

**Pacific Marine Environmental Laboratory (PMEL)
Science Review**

March 3-5, 2020

PMEL Response to Panel Review Recommendations

Updated July 11, 2022

Submitted by:

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Introduction

A review of the NOAA Pacific Marine Environmental Laboratory (PMEL) at NOAA's Western Regional Campus in Seattle, Washington was conducted by an independent science review panel on March 3 – 5, 2020. NOAA's Office of Oceanic and Atmospheric Research (OAR) requested the review as part of the required 5-year research laboratory review cycle.

The three-day review was organized around the four research themes in PMEL's 2013 strategic and research plan: Climate-Weather Research, Marine Ecosystems Research, Ocean and Coastal Processes Research, and Research Innovation and Development.

More information on the review can be found on the PMEL review website: <https://www.pmel.noaa.gov/2020-lab-review>.

In this report, each actionable recommendation provided by the Science Review Panel is italicized and followed by the PMEL response. Given the considerable overlap between a number of the panel's recommendations, we have grouped and combined some of our responses accordingly.

A table summarizing the actions with timelines for completion is included below. Detailed responses can be found in the Appendix following the tab

FMC Science Review Action Sheet

Theme 1: Strategic Approach to Laboratory Research Themes and Resources

Recommendation	Action	Champion	Target Start & Completion Dates	Status	Notes (last update 2022)
<p>1. Management should be grooming "heirs-apparent" to ensure continuity of leadership. This is particularly concerning because the same issue was raised by the previous PMEL Review Panel and little has been done to address it.</p> <p>2. The cooperative institute arrangement would be more advantageous to PMEL if it were used as a pathway to permanent PMEL employment for those people who demonstrate leadership qualities. Relying on a mechanism where a high percentage of the leadership team are essentially temporary employees is not in the laboratory's best interest.</p> <p>7. The time is now to groom the next generation of leaders. This is particularly important in order to afford continuity to the time series that have been a hallmark of the lab.</p>	<p>a) Identify needed expertise through strategic planning processes.</p> <p>b) As resources allow, increase federal staff.</p> <p>c) Build more explicit succession plan within strategic planning process.</p> <p>d) Promote leadership development and other professional development activities.</p>	<p>a) PMEL Leadership</p> <p>b) PMEL Leadership and supervisors as appropriate</p> <p>c) PMEL Leadership</p> <p>d) PMEL Leadership and supervisors</p>	<p>a-c) Completed</p> <p>d) Intended to be ongoing</p>	<p>PMEL can take advantage of existing hiring and retention tools, e.g. adding career ladders to positions, promoting training and development opportunities, using Pathways, Direct Hire Authorities, etc. to achieve some of the succession planning goals.</p> <p>NOAA and DOC offer a variety of opportunities to teach, train, and advance federal employees to leadership opportunities. Over the past 5 years, several PMEL employees have participated in NOAA and DOC leadership programs (e.g., NRAP, LCDP, mentoring, details, etc.). PMEL will continue to promote these and other leadership opportunities.</p> <p>Cooperative Institutes are a valuable tool in exposing potential PMEL federal employees to the federal government and vice versa. Indeed, over the past 5 years, PMEL has hired at least five previous CI employees as permanent Federal employees through the competitive processes required by federal law. PMEL will continue to take advantage of the opportunities afforded by NOAA's CI Cooperative Agreement.</p>	<p>As base funds allow, PMEL will make federal hires in priority areas, using federal Merit System principles. However, only ~10% of current base funds are used for hires at the CI. PMEL hired one CI employee into a permanent federal position in FY21. PMEL has made 8 hires using special authorities.</p> <p>Additionally, PMEL is currently working to use a direct hire authority to internally promote an employee to supervisory status, who will lead a new lab division. This individual has already taken leadership training, and we are providing opportunities to others who have expressed a further desire for such training.</p>

Recommendation	Action	Champion	Target Start & Completion Dates	Status	Notes (last update 2022)
				In these efforts, as a federal organization, PMEL is constrained by merit system principles, and cannot target hires to specific people.	
<p>4. <i>PMEL must develop a strategy for identifying when a project area has reached its research plateau and should transition from research to operation, effectively shifting the budget burden for that topical area to the operational side of NOAA (or to another client of the product).</i></p> <p>5. <i>PMEL needs a strategy for onboarding new research themes, particularly since the continued investments in existing research lines provides limited new opportunities.</i></p> <p>6. <i>PMEL is a leader with clear differentiation from the activities of other laboratories with which it collaborates. PMEL needs an onboarding strategy for science topics that clearly defines that vision at the outset and uses identification of its unique role as one of the criteria for investment decisions.</i></p> <p>10. <i>Use the opportunity with a new director to make some changes to the research thrusts and move towards evolution rather than succession.</i></p> <p>14. <i>It would be valuable for the Science and Engineering groups to identify a prioritized list of information needs that balances need versus development cost and time, as well as technology transition. Such a roadmap could assist in the</i></p>	<p>a) Convene a science leadership retreat to identify criteria for onboarding, continuing and phasing out research themes</p> <p>b) Develop a process for reviewing PMEL science, technology and emerging topics on an annual basis</p> <p>c) Conduct first review of PMEL research themes</p> <p>d) PMEL will increase use of Transition Plans to document and guide plans for transitioning R&D into operations, applications, commercialization, and other uses.</p>	<p>a) PMEL Leadership</p> <p>b) PMEL Leadership</p> <p>c) PMEL Leadership</p> <p>d) PMEL Leadership in collaboration with PIs</p>	<p>a-c) Completed</p> <p>d) Intended to be ongoing</p>	<p>PMEL's 2021-2030 Strategic Plan, which will guide the leadership retreat and other processes, is anticipated to be finalized February 2021.</p>	<p>The PMEL Strategic Plan was completed in 2021. PMEL developed a new governance structure in August of 2021 to include Management Team (M-team), the Executive team (E-team), and the Directors team (D-team). The E-team provides advice on science strategy and direction to the Director's office and has started the process of evaluating the alignment of existing programs and projects with the strategic plan, and assessing how to transition initiatives to meet emerging science needs.</p> <p>We are actively evaluating scientific direction and succession planning for several research groups to ensure that our resources are aligned with our scientific priorities and to better align hiring with those priorities.</p> <p>PMEL has finalized 5 transition plans (3 Saildrone, 1 for Oculus, and 1 for State of the Climate Report) in 2022.</p> <p>Leadership has identified top priority transition plan development for the next year.</p>

