

Assessment of the “NOAA Ocean and Great Lakes Acidification Research Plan 2020-2029”

Reviewers:

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Summary: The “NOAA Ocean and Great Lakes Acidification Research Plan 2020-2029” carefully and clearly lays out the causes of acidification, the potential impacts of acidification on the scope of human endeavors within NOAA’s purview, and a regionally-based assessment of the existing and additionally-needed resources to assess and monitor and mitigate (where possible) or adapt (where mitigation isn’t sufficient) to the effects of acidification.

Consistent with the terms of reference laid out in the guiding legislation (the FOARAM Act of 2009), NOAA’s mission with respect to acidification (OA, hereafter) has three components:

- Document and predict change via environmental monitoring, analysis and modeling;
- Characterize and predict biological sensitivity of species and ecosystems to; and
- Understand human dimensions and socioeconomic impacts of OA.

NOAA research goals with respect to OA are to:

- Advance OA observing systems, modeling, technologies and data stewardship to improve the understanding and predictive capability of OA trends and processes;
- Enhance understanding and prediction of OA as a stressor co-occurring with other prominent ocean and Great Lakes changes;
- Improve understanding of the biological response and adaptive capacity of ecologically and economically important species, ecosystems and communities;
- Increase research to understand the vulnerability of communities and stakeholders to OA and to generate useful data that supports adaptation and resilience plans.

This research plan captures NOAA’s extraordinary effort to improve the ability to understand, protect, manage, and restore ecosystems that support healthy fisheries, increase opportunities for aquaculture, and balance conservation with tourism and recreation and to promote the health and economy of our people and nation. The Plan will maintain and enhance NOAA’s mission, specifically with respect to recently released Blue Economy goals and the objectives outlined in the FOARAM Act of 2009.

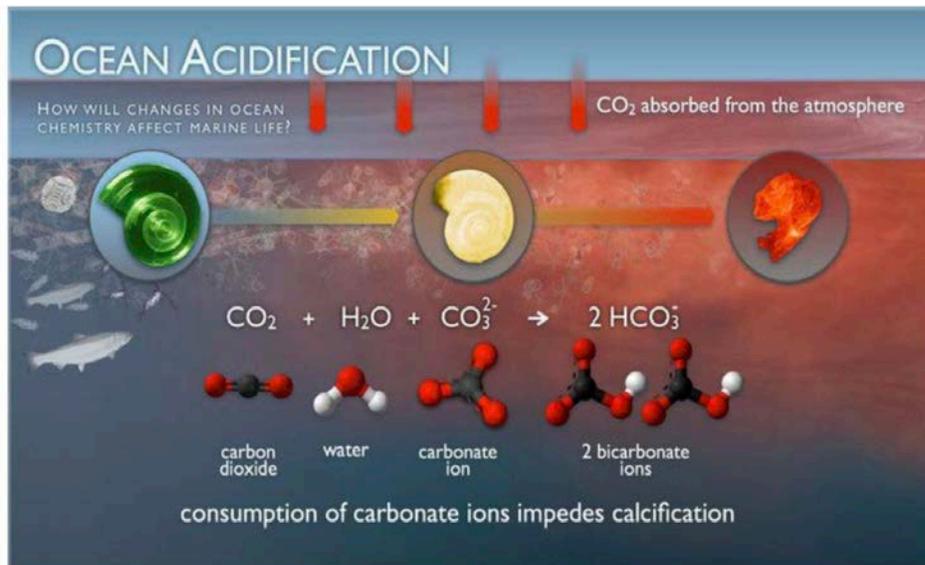


Figure 1: The pH of ocean water decreases (becomes more acidic) when CO₂ is added to it

Overall Assessment

We want to congratulate the authors for drafting a brilliant research plan, and on a terrific job of pulling this together under difficult funding circumstances. The hard work, care and creativity of the authors is evident and they should be commended. It is remarkable that OA research at NOAA spans across five of its six line offices: Ocean and Atmospheric Research (OAR); National Marine Fisheries Service (NMFS); National Ocean Service (NOS); National Environmental, Satellite, and Data Information Service (NESDIS); and Office of Marine and Aviation Operations (OMAO). As such, this document will be significant across NOAA as well as to researchers and stakeholders.

