

Implementation Plan and Completed Actions

Pacific Marine Environmental Laboratory's Action Plan and Completed Actions

to Respond to the Recommendations of the Reviewers

from the 2014

Pacific Marine Environmental Laboratory's Science Review

Pacific Marine Environmental Laboratory

7/31/2015

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1. Outline and Rationale for the Implementation Plan

The National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research (OAR) conducted a periodic review of the Pacific Marine Environmental Laboratory's (PMEL's) research portfolio over a three day period, September 9 – 11, 2014; the members of the Review Team were as follows:

Dr. Richard Signell, U.S. Geological Survey, Woods Hole, MA, review Chair

Dr. Fei Chai, University of Maine

Dr. Tom Curtin, Massachusetts Institute of Technology

Dr. Cornel de Ronde, Institute of Geological and Nuclear Sciences (GNS), New Zealand

Dr. Hermann Fritz, Georgia Institute of Technology

Dr. Jay McCreary, University of Hawai'i

Dr. Robert Odom, University of Washington

Dr. Rebecca Woodgate, University of Washington

PMEL greatly appreciates the time and thoughtful consideration the entire review team provided to help evaluate the quality, relevance, and performance of our entire research portfolio.

The review report contains a total of 33 recommendations and we have divided those into three categories: recommendations that apply to the laboratory at large, specific recommendations to the research projects underway at PMEL, and a few recommendations that apply to the review process itself.

As part of its oversight of the review process, OAR Headquarters has incorporated a numbering system for the recommendations. For sake of continuity, we will continue that numbering system throughout this Implementation Plan.

2. List of Recommendations, arranged by theme

Reviewer Recommendation	Addressed in Section...
1. A documented strategy is recommended for succession planning. It would be advantageous to have a phased retirement program that would allow a period of overlap between outgoing and incoming group leaders and thus mentorship for a new generation of PMEL research drivers.	3.1.1
2. As a first step to addressing [succession planning], PMEL should compile statistics on diversity in the lab, including salary equity; investigate/correct any biases and inequities found; investigate possible reasons for lack of diversity, and put into place policies to address deficiencies found in this area.	3.1.1
3. PMEL should assess the frequency of meetings between the heads of PMEL and The Joint Institute for the Study of the Atmosphere and Ocean (JISAO) to ensure that communication is optimal. There should be a plan in place to ensure good Federal/JISAO relationships and prevent building an "us and them" division in the lab.	3.1.2
4. PMEL should consider setting money aside for competitive seed ideas that might, if successful, might turn into larger programs.	3.1.2
5. Existing programs should be evaluated periodically to make sure they are still as effective and efficient.	3.1.2
6. PMEL should be active in ensuring that proposed new regulations contain sufficient routes for non-US citizens visiting the PMEL.	3.1.1
7. PMEL needs to play a major role again in controlling the design and operation of the Tropical Atmosphere Ocean (TAO) array	3.2.1
8. PMEL management should provide strong support for getting the tropical observing system back on course.	3.2.1
9. The Thermal Modeling and Analysis Project (TMAP) work is important and should continue.	3.2.1
10. PMEL should attempt an approach similar to the New Guinea Coastal Undercurrent NGCUC studies with gliders in another Western Boundary Currents (WBC) region.	3.2.1
11. Deep Argo measurements are critically important and must be expanded if the community is to have enough data to accurately understand where the heat due to climate change is being absorbed.	3.2.1
12. The ocean climate stations are an important member of NOAA's climate array and should continue being supported.	3.2.1
13. PMEL's carbon program clearly supports NOAA goal to acquire information about the impact of atmospheric CO ₂ on the ocean and should continue being supported.	3.2.1
14. There is a clear need to continue measurements of Arctic climate change, and to communicate results and understanding to society.	3.2.1

