

Comments for the Introduction Section

If this is a R&D strategic plan it needs to address "development" plans as well, not just research or scientific.

Enabling Elements for R&D - Political support is also needed to ensure that scientific findings are considered as input to public policy.

Key elements of the intro seem appropriate. However, under Enabling Elements, in contrast to the previous plan, this one does not flag "integration" (and systems framework), which strikes me as something meriting emphasis and inclusion.

I note that infrastructure and partnerships are included in the introduction. Not knowing the exact wording to be used in the intro, I suggest breaking out infrastructure as a separate section as well. Infrastructure is a critical element for NOAA, not just ships, but satellites, unmanned systems, buoys, and new technologies such as environmental DNA (eDNA)/omics. NOAA mission success depends on infrastructure and NOAA invests in two ways. First, is the development of elements of the infrastructure, such as satellites and importantly the R&D for algorithm development and products to use the satellites for weather and oceans. Second, is the development of applications for the use and exploitation of unmanned systems, as an example. There are other examples to be sure, such as doppler radar, dropsondes, acoustic monitoring of whales to name a few.

Vision Area 1 Comments

- Vision Area 1 Note right from the start that 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.
- Vision Area 1 These are good questions, but what I expect to see in a strategic plan are "strategies" which include actions, trade-offs and establishing of priorities.
- Vision Area 1 It surprises me that the only topics related even vaguely to climate change are in Vision Area 1. Should SAB suggest that climate change research is an important component of the NOAA mission and deserves more prominent discussion?
- Vision Area 1 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.
- Vision Area 1 In explaining/defining what is meant by "environmental phenomena" in vision 1, this would lead to better clarity about the breadth and depth of processes being targeted. Does it include the oceans? Land-surface processes?
- What is the timescale for the phenomena of interest? Is it less than an hour (tornadoes); hours to days (flash flooding, other flooding, tsunamis); up to a week? Are other longer term hazards like drought also included?
- For the global climate question, I would suggest a funnel approach in terms of the spatial scale of processes being considered from the global to hemispheric to synoptic to regional to local. That would ensure that the

processes/linkages and interactions across space and time are captured.
- I would also suggest moving the focus beyond precipitation and temperature only.

Vision Area 1 I would suggest adding "integrated framework" to the high precision GHG monitoring suggested

Vision Area 1 The title "Reduced Societal Impacts from Severe Weather and Other Environmental Phenomena" but only tangentially addresses societal impacts as currently formulated, with general terms for subtopics (decision support, risk communication). As already suggested in public comments, human activities should be 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. As noted in that report, weather impacts are shaped by how individuals, households, organizations, communities, respond to weather information, and how it informs decisions and behaviors. It follows that realizing the greatest return on investment from advancing meteorological research and numerical weather prediction requires fully engaging the social and behavioral sciences across the weather enterprise.

Vision Area 1 Rightfully, NOAA weather focuses on meeting the mandates created by Congress for NOAA. Much of the current mandate is in the Weather Bill. However, there are major changes in technology, science, and involvement of private sector in the weather enterprise. There are many other agencies who provide data, models, and science that enable NOAA's weather enterprise (e.g., NASA, DoE, NSF, etc.) Furthermore, there are many areas that NOAA should be expanding into- example better air quality forecasting, wildfire smoke forecasting, etc. Therefore, to make a NOAA for the 21st century, it is imperative that NOAA takes 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.

Use of atmospheric chemistry to understand and better predict weather and climate is crucial. For example, it would greatly help understand and predict boundary layer (where people live!) issues and develop better atmospheric parameterizations. Boundary layer is where people live, where people are impacted, and where people's influence on our environment starts. It is also where the atmosphere meets Earth's surface- solid earth and oceans. Yet, this lower most layer, may be a km or so in height, is one of the least understood and least well represented component of the earth system, be it for weather, climate, or aquatic systems. This is where the energy from the sun is deposited, orography plays a key role, and evaporation/deposition occurs. One of the problems is the scale of the processes, which goes from very small to large. Chemical with varying atmospheric lifetimes can be used to understand the boundary layer and, in turn, better understanding of boundary layer processes can help atmospheric chemistry and understanding human influences on air quality, climate, etc. Therefore, it would be highly beneficial for NOAA to emphasize atmospheric chemistry in the boundary layer.