Recommendation	Action	Champion	Target Start & Completion Dates	Status	Notes (last update 2022)
<i>creation of new technologies, the sunset-ing of existing technologies (e.g., what's good enough), and the transition of technologies to operations versus research (and allow for budget definition between those two efforts).</i>					
9. <i>Regarding systems that originated at PMEL and then were transitioned to another entity to operate, the 2020 review team was encouraged to learn that the data return has improved, but we believe that sustained vigilance by scientists, skilled data analysts and engineers "looking over the shoulders" of the operational agency will be required to ensure high quality continuation of valuable long-term records.</i>	a) Ensure that PIs work closely with transition partners and OAR leadership to highlight funding needs and ensure that end-user needs are met. b) PMEL will increase use of Transition Plans to document and implement transitioning R&D into operations, applications, commercialization, and other uses.	a) PMEL PIs b) PMEL Leadership in collaboration with PIs	a-b) <i>Intended to be ongoing</i>		PMEL has finalized 5 transition plans (3 Saildrone, 1 for Oculus, and 1 for State of the Climate Report) in 2022. PMEL leadership has identified high priority projects to develop new transition plans for 2023.
15. <i>It would be useful to develop metrics for performance such as days at sea, systems at sea, system reliability, amount of data collected, geographical areas covered, etc., especially with regard to needed ship time versus ship time available (and the impact of lost or potentially lost ship time).</i>	a) Develop lab-level, appropriate metrics for ship impact. b) Work with OAR, and NOAA to develop appropriate metrics for ship impact. c) At Leadership Retreat, consider developing one or more metrics for non-ship-related impacts to be used in AOP and related processes	a) PMEL Associate Director for Ship Operations b) PMEL Associate Director for Ship Operations c) PMEL Leadership	a) <i>PMEL action Completed</i> b) <i>PMEL action Completed</i> c) <i>Planned FY2023</i>	OAR's Global Ocean Monitoring and Observing Program (GOMO) is beginning work with OMAO on more appropriate ship-based metrics.	PMEL has worked closely with GOMO and OMAO to assess these needs. It has been determined that metrics must be at line office or NOAA level. PMEL will contribute SM expertise. The new deputy director, joining PMEL in July 2022, will be assessing AOP and working with the PIs and director to develop new measures and metrics in FY2023 that help capture PMEL impact.

Theme 2: Laboratory Culture

Recommendation	Action	Champion	Target Start & Completion Dates	Status	Notes (last update 2022)
<p>3. <i>Management should recognize and reward three aspects of the present culture: a) Client orientation, b) Collaborative attitude, and c) "License to fail".</i></p>	<p>a) Review and synthesize 3 recent culture assessments for PMEL leadership. b) Review this synthesis and develop actions in response to these three areas. c) Implement and manage innovation mini-grants.</p>	<p>a) PMEL Diversity and Inclusion (D&I) Team b) PMEL Leadership c) PMEL Leadership</p>	<p>a) Completed b) Completed 2022 c) Completed July 2021</p>		<p>New governance structure to allow non-supervisory staff a mechanism for input into lab wide processes and decisions. E-team efforts to prioritize science programs and projects in alignment with strategic planning. M-team development of Re-entry values statement 2021. PMEL launched the Innovation Grants program and supported 6 proposals. The 2022 Innovation Grant program was announced in May.</p>
<p>8. <i>With PMEL's ability to meet its objectives now critically dependent on CI contributions, more effort must be made to improve the working environment for these individuals.</i></p>	<p>a) Review synthesis of culture assessments; identify 1-3 key areas for dedicated effort. b) Build a team to develop options for appropriate mentorship programs at PMEL. c) Work with CI directors to coordinate efforts for career development and morale. d) Build PMEL awards team to identify awards and other recognition for which CI, contractor and federal staff are eligible, and to identify PMEL staff deserving of such awards. e) Raise awareness among all PMEL staff about differences in rules and regulations that affect Federal and CI employees and the appropriate relationships with CI staff.</p>	<p>a) PMEL Leadership b) PMEL M-team and DEI team c) PMEL and CI Leadership d) PMEL Leadership e) PMEL Leadership</p>	<p>a, b, d) Completed 2021 c, e) Ongoing and Plans for 2023</p>		<p>DEI team and the newly formed M-team completed review of culture assessments and have developed a list of initiatives to implement in response. PMEL is doing what we can within the legal restrictions in place under contract law. Any activities that fall outside of legal compliance have been corrected, which inherently sets up inequities in the lab that cannot be further resolved. CI and PMEL directors are planning all hands meeting to improve understanding of contracting law and the roles, responsibilities, and rules for staff. Exploring a new 'unsung hero' award for any employee at PMEL. Developing agenda for an all hands retreat later this summer.</p>

