

# **Global Ocean Monitoring and Observing Program, Program Review**

July 11-14, 2022

Global Ocean Monitoring and Observing Program - Response to Panel Review Recommendations

May, 1, 2023

Submitted by: David Legler, Director

## **Purpose of the Review:**

Program science reviews are conducted every five years to evaluate the quality, relevance, and performance of research conducted in the National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research (OAR). This review is for both internal OAR/NOAA use for planning, programming, and budgeting, and external interests. It helps the Program in its strategic planning of future research activities. These reviews are also intended to ensure that OAR research is linked to the NOAA Research mission and priorities, and other relevant strategic plans. Lastly, it is intended to ensure that research is of high quality as judged by preeminence criteria, and is carried out with a high level of performance.

## **Scope of the Review**

This review will cover the program activities of GOMO over the last five years (2017-2021).

The three Focus Areas for the review were:

- 1) US leadership of an ocean and arctic observing research enterprise;
- 2) Frontiers in ocean observing; and
- 3) Information and product development to ensure data access and usability and to increase the value/impact of ocean observations.

The review took place July 11-14, 2022 at NOAA Headquarters in Silver Spring, Maryland in hybrid format.

All materials can be found on the Review Website ([here](#)).

*In this report, each actionable recommendation provided by the Science Review Panel is italicized and followed by GOMO response. A table summarizing the actions with timelines for completion is included below.*

## Recommendations, Responses, and Action Plans

All queries about recommendations and actions should be requested through Jessica Snowden [Deputy Director] and Sandy Lucas [Arctic Research Program Director]. Both will act as point of contact.

The following table lists the number of the recommendation, section [Program wide, Focus Area 1, 2, 3, respectively], GOMO Program responses [Action] to the Program Review recommendations [Recommendation], target start and completion date; and highlights areas that are strongly budget independent [BD] (indicated in gray).

#	Section	Recommendation	Action	Target start & Completion Dates	BD
1	Program wide	<i>Bring GOMO's identity into clear focus. Work to sharpen both internal and external understanding of GOMO's portfolio/position/value with the NOAA enterprise. Define where the boundaries or 'handoffs' sit between GOMO and IOOS and GOMO and the broader climate effort and other relevant activities/applications. Look for points of collaboration and coordination.</i>	1.1 Develop an analysis of GOMO's relationships with organizations in NOAA considered to be GOMO stakeholders, end-users, contributors, etc. 1.2 List points of collaboration/coordination. 1.3 Establish regular communications with related programs: assess increased awareness, desire, and action to collaborate with GOMO.	2024-2027	

2	Program wide	<p><i>GOMO is poorly known as a program nationally, and thus not deeply appreciated, by the wider ocean community and in Congress. Increasing GOMO's visibility and their contribution to the larger NOAA mission is recommended, by specifically highlighting their contributions to critical baseline measurements that help fulfill NOAA's mission. GOMO's messaging should clearly articulate its contribution to our collective knowledge of the ocean and the climate system. These should also include illustrations of the merit of the expanding scope of the observing system, e.g., uncertainty of heat content change changing with the number of Argo profiles and the regions they cover, etc. See also Recommendations on Communication.</i></p>	<p>2.1 Review all messaging and update as needed to ensure the following are clearly articulated: a) GOMO's contributions to larger NOAA missions/goals, b) GOMO's contributions to critical baseline measurements that fulfill NOAA's missions, c) GOMO's contribution to knowledge of the ocean and the climate system.</p> <p>2.2 Develop more graphics and visual representations of GOMO's ocean observing impacts by working with a graphic designer/data visualization expert (3-5 products).</p> <p>2.3 With OAR, identify opportunities for GOMO to engage within OAR and NOAA to raise our visibility and expand the understanding of GOMO.</p> <p>2.4 Engage across NOAA to share info/updates on GOMO, its scope, mission, role in NOAA, opportunities, etc.</p>	2023-2025
3	Program wide	<p><i>Within GOMO's portfolio of ocean observations, develop a framework for prioritizing observational activities that can be used to guide investments in long-term, sustained efforts. Alongside this, develop and implement a process for regular review of sustained observing efforts, including an assessment of the observations' fitness for purpose (the measurements remain important in light of changes in the environment and in scientific</i></p>	<p>3.1 Develop and share a conceptual model for GOMO support of observing system development (including stakeholder engagement/co-design), and applied science research.</p> <p>3.2 Develop and incorporate commensurate prioritization processes at the program (strategic planning) and execution level (e.g. through grant/project review processes). [Links to recommendations # 9, 10 , 11]</p>	Spring 2023 - Spring 2026

