NOAA'S RESPONSE TO THE CLIMATE WORKING GROUP'S REVIEW OF THE NOAA OCEAN, COASTAL, AND GREAT LAKES ACIDIFICATION RESEARCH PLAN: 2020-2029

Research Plan Overview

The NOAA Ocean, Coastal, and Great Lakes Acidification Research Plan: 2020-2029 identifies agency-wide research objectives and actions with respect to NOAA's ocean acidification (OA) science for the coming decade. The research plan was drafted by nearly 70 authors that included both NOAA and non-NOAA researchers and technical experts. This plan serves as an update to the first 10-year NOAA OA research plan that was released in 2010. The plan includes a national chapter that provides high-level research objectives and actions that are relevant across NOAA's regional research domains. These domains are described in greater detail in nine subsequent regional chapters that outline research objectives and actions relevant to the OA science gaps and needs of the U.S. coastal regions, Great Lakes, and open ocean.

The Review

In October-November 2019, at the request of NOAA's Science Advisory Board (SAB), a panel of experts in climate and ocean science reviewed the draft NOAA Ocean, Coastal, and Great Lakes Acidification Research Plan: 2020-2029 (hereafter referred to as "OA Research Plan"). Reviewers provided comments on the scientific content and merit of the plan as well as the responsiveness of the plan goals and actions to NOAA's legislative mandates and agency mission. Convened under the auspices of the Climate Working Group (CWG) of NOAA's SAB, the Review Panel produced a report in December 2019 that included overarching and detailed revision recommendations. NOAA's response to that review follows.

Response to the Findings of Review Panel Members

NOAA is grateful for the review's summary statement that this is a "brilliant research plan" and is also thankful for the "hard work, care and creativity of the authors" who drafted it. We continue to be humbled by the intense energy and talents of the drafting authors who have guided and executed NOAA's efforts on OA to date. We appreciate the CWG's thoughtful recommendations on how to improve this OA Research Plan and respond to each comment below.

Response to the Recommendations of the Climate Working Group Review

1. NOAA-wide Integrated Modeling

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

We agree with the reviewers that a commitment to an integrated modeling approach across NOAA line offices would greatly enhance NOAA's modeling efforts. However, we feel that this integration effort must extend far beyond the topic of OA, so chose not to tackle it in the OA Research Plan. NOAA modelers working on OA have participated in NOAA's larger efforts on cross-line office model integration and are in regular conversation through the NOAA OA Working Group organized by the NOAA OA Program.

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

Linking regional ecosystem models with biogeochemical frameworks is indeed a robust path for utilizing OA observations in the context of living marine resource management. In regions where suitable ecosystem and biogeochemical models have already been developed, such integration has been funded and executed by NOAA. In other regions, NOAA is working to develop the models needed to do such joining. The OA Research Plan now prioritizes this work through an action in chapter 1, which outlines nation-wide needs: "Action 1.1.6: Develop and expand coverage of regionally linked biogeochemical-ecosystem models, with a focus on timescales of days to decades, capable of resolving conditions most relevant to local living marine and Great Lakes resources and dependent communities.

2. **Interactions between Onshore, Nearshore and Offshore Processes**

Recommendation 3: Increase sampling of nearshore waters in sensitive and economically important areas.

NOAA agrees with this suggestion and revisions to the OA Research Plan were made accordingly. A new national chapter action has been added to elevate the importance of nearshore observing and connectivity with offshore processes within the research plan "Action 1.1.2: Increase sampling of nearshore waters in sensitive and economically important areas and improve observing connectivity between coastal and open ocean to explicitly characterize the anthropogenic carbon content present in these environments." In addition, actions can be found scattered throughout the regional chapters regarding observing efforts in nearshore regions, particularly those that are economically and ecologically important. For example, the Pacific Islands chapter nicely emphasizes nearshore observing in sensitive regions with, "Action 6.1.1: Maintain carbonate chemistry water sampling in shallow coral reef environments and expand nearshore OA monitoring in collaboration with local partners to describe spatial patterns and longer-term temporal trends in OA across Pacific insular areas."