Recommendation	Action	Champion	Target Start & Completion Dates	Status	Notes (last update 2022)
<p>17. <i>PMEL needs to review the cost of supporting quality engineering in Seattle and work to ensure that competitive salaries and benefits are available. Engineering of all types, but especially electrical and software, are in high demand by industry. The high cost of housing and commuting is making it difficult for the engineers in the maritime domain to support a family. The new generation is also much more mobile and willing (and able) to change jobs in response to better opportunities, internal dissatisfaction and boredom. Hence, it becomes more difficult to find quality stable staff to work long hours on complex problems (especially at sea).</i></p>	<p>a) Use CAPS effectively to incentivize and reward strong performance. b) Emphasize and build capacity for non-monetary benefits and incentives (career development, purpose-driven research) in PMEL culture. c) Explore lab-wide options, such as increased support, that may reduce the administrative burden on scientific and engineering staff.</p>	<p>a) PMEL Supervisors b) PMEL Leadership c) PMEL Leadership</p>	<p>a) <i>Intended to be ongoing</i> b-c) <i>Completed 2021-2022</i></p>	<p>This issue extends to other arenas such as IT, and some technical jobs as well. Salaries in the federal government are determined at the national level rates.</p>	<p>PMEL is currently working to use a direct hire authority to internally promote an employee to supervisory status, who will lead a new lab division. PMEL is also using temporary promotion authority to provide acting group lead experience to a staff member while completing a new federal hire. To increase support PMEL has brought in a new Deputy and formalized the facility manager role, streamlined purchasing processes using BPAs, realigned the creative services group, and recruited an LCDP detailee. New federal hires for additional support is limited by federal funding support and hindered by the DOC telework and remote work restrictions.</p>

Theme 3: Data Management

Recommendation	Action	Champion	Target Start & Completion Dates	Status	Notes (last update 2022)
<p>11. PMEL should continue to ensure that collected data are available to users in a timely fashion especially as systems are operated by contractors and/or transitioned to other organizations. Specifically, a careful review of the Saildrone contract with regard to data rights would be useful to ensure open access to the collected data.</p> <p>12. In parallel with their efforts to optimize environmental sampling, sensor integration and data handling/synthesis using Saildrones and other uncrewed measurement systems, PMEL investigators are encouraged to think hard about the issues of data availability from commercial and other non-traditional sources.</p>	<p>a) Develop a PMEL data strategy, consistent with the NOAA Data Strategy.</p> <p>b) Complete data delivery modernization for Saildrone.</p> <p>c) Continue work toward establishing PMEL as a Data Assembly Center for data from uncrewed surface data.</p>	<p>a) PMEL Science Data Integration Group (SDIG)</p> <p>b) PMEL Science Data Integration Group (SDIG)</p> <p>c) PMEL Science Data Integration Group (SDIG)</p>	<p>a) Completed 2022</p> <p>B) PMEL action completed 2021</p> <p>c) Ongoing planned for end FY 23</p>		<p>PMEL is leading this effort for NOAA under the leadership of Eugene Burger, who presents OAR on the Environmental Data Management Council (EDMC). Under the EDMC a NOAA Data Licensing task team was created, led by Eugene, to address this action item for the agency.</p> <p>Cloud-to cloud data delivery modernization efforts have been postponed because of OAR wide N-wave cloud to on-premise configuration activity.</p> <p>Initial approach to establish PMEL as a Data Assembly Center proved non-feasible for PMEL sourced data, however, a PMEL innovation grant funded seed grant for a new approach to level zero quality control that we are in the process of implementing.</p> <p>Implemented data integrity checks for all UAS platforms. Remainder of work is ongoing.</p>
<p>13. It was noted during the review that resource allocation for data management did not always meet the need. This is not unique to PMEL, but leadership might be reminded to not overlook this critical function.</p>	<p>a) Consider data management review of PMEL proposals that include data collection to ensure the lab is prepared to accept data and appropriate funding support is included.</p> <p>b) Develop a template including data management costs into project budgets.</p>	<p>a) PMEL leadership</p> <p>b) PMEL Science Data Integration Group (SDIG)</p>	<p>a-b) Ongoing/ planned for FY2023</p>		<p>Under the new PMEL governance structure this policy will be reviewed and implemented in FY23.</p>

Recommendation	Action	Champion	Target Start & Completion Dates	Status	Notes (last update 2022)
<p>16. <i>The development of the Science Data Integration Group is a good start to better (i.e., more relevant, timely) and more efficient use of PMEL data. However, as the breadth of PMEL becomes more multi-disciplinary the range of data inputs and the utilization of data to support science and decision makers will make this group more critical. Security issues will impede the progress of this group. We recommend evaluating the needs of the group in order to accomplish future goals. The group may need to be larger, especially to support at-sea operations and interactions with users.</i></p>	<p>a) Consider data group needs in the strategic planning process and hiring prioritization. b) Consider forming a “data team” to identify data needs/issues common to the lab and unique to individual research groups, and to design systematic approaches to meet the lab’s data needs.</p>	<p>a) PMEL leadership/ Science Data Integration Group (SDIG) b) PMEL leadership/ Science Data Integration Group (SDIG)</p>	<p>a) Completed b) Ongoing</p>		<p>Data team and group has been established and is currently being led by SDIG; however, a new permanent data steward role will also be hired. To fully understand the scope of needs, the first step is to consolidate all saildrone data from different deployments funded by different programs.</p>