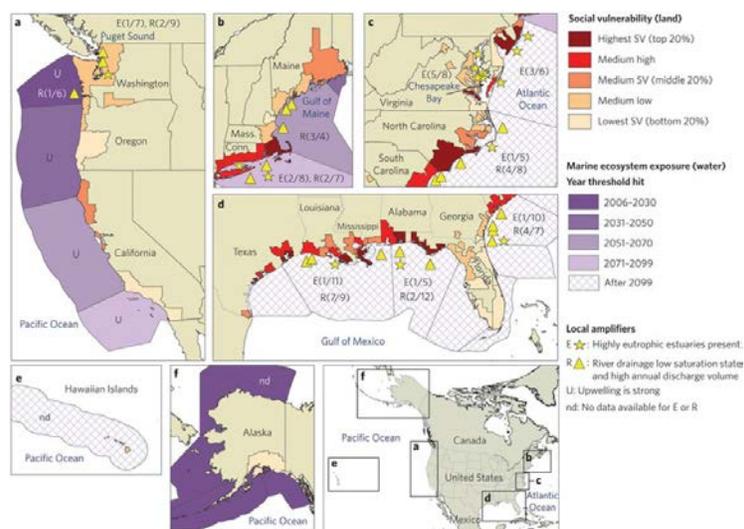


Figure 2: Overall vulnerability of places to ocean acidification. From Ekstrom et al. 2015

Recommendations:

1.0 NOAA-wide Integrated Modeling

Although there is information about NOAA's various OA modeling efforts scattered through out the chapters, we would like to see a more focused and integrated effort across the line offices. NOAA should formally commit to an integrated modeling approach for OA across its line offices and departments. NOAA/GFDL is ready and capable of synthesizing, projecting and predicting OA-related issues numerically, thereby enhancing the abilities of NOAA decision-makers and external stakeholders to rely on the most up-to-date data and assessments. We appreciated the consistent effort throughout the text to integrate the ecological and chemical components of OA and respective science communities. To strengthen this point, linking regional ecosystem models and biogeochemical frameworks should be prioritized so that OA observations can be utilized to their full potential and put into context. Increasing the near-term and longer-term predictive capabilities of NOAA's OA research will enhance NOAA's ability to act quickly in times of crisis and to provide stakeholders with timely information to enhance the economic utility of our national waters and ensure both the public safety.

Recommendation 1: Formally commit to an integrated modeling approach across NOAA line offices.

Recommendation 2: Prioritize the linking of regional ecosystem models and biogeochemical frameworks so that OA observations can be utilized to their full potential.

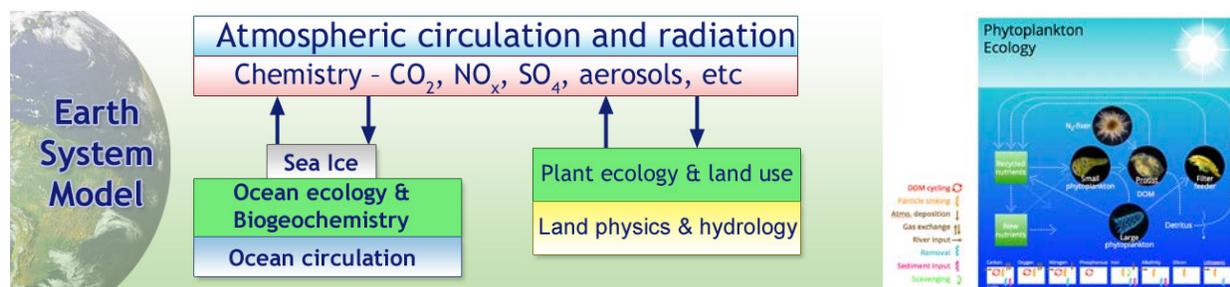


Figure 3: The figure on the left is a schematic showing the main components of an Earth System Model with biogeochemical and ecological components in green [Figure from <https://www.gfdl.noaa.gov/earth-system-model/>]. To the right is a simplified schematic showing the complex relationships that describe the connection between ocean ecology and ocean biogeochemistry. Simulations of ocean acidification require models of this complexity [Figure adapted from Dunne et al. (2005, 2007)]

2.0 Interactions between Onshore, Nearshore and Offshore Processes

NOAA's OA research plan includes monitoring both the onshore and/or nearshore and offshore connections associated with OA. Aquaculture in particular is expanding in every state: OA in the nearshore waters where aquaculture occurs can be driven by biogeochemistry and freshwater supply, and these regions are often chronically undersampled. In addition, several chapters raise the possibility of interactions between eutrophication and acidification – monitoring the coexistence and coevolution of these processes should be a higher priority.

Recommendation 1: Increase sampling of nearshore waters in sensitive and economically important areas.

Recommendation 2: The co-varying and possibly exacerbating effects of eutrophication and acidification on each other should be studied.

