estuaries, or moderate depth sites in some of the larger estuaries like Delaware Bay. These sites will require larger vessels and work platforms that can survive heavy seas and gear that can stand up to storms.
c. Continue to worry about the increasing frequency and intensity of HAB blooms of Cochlodinium which, while non-toxic to humans, are causing mortalities of shellfish and probably fish and crustaceans from the mid-Atlantic to southern New England. This species deserves greater attention.
d. Though the enabling condition "partnerships" is mentioned in the intro, it does not appear to be picked up for discussion in the topic areas.