Theme 4: Logistics of Science Execution

Recommendation	Action	Champion	Target Start & Completion Dates	Status	Notes (last update 2022)
<p>18. We concur with the previous 2014 Strategic Plan review, "Relatively low cost, low earth orbiting satellite communication technology (e.g., microsat) is rapidly advancing in other arenas, driven by the high cost of large communication satellites. Exploring communication alternatives to avoid reliance on a single network would be a wise investment." Consider looking at the range of satellites (including CubeSats and MicroSats) for communication and sensors. This, like the new genomics and bioinformatics effort, could be a means of acquiring new engineering staff in a new capability area.</p>	<p>a) Evaluate Mini-sats with standard engineering 5-step principles. b) Coordinate across users within NOAA, as relevant. c) Incorporate the use of NOAA Observing Systems Council (NOSC) processes to inform satellite modifications to meet PMEL requirements.</p>	<p>a) PMEL Engineering Division b) PMEL Engineering Division c) PMEL Leadership and PMEL Engineering Division</p>	<p>a-c) Completed</p>		<p>PMEL has evaluated the mini-sats and would need to explore new funding streams to do this work. PMEL is working more closely with NASA. We have established a multi-year MOU to validate the Sentinel-6 altimeter and the new SWOT swath altimeter, launching this fall with in-situ buoy technology. PMEL has considered this possibility but decided this was not the best path forward for PMEL EDD at this time.</p>
<p>19. PMEL should explore the use of employee "interns" for summer work within the engineering group. Given the proximity to UW and other Universities, there may be good opportunities to have students participate in PMEL engineering. We suggest that a specific program be put in place to facilitate the use of students, especially for the Science Data Integration Group.</p>	<p>a) Continue emphasis on summer intern programs, including the William Lapenta internship, the use of NOAA EPP at Cooperative Science Centers, as well as others. b) Identify administrative requirements for establishing a PMEL-specific internship program. c) Evaluate budgetary constraints and implement a PMEL program if appropriate.</p>	<p>a) PMEL Leadership b) PMEL Administrative Division c) PMEL Leadership</p>	<p>a) Intended to be ongoing b-c) Ongoing</p>	<p>Note that PMEL hosted two engineering (high school age) interns from under-represented communities. We also seek to maintain continued engagement with the Youth Maritime Collaborative, and are building a relationship with the brand new Seattle Maritime Academy. PMEL is making use of the NOAA Educational Partnership Program (EPP) Cooperative Science Centers to address this. We had our first EPP students this last summer (2020) and look forward to having more.</p>	<p>In summer of 2021 PMEL mentored 21 undergraduates and 3 graduate students from 7 different programs. This summer, PMEL will host 11 undergraduates and 7 graduate students, from seven different programs.</p>

Appendix

Theme 1: Strategic Approach to Laboratory Research Themes and Resources

Recommendation Set 1: Leadership and succession planning.

Recommendation 1: Management should be grooming “heirs-apparent” to ensure continuity of leadership. This is particularly concerning because the same issue was raised by the previous PMEL Review Panel and little has been done to address it.

Recommendation 2: The cooperative institute arrangement would be more advantageous to PMEL if it were used as a pathway to permanent PMEL employment for those people who demonstrate leadership qualities. Relying on a mechanism where a high percentage of the leadership team are essentially temporary employees is not in the laboratory’s best interest.

Recommendation 7: The time is now to groom the next generation of leaders. This is particularly important in order to afford continuity to the time series that have been a hallmark of the lab.

Response to Recommendations 1, 2, 7: Agree. These recommendations highlight the need to build leadership capacity and a succession plan as many in our workforce reach retirement eligibility. Such efforts are intimately tied to our strategic planning processes (see below) and a key part of our response to this recommendation will be to identify programs in need of increased or different staffing and key areas of expertise that need to be enhanced. Our ultimate goal is to increase the number of federal employees as resources allow and within the constraints of federal hiring processes to meet the mission of PMEL. Such hires will also allow us to increase diversity within our ranks and sustain innovation and our ability to maintain long-term data sets. We also seek to maintain the strong partnership and benefits of close collaboration with universities that our CI relationships bring. Cooperative Institutes are a valuable tool in exposing potential PMEL federal employees to the federal government and vice versa. Indeed, over the past 5 years, PMEL has hired at least four former CI employees as permanent Federal employees through the competitive processes required by federal law. PMEL will continue to take advantage of the opportunities afforded by NOAA's CI Cooperative Agreement. NOAA and DOC offer a variety of opportunities to teach, train, and advance federal employees to leadership opportunities. Over the past 5 years, several PMEL employees have participated in NOAA and DOC leadership programs (e.g., NRAP, LCDP, mentoring, details, etc.). PMEL will continue to promote these and other leadership opportunities. In addition, one of our primary CIs (CICOES) has developed a professional development program for its employees, which is intended to contribute to the career development for these important partners.

Action Plan for Recommendations 1, 2, 7:

- Identify needed expertise through strategic planning processes.
 - Dates: **Completed**. Strategic Plan completed 2021

- Responsibility: PMEL Leadership
- As resources allow, increase federal hiring to increase the ratio of federal to non-federal PMEL staff.
 - Dates: **Completed**. As base funds allow, PMEL will make federal hires in priority areas, using federal Merit System principles. However, only ~10% of current base funds are used for hires at the CI. PMEL hired one CI employee into a permanent federal position in FY21. PMEL has made 8 hires using special authorities. Responsibility: PMEL Leadership
- Build a more explicit succession plan within the strategic planning process.
 - Dates: **Completed**. As part of overall alignment of resources with science priorities we will continue to identify key hires to ensure appropriate succession.
 - Responsibility: PMEL Leadership
- Encourage participation in leadership and other professional development activities
 - Dates: **Intended to be ongoing**. PMEL is currently working to use a direct hire authority to internally promote an employee to supervisory status, who will lead a new lab division. This individual has already taken leadership training, and we are providing opportunities to others who have expressed a further desire for such training.
 - Responsibility: Supervisory staff and research group leads

Recommendation Set 2: On-boarding, off-boarding, transitions and prioritizing research themes.