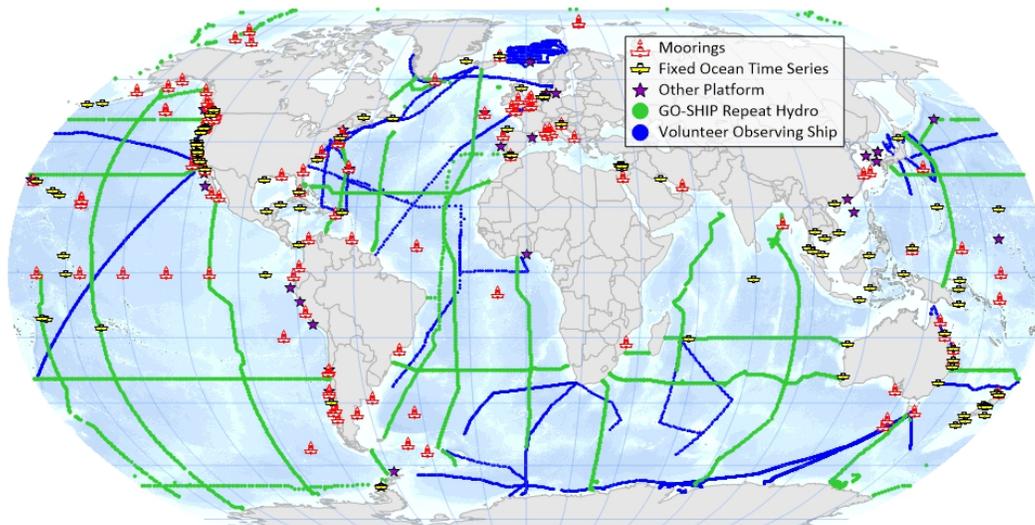


Figure 4: The preset-day Global Ocean Acidification Observing Network

3.0 Data Management and Products

The importance of data management is emphasized in the executive summary, and many of the action items in the various chapters mention stakeholder needs and expectations, but a more centrally-placed, overarching focus on the need to provide useful data products would emphasize the importance that NOAA's OA program places on this objective. In our data-rich world, the FAIR (findable, accessible, interoperable and reusable) standard for data management is essential: NOAA is already a leader in these practices and it can and should continue to set the standards for data generation, storage, management and dissemination. More attention should be paid to the data products that NOAA provides and the stakeholder requirements of those products. Communication with stakeholders on the products and syntheses they need should be a high priority.

Recommendation 1: Highlight centralized access to NOAA's existing data syntheses and products.

Recommendation 2: Highlight and or initiate planned communications with stakeholders on the desired data products and syntheses that would be most useful to those communities.

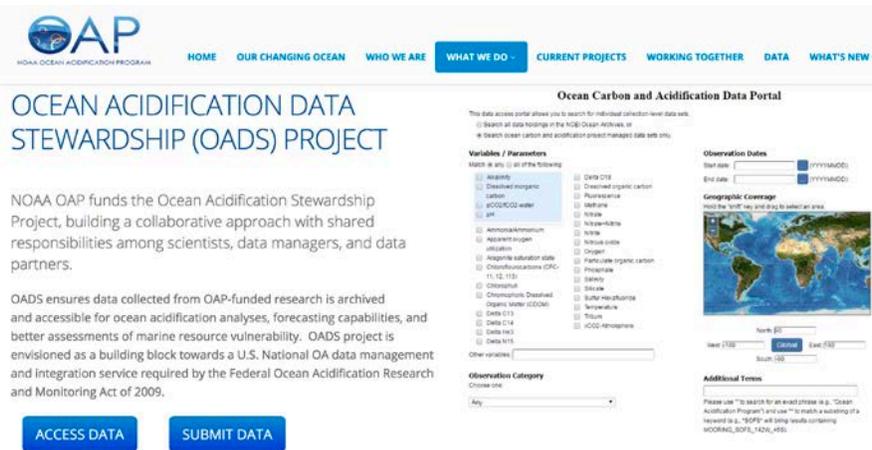


Figure 5: The critical importance of data management, integration and standardization, as well as user accessibility and data product formatting cannot be overstated. From: <https://oceanacidification.noaa.gov/WhatWeDo/Data.aspx>

4.0 Metrics of Success

Metrics for assessing the success of NOAA’s OA research plan should be included in the plan. The research plan would be significantly stronger if there were metrics by which NOAA, Congress and the public could assess:

- The execution of the research plan (did we accomplish what we set out to)
- The excellence of the outcomes (these are all of the amazing products and services we provided)
- The total contribution of the plan in dollars to the Blue Economy

Putting a dollar value on usefulness of NOAA’s OA research and products to the nation and the economy would specifically highlight the importance and effectiveness of NOAA contribution to commerce and the safety and the livelihoods of stakeholders and the public in U.S. waters.

Recommendation 1: Include metrics by which NOAA can quantify the success of its OA research and outreach.

Recommendation 2: Quantify the economic benefit of NOAA’s OA research and products to the Blue Economy.

5.0 Further minor comments and suggestions are included in the attached spreadsheet