		<i>understanding), efficiency of the observational approach and quality of the data being delivered.</i>			
4	Program wide	<i>GOMO should develop best practices for interactions with Industry. GOMO must find ways to ensure that observational systems remain resilient to industry changes. This means developing strategies to foster competition and avoid sole sources for critical components (e.g., SeaBird CTDs in the Argo Array), while also nurturing developing technologies by allowing for risk to achieve advancement.</i>	<p>4.1 Review GOOS-MTS Dialogues for suggestions and potential points of intersection, e.g., 1) sensor and platform development and testing for current and new capabilities in-network; on-ramps (testing/evaluating/incorporating) for new (alternative) observing capabilities, alternatives to existing approaches; and data as a service approaches</p> <p>4.2 Identify and invest in pilot activities to increase private sector engagement in GOMO missions. [Links to recommendation #14]</p>	Spring 2023 - Fall 2026	
5	Program wide	<i>To capitalize fully on investment in ocean observing, GOMO should consider being more proactive in this unique leadership role to strive to strengthen the global enterprise and lead by example to guide the future of Global Ocean Observing.</i>	Develop a set of 1-3 objectives that GOMO wants from participation in GOOS, that includes an engagement strategy for GOOS, possible membership and leadership of key GOOS bodies and activities that maps onto those objectives.	Spring 2023 - Fall 2024	
6	Program wide	<i>GOMO should continue pursuing and championing conversations to link the open ocean and coastal areas better through conversations with partners like IOOS. Though Planning horizons and processes are different across programs, work on finding a common set of priorities, and consider developing joint projects on boundary currents, extreme events, etc.</i>	<p>6.1 If budget allows, support IOOC workshop (proposed to US CLIVAR). Use outcomes and ongoing actions from the OAR/NOS Summit to find specific projects of intersection.</p> <p>6.2 Hold an ocean-coastal observing science session at 2023 GOMO Community Workshop to identify top priority areas for joint projects.</p>	Spring 2025	

7	Program wide	<p><i>GOMO should work to build leadership capacity and succession planning within program management, and within the science and technological ranks. GOMO appears to be working on this problem, but the criticality of the need should be emphasized. For coordination and management staff, being clear or creating a clear policy about developing pathways for responsibility and leadership experience is useful. Consider secondment and exchange with partner programs, such as the GOOS office, as potential avenues for training or experience for GOMO staff. For succession strategy, there needs to be a strategy in place that will ensure that retirements/loss of personnel does not result in loss of information.</i></p>	<p>7.1 Use OAR guidance on professional development investment (new Steve Thur initiative) to ensure federal employees are growing in leadership skills. Ensure contract employees are talking with their supervisors about opportunities within their companies for growth. With other OAR programs and labs, discuss how OAR can better plan for its future workforce.</p> <p>7.2 Require annual presentations by each program manager on their portfolio to the team to facilitate more regular sharing of information and promote cross-portfolio learning and understanding.</p>	Spring 2023 - Spring 2025	
8	Program wide	<p><i>GOMO should consider devoting more dedicated human resources to key capacities needed to operate as a program. For example, to the areas of professionalized and tightly coordinated data and information management (e.g., a team led by a digital transformation manager), communications (e.g., social media, website), and in-house consultants (jack of all trades). These resources should be clearly aligned to GOMO's strategic and implementation plans.</i></p>	Update staffing plan for FY23-FY25 in light of Review recommendations and take action towards realizing the staffing plan.	Spring 2023 - Spring 2025	
9	Focus Area 1	<p><i>Developing a set of (flexible) priorities so that GOMO can seize funding opportunities. An example could be marine carbon dioxide removal</i></p>	Using the common budget formulation template for NOAA, draft known needs and new areas for investment and ensure these proposals are in a	Spring 2023 - Fall 2024	

		(mCDR).	shared, common place for easy access, updating, and review.		
10	Focus Area 1	<i>Better understanding stakeholder requirements. GOMO should identify who could be a new stakeholder/partner that then can use their data. It is part of the strategic plan.</i>	10.1 Build off of work done in the Arctic Research Program to continue identifying GOMO existing stakeholders and gaps in stakeholder engagement. 10.2 Consider having each program/manager find and engage with one new stakeholder/sector annually to identify their needs and educate them on GOMO.	Spring 2023 - Fall 2026	
11	Focus Area 1	<i>Developing a framework of decision making that will help dictate how/what GOMO will invest into in the future. This within the framework of sustained ocean observations. Consider also <b>observing system design</b>.</i>	The program is planning to revise our management structure to better address needs (such as EOVs, regional priorities, phenomena) and will utilize results from the Co-design work to evolve to understand user needs and priorities. GOMO will consider the outcomes of recommendation #3, 5 and 9 to inform decision making approaches.	Spring 2023 - Fall 2026	
12	Focus Area 1	<i>Leveraging the increased visibility of the Arctic and NOAA's renewed climate focus to lead the buildout of a sustained Arctic observing system. This could be started by extending key global observing networks, such as Argo, into the Arctic and partnering with IOOS to accelerate development of real-time, in situ observing networks that serve Arctic coastal communities.</i>	Should NOAA advance and fund the implementation of the US AON report to congress, GOMO would use the report to advance the Arctic observing system.	Spring 2023 - Spring 2025	