Recommendation 4: PMEL must develop a strategy for identifying when a project area has reached its research plateau and should transition from research to operation, effectively shifting the budget burden for that topical area to the operational side of NOAA (or to another client of the product).

Recommendation 5: PMEL needs a strategy for onboarding new research themes, particularly since the continued investments in existing research lines provides limited new opportunities.

Recommendation 6: PMEL is a leader with clear differentiation from the activities of other laboratories with which it collaborates. PMEL needs an onboarding strategy for science topics that clearly defines that vision at the outset and uses identification of its unique role as one of the criteria for investment decisions.

Recommendation 10: Use the opportunity with a new director to make some changes to the research thrusts and move towards evolution rather than succession.

Recommendation 14: It would be valuable for the Science and Engineering groups to identify a prioritized list of information needs that balances need versus development cost and time, as well as technology transition. Such a roadmap could assist in the creation of new technologies, the sunset-ing of existing technologies (e.g., what's good enough), and the transition of technologies to operations versus research (and allow for budget definition between those two efforts).

Response to Recommendations 4, 5, 6, 10, 14: Agree. The reviewers highlight the challenges of determining what broad areas of research the laboratory should undertake, when to decrease or eliminate effort in particular efforts, and how to transfer activities to other entities when appropriate. Thoughtful initiation and sunseting of

research themes allows the most effective use of limited resources. In order to evaluate topical areas, PMEL leadership will develop a prioritization schema to evaluate the importance of existing and emerging research areas. The rubric may include NOAA, OAR and PMEL goals, societal importance, continuity and sustaining of long-term data sets, costs and obsolescence of technologies. After the rubric is developed, evaluation will occur on an approximately annual time scale. Because this is new to PMEL, we will also likely need to evaluate and improve the processes we develop for this purpose. This process should enable us to position ourselves for unanticipated opportunities, keep up with the fast moving technology development and societal needs.

Regarding transitions, PMEL will increase use of Transition Plans to document and implement transitions of R&D into operations, applications, commercialization, and other uses. Also, a new OAR HQ position will be leading a new Office of Research and Technology Applications (ORTA) that reports to the OAR Deputy Assistant Administrator (DAA) and may be a good contact point for PMEL to help fund, facilitate and manage transitions. Importantly, transitioning of projects or activities to other entities is a process that is highly dependent upon the ultimate user(s), the technology being transitioned, whether the organization to which a transition will occur has the budget to support the activity, and more (see also below).

Action Plan for Recommendations 4, 5, 6, 10, 14:

- Convene a science leadership retreat to identify criteria for onboarding, continuing and phasing out research themes
 - Date: **Completed**. Developed a governance structure in August of 2021 to include Management Team (M-team), the Executive team (E-team), and the Directors team (D-team).
 - Responsibility: PMEL leadership
- Develop a process for reviewing PMEL science, technology and emerging topics on an annual basis.
 - Date: **Completed**. In May 2022 E-team developed criteria for transitioning research themes and programs according to science priority.
 - Responsibility: PMEL leadership
- Conduct first review of PMEL research themes
 - Date: **Completed** May 2022
 - Responsibility: PMEL leadership
- Increase use of Transition Plans to document plans for transitioning R&D into operations, applications, commercialization, and other uses.
 - Date: **Intended to be ongoing**. Completed 5 (3 saildrone, 1 Oculus, 1 for State of the Climate report) transition plans in 2022
 - Responsibility: PMEL leadership and PIs.

Recommendation 9: Transitions

Recommendation 9: Regarding systems that originated at PMEL and then were transitioned to another entity to operate, the 2020 review team was encouraged to learn that the data return has improved, but we believe that sustained vigilance by scientists, skilled data analysts and engineers “looking over the shoulders” of the operational

agency will be required to ensure high quality continuation of valuable long-term records.

Response to Recommendation 9: Largely agree. (Please note that this recommendation, when compared with recommendation 4 makes clear some of the challenges involved in transitioning research and development products.) Transitions are complex, mostly unfunded and require engagement with the end-user from the initiation of the project. In many cases, there will, in fact, be an ongoing need for continuous upgrading, improvement and development, using a Research AND Operations model rather than a Research TO Operations model. In addition, many transitions continue to have a scientific component to the transitioned operations. Overall, PMEL will increase use of Transition Plans to document plans for transitioning R&D into operations, applications, commercialization, and other uses.

Action Plan for Recommendation 9:

- Encourage and ensure that PIs work closely with transition partners and OAR leadership to highlight funding needs
 - Date: **Intended to be ongoing.** Completed 5 (3 saildrone, 1 Oculus, 1 for State of the Climate report) transition plans in 2022
 - Responsibility: PIs and PMEL Engineering Development Division
- Increase use of Transition Plans to document plans for transitioning R&D into operations, applications, commercialization, and other uses.
 - Date: **Intended to be ongoing.** PMEL leadership has identified high priority projects to develop new transition plans for 2023.
 - Responsibility: PMEL leadership and PIs.