- Vision Area 1 Forecasts and warnings may be made more useful by understanding and addressing the socioeconomic issues that influence whether people hear or heed these warnings. Similarly, efforts to improve the societal value of the cone of uncertainty could benefit from further research on risk perception, trusted sources, the role of experience in judging threats, as well as further research on risk communication. I see the potential for complementary social science to allow NOAA to more fully achieve its goals. For instance, in thinking about the impacts of changing climate there is substantial research that identifies direct impacts, but the questions of how those direct impacts interact with complex societal systems leading to potential cascades of indirect impacts is poorly understood. Working with social scientists to consult decision-makers from different sectors on which impacts are most significant for their resilience and risk management is another way in which social science could add substantial value to this agenda.
- Vision Area 1:
Question 1 How can forecasts and warnings for severe weather and other environmental phenomena be improved? - And then what? How can improved forecasts be used for better responses to save life and property? Techno-fascination will not do. We know that.
- Vision Area 1:
Question 1 Suggestion: Improve skill in precipitation (especially extreme rainfall) events
Comment - Only marginal increase in skill has been noted in precipitation amount/intensity across the U.S. in the past couple of decades, but damage due to flooding has increased substantially.
- Vision Area 1:
Question 2 Include a bullet at the end titled, "● System, community and individual responses to avoid climate change and to mitigate its impact."
- Vision Area 1:
Question 3 Why is the risk communication piece missing from section 2?
- Vision Area 1:
Question 3 This implies that the current services are sub-standard. Should it be more focused on enhancing utility of space weather products and services?

Vision Area 2 Comments

Vision Area 2 In this vision area there is an explicit recognition that social sciences can inform progress, but there could be more attention to how to integrate social, behavioral, and 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.

In each of the vision areas, not just Vision Area 3, it will be important to recognize explicitly (more so than in the current outline) 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.

The "evolving context" described in the executive report of the 2013-2017 strategic plan should be revisited and considered in the development of this new strategic plan.

- Vision Area 2 There have been many studies over the years about the potential contributions of social science towards the sustainable use of ocean and coastal resources. Here I see interest in the economic dimension which I applaud as a major concern. But 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.
- Vision Area 2 This section references human activities, in that it is titled "Sustainable use of ocean and coastal resources." Recommendations from the 2018 NASEM report referenced above apply here as well; social and behavioral science leadership, capacity, and focused expertise and efforts are critical to achieve progress in this vision area. For example, better understanding of fishing behaviors and fishing community needs will be essential to address the second topic within this vision area Here in particular 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.
- Vision Area 2 Despite the title of this Vision Area, the 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.
- Vision Area 2 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).
- Vision Area 2 Notably absent is any reference to ecosystem "services" (whether using that language or other terminology).
- Vision Area 2 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.
- Vision Area 2: Question 1: Include a bullet at the beginning of this titled, "● Economic analyses of ROIs?"
- Vision Area 2: Question 1: Bullet 1&2 New genomics tools will allow aquaculture to accelerate selective breeding efforts by utilizing marker assisted selective breeding. Especially in shellfish culture where selection efforts are in their earliest stages, these efforts have the potential to greatly improve production traits such as disease resistance, growth rate, shape etc. These efforts are expensive and require sustained investments.

- Vision Area 2:
Question 1:
Bullet 3
- For shellfish, (which have a rudimentary immune system), drugs, antibiotics and vaccines are unlikely to be effective. Selective breeding efforts have the best hope of resolving disease impacts on aquaculture. These efforts can take two approaches – 1) the brute force approach – spawning many families and exposing them to disease pressure and selectively breeding survivors. 2) utilizing the new genomic tools to identify which genes are associated with traits associated with resistance and survival and select for brood stock with those traits.
- Vision Area 2:
Question 1:
Bullet 4
- This need to explicitly consider changing conditions – provide planning tools that enable decadal scale planning of coastal/estuarine conditions and how space-use conflicts will be influenced by climate/sea level rise
- Vision Area 2:
Question 1:
Bullet 4
- 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.
- Vision Area 2:
Question 2
- Include two bullets at the end of this section titled, " • Improved needs assessment and market analyses" AND "• Indicators for ecosystem sustainability"
- Vision Area 2:
Question 2
- 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...”).
- Vision Area 2:
Question 2:
Bullet 4
- 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?
- Vision Area 2:
Question 3
- 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.
- Vision Area 2:
Question 3
- Include a bullet at the end titled, "• Ecosystem modeling"
- Vision Area 2:
Question 3:
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.
- Vision Area 2:
Question 4
- Include a bullet at the end titles, "• Effects of improved training and professional development personnel?"
- Vision Area 2:
Question 4:
Bullet 3
- Oil spill response technologies - This seems out of place here and would be better in knowledge tools and technologies above.
- Vision Area 2:
Question 4:
Bullet 5
- This is really unclear. Do you mean what are the costs and benefits? And the distribution of those costs/benefits – who pays? Who gains?