13	Focus Area 2	<i>Maintaining a continuous dialogue with co-design partners (e.g., Indigenous communities) to assure their interests are met by the observing systems, and to build on the trust and credibility of the process for the future evolution of the observing systems. Their interests and support should be turned into an asset to help raise GOMO's profile.</i>	<p>13.1 Establish dialogue and foster sustainable engagement with Arctic and Pacific island communities;</p> <p>13.2 Apply lessons learned to continue and expand dialogues with other stakeholders.</p>	Spring 2023 - Spring 2027
14	Focus Area 2	<i>Taking steps to resolve supply chain issues threatening its observing systems (e.g., pH sensors and CTDs for Argo floats). These threats are increasingly common, made more evident across society during the ongoing pandemic (e.g., baby formula, ventilator, masks), and is a problem that requires broader expertise beyond the technical scope of this review. GOMO should seek advice and input from supply chain experts to chart a solution.</i>	<p>14.1 Engage with companies to discuss sensors and which ones they are considering in the future. \</p> <p>14.2 Consult widely across NOAA about supply chain issues and identify recommendations and engage with the community to avoid single-source failure [links to recommendation 4].</p>	Spring 2024 - Spring 2026
15	Focus Area 2	<i>Further progress is urgently needed in the observing system innovation, integration - specifically GOMO should be encouraged to systematically integrate processes to look across the observing system from an applications perspective, engaging with modeling and user groups into their work program. GOMO clearly plays a key leadership role through a number of specific examples, but this work needs to be bolstered and taken further. Hence the balance of scores in this</i>	<p>15.1 Work with the GOMO community to identify gaps in our research-to-applications pipeline.</p> <p>15.2 Leverage lessons learned from GOMO programs that have effectively brought together researchers, modelers, and user groups.</p> <p>15.3 Establish a process for integrating this across the entire GOMO program where appropriate.</p>	Spring 2024 - Summer 2027

		section.		
16	Focus Area 2	<i>Better positioning ocean carbon work at GOMO to support future measurement verification and reporting (MRV) requirements for an ocean carbon industry that will only succeed if there is trust in science and technology. As ocean carbon work will be fundamental to the near future of climate mitigation and the blue economy, this is a major opportunity for GOMO to establish a position of intellectual leadership and leverage NOAA's placement in the Dept. of Commerce.</i>	<p>16.1 Lead the establishment of a Global Operational Surface Ocean Carbon Dioxide (CO<sub>2</sub>) Network (SOCONET) to integrate national and regional surface ocean carbon dioxide research and monitoring efforts into a global framework that will serve as the backbone of a monitoring, reporting and verification (MRV) scheme to incorporate natural ocean sinks in global surface water and marine air carbon data for assessments and reporting to produce global stocktake assessments. Specifically,</p> <p>16.1.1 Expand geographic coverage of GOMO high-quality ocean carbon observations from ships and moorings to determine the global ocean anthropogenic carbon sources, sinks, and long-term trends</p> <p>16.1.2 Develop and deploy autonomous ocean observing platforms and improved instrumentation, particularly for autonomous platforms, to fill gaps in undersampled regions</p> <p>While these actions will be partially supported by funding for sustained surface ocean CO<sub>2</sub> projects, new funding will be required to expand coverage of the network and implement autonomous platforms and improved instrumentation. An IIJA/BIL funding request for FY 24-26 has been developed to address this gap.</p>	Spring 2023 - Spring 2027