Recommendation 15: Performance Metrics

Recommendation 15: It would be useful to develop metrics for performance such as days at sea, systems at sea, system reliability, amount of data collected, geographical areas covered, etc., especially with regard to needed ship time versus ship time available (and the impact of lost or potentially lost ship time).

Response to Recommendation 15: Agree. Adequately and usefully documenting the performance and success of field missions has been an ongoing challenge for all NOAA scientists. Currently, an OMAO officer on duty at GOMO is working with OMAO to develop easily available metrics that capture mission success better than days at sea. Similarly, performance metrics for other PMEL activities would be useful for overall lab management. Developing useful metrics, rather than 'easy-to-count' metrics, however, can be very challenging.

Action Plan for Recommendation 15:

- Develop lab-level, appropriate metrics for ship impact (begin May 2021)
 - Date: **PMEL action Completed.** In May 2021 PMEL began working with GOMO and OMAO to assess these needs. It has been determined that metrics must be at line office or NOAA level. PMEL will contribute SM expertise.

- Responsibility: PMEL Associate Director for Vessel Operations
- Work with OAR and NOAA effort for ship impact metrics
 - Date: **PMEL action completed.** OMAO workgroup was initiated by HQ and has charged to the workgroup they have been charged to deal with the metrics determination
 - Responsibility: PMEL Associate Director for Vessel Operations
- Consider developing one or more metrics for non-ship-related impacts to be used in AOP and related processes
 - Date: **Ongoing.** The new deputy director, joining PMEL in July 2022, will be assessing AOP and working with the PIs and director to develop new measures and metrics in FY2023 that help capture PMEL impact.
 - Responsibility: PMEL leadership

Theme 2: Laboratory Culture

Recommendation 3: Maintain positive cultural attributes

Recommendation 3: Management should recognize and reward three aspects of the present culture: a) Client orientation, b) Collaborative attitude, and c) "License to fail".

Response to Recommendation 3: Agree. PMEL Leadership recognizes the importance of culture and that proactive management (setting clear goals, identifying problems, diagnosing problems to get to the root issues, designing a plan, monitor plan through completion) with clear and transparent communication is required to continuously monitor, evaluate and course correct to hone and improve PMEL's competitive edge. Considerations to performance management and continuous engagement strategies will be included.

Action Plan for Recommendation 3:

- Review and synthesize 3 recent culture assessments for PMEL leadership
 - Date: **Completed 2021**
 - Responsibility: PMEL Diversity and Inclusion Team
- Review this synthesis and develop actions responsive to the three areas
 - Date: **Completed and implemented in 2022.**
 1. New governance structure to allow non-supervisory staff a mechanism for input into lab wide processes and decisions
 2. E-team efforts to prioritize science programs and projects in alignment with strategic planning
 3. M-team development of Re-entry values statement
 - Responsibility: PMEL leadership (begin March 2021)
- Implement and manage innovation mini-grants
 - Date: **Completed.** Initiated Innovative min-grant program in July 2021 and funded 6 projects in 2021; announced 2022 request for proposals in May. After one cycle, preliminary data and proof-of-concept was to develop an external proposal.
 - Responsibility: PMEL leadership, Eugene Burger, Chris Meinig, Dick Feely, Mike McPhaden

Recommendation 8: Improve working environment for CI employees

Recommendation 8: With PMEL's ability to meet its objectives now critically dependent on CI contributions, more effort must be made to improve the working environment for these individuals.

Response to Recommendation 8: Agree. The three existing cultural assessments available to PMEL (see R3) indicate that there are significant concerns among our non-federal staff about career paths and other aspects of our blended workforce. PMEL values our CI and contracted staff as full scientific partners, and believes it is important to increase our overall inclusivity and to strive for equity in all ways within our control. We acknowledge the need to raise awareness among all PMEL staff about differences in rules and regulations that affect Federal and CI employees and appropriate relationships between federal and non-federal employees..

Action Plan for Recommendation 8:

- Review synthesis of culture assessments; identify 1-3 key areas for dedicated effort
 - Date: **Completed** 2022
 - Responsibility: PMEL leadership; Completed by the newly formed M-team and developed list of initiatives to implement in response. Also developing an agenda for an all hands retreat later this summer.
- Build a team to develop options for appropriate mentorship programs at PMEL
 - Date: **Completed**
 - Responsibility: D&I team and M-team
- Work with CI directors to coordinate efforts for career development and morale
 - Date: **Ongoing plans for 2023**; PMEL is doing what we can within the legal restrictions in place under contract law Any activities that fall outside of legal compliance have been corrected, which inherently sets up inequities in the lab that can not be further resolved. CI and PMEL directors are planning an all hands meeting to improve understanding of contracting law and the roles, responsibilities, and rules for staff.
 - Responsibility: PMEL and CI leadership
- Build awards team to identify awards and other recognition for which CI, contractor and federal staff are eligible, and to identify PMEL staff deserving of such awards.
 - Date: **Completed**. Also working to exploring new unsung hero award for any PMEL staff member.
 - Responsibility: PMEL leadership/Awards Team
- Raise awareness among all PMEL staff about differences in rules and regulations that affect Federal and CI employees.
 - Date: **Planning 2023** (see above)
 - Responsibility: PMEL leadership

Recommendation 17: Competitive salaries

Recommendation 17: PMEL needs to review the cost of supporting quality engineering in Seattle and work to ensure that competitive salaries and benefits are available. Engineering of all types, but especially electrical and software, are in high demand by industry. The high cost of housing and commuting is making it difficult for the engineers

in the maritime domain to support a family. The new generation is also much more mobile and willing (and able) to change jobs in response to better opportunities, internal dissatisfaction and boredom. Hence, it becomes more difficult to find quality stable staff to work long hours on complex problems (especially at sea).