Recommendation 4: The co-varying and possibly exacerbating effects of eutrophication and acidification on each other should be studied.

To address this recommendation, we revised the National chapter to clarify the importance of examining multi-stressor environments, adding "Action 1.2.1: Assess acidification and multi-stressor sensitivity among species, particularly ecologically and economically important species, to build understanding, provide important information to ecosystem modeling efforts, and inform management decisions." Chapters on regions that are subject to eutrophication specifically described this interaction and articulated corollary research actions (see the New England, Mid-Atlantic Bight, Gulf of Mexico and Southeast Atlantic, and Great Lakes chapters). For example, we refer to this action within the Gulf of Mexico and Southeast Atlantic chapter: "Action 7.1.4: Establish OA and water quality monitoring stations at inlets and near commercially and recreationally important estuaries (e.g., oyster bed leases, public clam beds, shellfish hatcheries)

to monitor coastal acidification and eutrophication co-stressors in areas where fresh water systems are highly impacted by human activities and strongly influence coastal oceans."

3. **Data Management and Products**

Recommendation 5: Highlight centralized access to NOAA's existing data syntheses and products.
Recommendation 6: Highlight and or initiate planned communications with stakeholders on the desired data products and syntheses that would be most useful to those communities.

NOAA agrees that the OA Research Plan would be improved by better highlighting access to data syntheses and products and engagement with stakeholders in their development. We feel that NOAA OA efforts do follow best practices related to access and engagement and have made revisions in the National chapter of the Plan accordingly. In terms of access, the National chapter now includes, "Action 1.1.8: Ensure all data collected by observing systems comply with FAIR data principles." and "Action 1.1.9: Support synthesis activities to ensure environmental data are transitioned to useful products for modelers and other audiences." The two revised actions most responsive to Recommendation 6 are, "Action 1.3.4: Encourage research partnerships and two-way dialogues with stakeholders to ensure that science is aligned with local to regional level priorities, by supporting networks that are engaging in outreach, communication, and research, such as the OA Information Exchange and Coastal Acidification Networks," and "Action 1.3.5: Develop and operationalize data synthesis, visualization tools, and communication products with robust stakeholder and partner input to ensure products are responsive to needs." In addressing this recommendation, we also point to revisions found in Actions, 1.3.1, 1.3.2, 1.3.3, 1.3.6, and 1.3.7.

4. **Metrics of Success**

Recommendation 7: Include metrics by which NOAA can quantify the success of its OA research and outreach.
Recommendation 8: Quantify the economic benefit of NOAA's OA research and products to the Blue Economy.

We agree that metrics and economic benefit quantification are important ways to mark success in the implementation of research plans. We note that NOAA chairs and staffs the Interagency Working Group on OA, which is charged by the Federal Ocean Acidification Research and Monitoring Act of 2009 with coordinating and tracking implementation of the Strategic Plan for Federal Research and Monitoring of OA. We suggest that NOAA's efforts related to tracking metrics of success related to OA research are best folded into the obligations of the Federal government as a whole. This Federal-wide approach acknowledges the cross-agency synergies in OA research that the Interagency Working Group on OA has spent a decade building. That said, we did revise an action in the National chapter to directly address Recommendation 7, "Action 1.3.7: Monitor trends in community awareness and perceptions of acidification impacts and participation in stewardship activities across diverse stakeholders." Further, we note that the

NOAA OA Program is currently funding a study to understand the economic benefit of the OA Program's investments.

5. **Further minor comments and suggestions are included in the spreadsheet in Appendix A.**

NOAA is grateful to the review members for their detailed comments on the individual chapters within the draft research plan. Each suggested revision was made within the draft document.

Conclusion and Acknowledgements

As the Congressionally mandated lead agency for Federal efforts on OA, NOAA has a large responsibility to the nation on the issue. The OA Research Plan was drafted with this responsibility in mind and we are grateful that the SAB review indicates we have risen to the challenge. NOAA acknowledges the Climate Working Group and the Review Panel members for their dedication to NOAA and attention to climate change and ocean acidification, two key challenges of our age.