17	Focus Area 2	<p><i>If GOMO is to be identified as a leader at the frontiers of ocean observing, it needs additional opportunities to be seen and heard within the community. It is incumbent on GOMO to develop a strong identity/vision/mission commensurate with this thought leadership role. NOAA leadership should ensure the program has the opportunity to present that both within the agency and the wider community.</i></p>	<p>This recommendation is tightly linked to recommendation and action for #2:</p> <p>17.1 Review all messaging and update as needed to ensure the following are clearly articulated: a) GOMO's contributions to larger NOAA missions/goals, b) GOMO's contributions to critical baseline measurements that fulfill NOAA's missions, c) GOMO's contribution to baseline knowledge and key products of the ocean and the climate system.</p> <p>17.2 Develop more graphics and visual representations of GOMO's ocean observing impacts by working with a graphic designer/data visualization expert (3-5 products).</p> <p>17.3 With OAR, identify places for GOMO to engage within OAR/NOAA to raise our visibility and expand the understanding of GOMO.</p> <p>17.4 Engage across NOAA to share info/updates on GOMO, its scope, mission, role in NOAA, opportunities, etc.</p>	2023-2025	
18	Focus Area 3	<p><i>Developing a coherent and long-term data management policy. DMAC involves ingest, archive, and access of data, but the current situation seems to be a patchwork of activities, i.e. platform specific such as the glider DAC. What is needed is a Program wide strategic and consistent approach. This doesn't have to be an organic activity within GOMO, but it does need to be part of the planning and implementation of</i></p>	<p>Develop a draft program wide data strategy/implementation plan to streamline data processes. This will include measures of success and uniform expectations and timelines for all GOMO PI's (see recommendation #20).</p>	Spring 2023 - Fall 2025	

		<i>global observing systems.</i>			
19	Focus Area 3	<i>NOAA/GOMO should increase effort in engaging in the international data management and data infrastructure landscape to ensure NOAA benefits from broader developments in this space across the international community.</i>	GOMO has started engaging in international data efforts including GOOS/ OCG, and IODE, Digital Twin activities, and is increasing its efforts in the NOAA data landscape. GOMO plans to hire a Program Manager focussed on data and create a plan for international engagement and set priorities to ensure maximum return of knowledge to the GOMO program.	Spring 2023 - 2025	
20	Focus Area 3	<i>GOMO should establish metrics to measure its progress in data management to guide its effort. For instance, having a long list of products is not by itself meaningful if individual products are not used. GTS, in particular, is not used by most in the research community. The number of users by itself is also not useful, as some are casual users while others depend critically on the provided data. Statistics should be obtained of the communities' usage of different products (e.g., amount [GB] of data used by whom). User community surveys should also be conducted to gauge the utility of the products, including their own metrics, and to assess areas for improvement</i>	<p>20.1 GOMO will explore expanding data website efforts linking to products, services and data archives across the whole program.</p> <p>20.2 Metrics for success will be developed for the data strategy/implementation plan to ensure the development of meaningful products and services, tracking of progress, and enhanced return on investment which can include metrics towards implementation of FAIR principles, such as percentage of program metadata available through m2m services for discovery harvesting.</p>	<p>1) Fall 2025 - Fall 2027</p> <p>2) Summer 2023 - Fall 2025</p>	

21	Focus Area 3	<p><i>Establishing and accomplishing tangible milestones in a timely and pragmatic manner are more important than implementing a complete and perfect data system. As a first step, GOMO should consider establishing a simple “findable” system in which all known data can be easily identified given a search criterion (e.g., temperature at 100m±20m depth, within 300-km of 30N 40W, during January 2022) with links provided to corresponding DACs/websites for data access. Milestones should be collectively established, as what system engineers, data scientists, and oceanographers consider important are often different from one another. For instance, graphical/visualization interfaces and “toolboxes” are superfluous for most ocean research applications. Metadata are important for tracing potential data problems but are not always needed/used; although valuable, metadata are secondary to scientific data itself and, therefore, metadata availability should not detract from the data being findable. Finding scientific data should be simple, with the least amount of searching/scrolling/typing/reading. Model products and data syntheses (i.e., mapped and/or gridded data) should be clearly distinguished from observations.</i></p>	<p>21.1 Use GOMO data strategy development to scope development of a data landing page through which all GOMO data is discoverable and accessible, (see recommendation #20).</p> <p>21.2 Utilize the GOMO community workshop to gather PI and stakeholder input on metrics and milestones for the evolution of GOMO data efforts.</p>	Fall 2025 - Fall 2027
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22	Focus Area 3	<p><i>GOMO should capitalize on efforts and expertise assessing data quality across different observing systems for research (modeling and syntheses). Different observing systems employ different quality control measures, necessitating expertise across systems. Quality control efforts by projects that utilize multiple components of GOMO data, such as the World Ocean Database and NCEP Global Ocean Data Assimilation System, should be embraced and supported towards an integrated effort.</i></p>	<p>Continue to assess and leverage ongoing efforts to develop QC requirements via the GOMO data strategy/implementation plan. Convene experts and provide recommendations to be considered.</p>	<p>Summer 2023 - Fall 2025</p>
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