Response to Recommendation 17: Agree in principle. This issue extends to a variety of our staff, including IT, data management, technical and other staff. Federal salaries, however, are set at the national level, and PMEL has no control over these levels. In the absence of controls on salary, we seek to maintain and foster a dynamic R&D environment with strong societal value (i.e. purpose) and to improve opportunities for professional development.

Action Plan for Recommendation 17:

- Use CAPS effectively to incentivize and reward strong performance in the federal workforce
 - Date: **Intended to be ongoing**
 - Responsibility: Federal Supervisors
- Emphasize and build capacity for career development and purpose-driven research in PMEL
 - Date: **Completed**. PMEL is currently working to use a direct hire authority to internally promote an employee to supervisory status, who will lead a new lab division. PMEL is also using temporary promotion authority to provide acting group lead experience to a staff member while completing a new federal hire.
 - Responsibility: Supervisors, research group leads
- Explore lab-wide options, such as increased support, that may reduce the administrative burden on scientific and engineering staff
 - Date: **Completed**. Bringing in a new Deputy and formalizing facility manager role; Streamlining purchasing processes using BPAs, Realigning creative services group, recruited an LCDP detailee. New federal hires for additional support is limited by federal funding support and hindered by the DOC telework and remote work restrictions.
 - Responsibility: Rebecca Briggs, Diane Stanitski, Ogie Olanday

Theme 3: Data Management

Recommendation Set 3: Commercial Data

Recommendation 11: PMEL should continue to ensure that collected data are available to users in a timely fashion especially as systems are operated by contractors and/or transitioned to other organizations. Specifically, a careful review of the Saildrone contract with regard to data rights would be useful to ensure open access to the collected data.

Recommendation 12: In parallel with their efforts to optimize environmental sampling, sensor integration and data handling/synthesis using Saildrones and other uncrewed measurement systems, PMEL investigators are encouraged to think hard about the issues of data availability from commercial and other non-traditional sources.

Response to Recommendations 11, 12: Agree. Data licensing and the timely delivery of data were highlighted. PMEL has made pioneering efforts over the past decades to apply the FAIR principles (Findable, Accessible, Interoperable and Reusable) in data management to most data collected at PMEL, especially with a new generation of uncrewed robotic observing platforms. The concern raised on the licensing of in situ observation data buys from commercial data providers and timely public access to data are acknowledged. We also acknowledge the need to identify non-conventional sources for environmental data. Additional overhead associated with data acceptance, data integrity and quality control does place an additional burden on infrastructure that can, in some cases, offset the benefits to these data.

Action Plan for Recommendation 11, 12:

- Data licensing of the in situ observation data is on the NOAA Data Strategy Implementation Plan to be addressed at the NOAA level with active input and participation from PMEL.
 - Date: **Completed FY22**; PMEL is leading this effort for NOAA under the leadership of Eugene Burger, who presents OAR on the Environmental Data Management Council (EDMC). Under the EDMC a NOAA Data Licensing task team was created, lead by Eugene, to address this action item for the agency.
 - Responsibility: Eugene Burger
- Complete data delivery modernization now in progress for more efficient cloud-to-cloud delivery of Saildrone data. SDIG/Saildrone
 - Date: **PMEL action completed**; PMEL's work in this project has been postponed because of OAR wide N-wave cloud to on-premise configuration activity.
 - Responsibility: SDIG
- Implement a lab-wide data accessible quality control and metadata assembly functionality for PMEL to reduce data dissemination delays.
 - Date: **Ongoing planned for end FY 23**; Initial approach proved non-feasible for PMEL sourced data, however, a PMEL innovation grant funded seed grant for a new approach to level zero quality control that we are in the process of implementing.
 - Responsibility: SDIG
- To reduce latency and data handling and integration overhead, the harmonization of systems that receive data at PMEL and integration with data management workflows. PMEL will set a goal to on-board 40% data through these unified systems over the next 5 years. (Also relevant for R16).
 - Dates: **Completed**. Implemented data integrity checks for all UAS platforms.
 - Responsibility: SDIG

Recommendation Set 3: Resourcing for Data Management

Recommendation 13: It was noted during the review that resource allocation for data management did not always meet the need. This is not unique to PMEL, but leadership might be reminded to not overlook this critical function.

Recommendation 16: The development of the Science Data Integration Group is a good start to better (i.e., more relevant, timely) and more efficient use of PMEL data. However, as the breadth of PMEL becomes more multi-disciplinary the range of data inputs and the utilization of data to support science and decision makers will make this group more critical. Security issues will impede the progress of this group. We recommend evaluating the needs of the group in order to accomplish future goals. The group may need to be larger, especially to support at-sea operations and interactions with users.

Response to Recommendations 13, 16: Agree. Resources for, and the relevance of the Science Data Integration Group (SDIG), were highlighted. Most (90%) of the SDIG funding is proposal-derived from non-PMEL sources to support non-PMEL development efforts. While PMEL support amounts to only 10%, this is an increase over the historic funding of this group where 100% of SDIG funding was towards non-PMEL focused efforts. Noteworthy is the non-PMEL efforts that are leveraged in support of the PMEL data integration effort, thereby reducing the cost of data management capacity and capability development to PMEL. We recognize the capacity this group can offer PMEL, and will encourage this group's close collaborations with the other research groups to accomplish its objectives. An area this group needs to develop is ML/AI applications in data QC and analysis.