- Vision Area 2: Modify the first bullet to, "● Model, monitor, and forecast events and behaviors that
Question 6 degrade coastal habitats"
- Vision Area 2: This has to be more than just events. We need to model, monitor and predict (maybe
Question 6: not forecast) the effects of different activities. Reframe this to focus on both chronic
Bullet 1 and acute stresses – and enable seeing one in the context of the other. Storm damage
vs sea level rise?
- Vision Area 2: Economic tradeoffs is unclear. Does this mean economic consequences? Who is
Question 6: suffering those consequences?
Bullet 4

Vision Area 3 Comments

- Vision Area 3 There needs to be a mechanism(s) by which stakeholder input is solicited and
Question 3 incorporated (questions 1 and 5). This could involve existing frameworks such as State
Climate Offices, Regional Climate Centers, Sea Grants, and Extension Services OR
creating new ones.
- Vision Area 3: Suggestion: Emphasize acquisition/sharing of private sector data networks, especially
Question 2 for model initialization
- Comment - This would dovetail with remarks by NOAA acting Administrator for model
changes (SAB meeting Feb 2019)
- Vision Area 3: There is a reference to an existing/planned gap analysis from which NOAA's needs
Question 2 have/will be identified is important. In addition, all forms of data, platforms and
analysis should be considered.
- Vision Area 3: What seems to be missing is better use of commercial products.
Question 2
- Vision Area 3: NOAA will never make progress on incorporating social science when it is seen as a
Question 3 separate activity. Rather than having this as a focus area make sure it is embedded
above 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..
- Vision Area 3: This refer to NOAA only or linkages to the private sector as well?
Question 3
- Vision Area 3: Include a bullet at the end titled, "● Next generation transdisciplinary experts: what
Question 3 strategies exist in creating a new type of researcher?"
- Vision Area 3: The language implies a focus on having social science evaluate work once it is done
Question 4 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.

- Vision Area 3: The specific type of social science (psychology, sociology, anthropology, economics etc.)
Question 4 should be specified so as to better address the needs and gaps raised in the previous sub-questions.
- Vision Area 3: Modify the third bullet from, "● Methodology for reaching targeted audiences" to " ●
Question 4 Methodology for reaching targeted audiences, and hearing back from them"
- Vision Area 3: Modify the fourth bullet from, "● Integrated climate and ecosystem data with economic
Question 4: and human dimensions data" to "● Integrated climate and ecosystem data **modeling**
Bullet 4 with economic and human dimensions data"
- Vision Area 3: Include a bullet at the beginning titled, ● "Bench-to-bedside" analyses'
Question 5
- Vision Area 3: Modify the current first bullet to include the following phrase, "(based on above
Question 5:L analyses)"
Bullet 1

Comments on the Evaluation Section

The current language seems to indicate that "evaluation" is a purely technical exercise. It is not, and it requires improvements and new methodologies. I would make that a research item itself: Developing appropriate theories of change, measurement constructs, indicators for outcomes, and evaluation designs for key focus areas. Creating data systems to capture outputs and reach of NOAA efforts using automatized and reliable mechanisms.

Strategy - briefly discuss how NOAA can address these vision areas, key questions, and objectives under the current financial constraint and organizational structure. For instance, Cooperative Institutes (CIs) may be the most flexible component within NOAA that can be used for this purpose. However, the co-location requirements of CIs with NOAA organizations are much less important now than in the past. Therefore NOAA may reconsider whether it wants to have CIs with specific universities or with the best qualified teams at different universities (through a consortium) for specific vision areas, key questions, and objectives.

General Comments to the Plan Outline

Growers could benefit from advances in labor saving devices – engineering solutions are needed to lessen the reliance on back-breaking, repetitive manual labor

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.

I 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.

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?

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?

A strategic plan is basically about meeting goals with specific strategies, establishing priorities and the resources to meet those priorities. I really don't see any of that. I see strategic questions, but to be a "plan" there has to be trade-offs of strategic choices. I don't see the elements of a real plan. One of the most important aspects of a strategic plan is "what are you not going to do?". That gets back to priorities. If these basic elements are not included then it's a nice communications brochure or a policy paper of no real value.

Overall there is much to like about the outline.

- It 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

thought from John Knauss, from the days when he was Under Secretary/NOAA Administrator years ago, and I was Acting Chief Scientist. He said, "your job is to make sure that NOAA is as relevant fifteen years from now as it is today."

As NOAA scientific leadership works to flesh out this outline, it might be helpful to keep that thought in mind

I 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.

Though the enabling condition "partnerships" is mentioned in the intro, it does not appear to be picked up for discussion in the topic areas.

All of the basic elements that one would hope to see in a "plan" seem to be included in the outline; however, I may have missed it or it may not be relevant today, but I 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." Seems to me if these two priorities are still guiding principles for NOAA they should be referenced up front. I'm not exactly sure of the wording of the two high level priorities.

I do not believe 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. In any event, without including budget and timelines I'm not sure this meets the criteria for a "plan."

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.

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)."

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

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.

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.

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

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

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 description 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 to me 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.

The NOAA R and 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. I recognize that this is only brief outline and perhaps the issues I raise 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 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.