NOAA is entering a new realm of data management with requirements for NOAA enterprise business data. This will place additional constraints on PMEL and NOAA IT infrastructure and the need for recordkeeping.

Action Plan for Recommendations 13, 16:

- R13: Appropriate support for the Data Integration Group is essential to meet PMEL data management requirements. The following items will be considered to ensure calibrated support.
 - R13: Consideration of data management review of PMEL proposals that include data collection. This will ensure the lab is prepared to accept data, and the proposal includes full data lifecycle funding support. R13 and R16: SDIG will develop a "template" for including data management costs into project budgets. This template could be a starting point towards ensuring that realistic data management AND data stewardship costs are included and could be tweaked and customized for each project/submission.
 - Date: Ongoing/planned for FY 23. Under the new PMEL governance structure this policy will be reviewed and implemented in FY23.
 - Responsibility: Eugene Burger, Michelle McClure, Science project leads
- R16: The role of a data steward in the PMEL Data Integration Group dedicated to PMEL data integration matters will allow for a timely response to PMEL data Integration support.
 - Date: Completed FY21; Data team and group has been established and is currently being led by SDIG however, a new permanent data steward role will also be hired.
 - Responsibility: Eugene Burger/ Michelle McClure

- R16: PMEL will entertain the formation of a “data team” with its core members from the data group and additional members from each research group. This data team will identify data needs/issues common to the lab and those unique to individual research groups, and to design systematic approaches to meet the lab’s data needs.
 - Dates: **Ongoing**. To fully understand the scope of needs, the first step is to consolidate all saildrone data from different deployments funded by different programs.
 - Responsibility: Eugene Burger/Chidong Zhang

Theme 4: Logistics of Science Execution

Recommendation 18: Microsatellites

Recommendation 18: We concur with the previous 2014 Strategic Plan review, “Relatively low cost, low earth orbiting satellite communication technology (e.g., microsat) is rapidly advancing in other arenas, driven by the high cost of large communication satellites. Exploring communication alternatives to avoid reliance on a single network would be a wise investment.” Consider looking at the range of satellites (including CubeSats and MicroSats) for communication and sensors. This, like the new genomics and bioinformatics effort, could be a means of acquiring new engineering staff in a new capability area.

Response to Recommendation 18: We agree that ongoing exploration of emerging technologies is important, and note that we have not ignored microsats since the last review. Miniature low earth orbiting satellites (Cubesats and smaller form factors) are a fast-moving and disrupting technology that present opportunities to PMEL’s core mission. While Iridium has served us well for global, realtime and bi-directional communications, we are somewhat vulnerable by relying on a single vendor. New advancements and reduction in broadband costs will be systematically evaluated for requirements in new observing systems. We will also consider incorporating the use of NOAA Observing Systems Council (NOSC) processes to inform satellite modifications to meet PMEL requirements.

Action Plan for Recommendation 18:

- Evaluate Mini-sats with standard engineering 5-step principles.
 - Date: **Completed**. PMEL has evaluated the mini-sats and would need to explore new funding streams to do this work.
 - Responsibility: PMEL Engineering Division (EDD)
- As relevant coordinate across users within NOAA
 - Date: **Completed**: PMEL is working more closely with NASA. We have established a multiyear MOU to validate the Sentinel-6 altimeter and the new SWOT swath altimeter, launching this fall with in-situ buoy technology.
 - Responsibility: PMEL Engineering Division (EDD)
- Consider incorporating the use of NOAA Observing Systems Council (NOSC) processes to inform satellite modifications to meet PMEL requirements.
 - Date: **Completed**. PMEL has considered this possibility but decided this was not the best path forward for PMEL EDD at this time.

- Responsibility: PMEL Engineering Division (EDD)

Recommendation 19: Internships

Recommendation 19: PMEL should explore the use of employee “interns” for summer work within the engineering group. Given the proximity to UW and other Universities, there may be good opportunities to have students participate in PMEL engineering. We suggest that a specific program be put in place to facilitate the use of students, especially for the Science Data Integration Group.

Response to Recommendation 19: We agree, and in fact, have already brought on two college-bound high school graduates as summer engineering interns through the Youth Maritime Collaborative. PMEL is also making use of the NOAA Educational Partnership Program (EPP) Cooperative Science Centers to address this. We had our first EPP students this last summer (2020) and look forward to having more. PMEL has a long history of summer scientific interns, and the new Bill Lapenta Internship program offers additional data science and engineering internship opportunities. We will seek to increase opportunities for interns both to build the next generation of NOAA employees and to increase the pipelines of diverse candidates for NOAA positions.

Action Plan for Recommendation 19:

- Continue emphasis on summer intern programs, including the William Lapenta internship, NOAA Cooperative Science Centers and their EPP scholarships, as well as others.
 - Date: **Intended to be ongoing**. In summer of 21 PMEL mentored 21 undergraduates and 3 graduate students from seven different programs (Hollings, EPP/MSI, Lapenta, UW CICOES, Pathways, NERTO, NOAA College Supported Program at Smith College. This summer, PMEL will host 11 undergraduates and 7 graduate students from seven different programs (Hollings, Lapenta, UW CICOES, NERTO, NOAA College Supported Program, Georgetown Environmental Metrology & Policy Program, and Future Leaders in Public Service Internship Program)
 - Responsibility: PMEL PIs
- Identify administrative requirements for establishing a PMEL-specific internship program
 - Date: **Ongoing**.
 - Responsibility: PMEL Administrative Officer
- Evaluate budgetary constraints and implement a PMEL program if appropriate
 - Date: **Ongoing**
 - Responsibility: PMEL leadership