15. The [atmospheric chemistry] project contributes to NOAA's goal to improve understanding of atmospheric composition (clouds, aerosols, precipitation) and should be continued.	3.2.1
16. PMEL should explore greater connections between the acoustics group and other projects such as ocean acidification, climate, tsunami and Arctic programs.	3.2.2
17. It is recommended that the focus and approach [to investigating Alaska and Arctic Ecosystems] be extended to the Gulf of Alaska and other high priority coastal areas.	3.2.2
18. It is recommended that PMEL conduct a modeling study and, if needed, an observational process study to understand the mechanisms of cross-shelf exchange.	3.2.2
19. PMEL is well-positioned to play a leadership role in the Arctic, and that the time is right to make a significant investment toward this goal. Coordination with other arctic research groups will be critical to ensuring success.	3.2.2
20. PMEL should consider working with coastal ocean observing communities to design regional ocean acidification network.	3.2.2
21. PMEL should also investigate whether high-resolution data now obtainable from Greenland and Antarctica ice cores could be combined with modern ocean acidification effects to compare and contrast similar episodes in the recent past for better understanding of the evolution of our climate.	3.2.2
22. The Earth-Oceans Interactions group should actively pursue linkages associated with natural acidification laboratories, drug discovery, and the future opportunities and challenges of deep ocean mining.	3.2.2
23. PMEL should conduct an internal review of the engineering group with the primary aim of assessing and prioritizing core engineering competencies and staffing levels required to support projected science needs.	3.2.3
24. The [research IT, data management, and data telemetry] group should take advantage of the standardized framework it has been helping to develop and deploy it for the benefit of PMEL research, building tools, portals and clients that utilize standardized web services for search and access to PMEL data.	3.2.3
25. Exploring communication alternatives to avoid reliance on a single network would be a wise investment.	3.2.3
26. The tracer group should increase collaboration with modeling groups that use the tracer data.	3.2.4
27. PMEL scientists are world leaders in seafloor hydrothermal systems, and should make the transition to enable them to be world leaders in understanding related mineral deposits and their possible exploitation.	3.2.4
28. The on-going [tsunami] technology and forecasting innovations at PMEL appear well-planned and should be completed.	3.2.4

29. PMEL should study whether coastlines at high risk and vulnerability could benefit from shallower water sensors on deployed at depths of order a hundred meters to confirm incoming tsunami signals and facilitate more reliable model inundation forecasting for target coastlines.	3.2.4
30. The following recommendations are for OAR Headquarters to improve the review process:	
a. OAR should ensure there is sufficient time for reviewer questions and discussion during the presentations.	3.3
b. The roles of the laboratory and its cooperative institute partner should be explained more at the very beginning of the review.	3.3
c. The panel’s interviews of the stakeholders should probably be extended from 12 minutes to 20 minutes each.	3.3
d. It would be useful to have a separate discussion with early career scientists.	3.3

3. PMEL Responses to the Reviewers’ Recommendations

3.1 Laboratory-wide Recommendations

3.1.1 Staffing-specific Recommendations

Recommendation 1. A documented strategy is recommended for succession planning. It would be advantageous to have a phased retirement program that would allow a period of overlap between outgoing and incoming group leaders and thus mentorship for a new generation of PMEL research drivers.

Response: Agreed. PMEL Management is in the process of developing a Workforce Management plan, which addresses staffing projections and succession planning, among other workforce issues. The plan is due to be completed by June 1, 2015. The federal Office of Personnel Management has published its final rules on the implementation of a phased retirement program within the federal government. The Department of Commerce has not authorized phased retirement, and until they do, we are unable to offer this option. However, we are encouraging mentorship and the smooth transition of responsibility from retiring scientists and staff to their more junior counterparts through several means at our disposal: 1) making use of Visiting Scholar appointments for retiring federal employees (in accordance with the 2014 OAR Visiting Scholar Policy), 2) with the support of our JISAO partners, transitioning retired federal personnel to part time JISAO research positions, and 3) supporting requests from staff to move from full time to part time work. Until the Commerce Department officially recognizes “phased retirement” as a federal option, we are restricted to the above-mentioned and possibly other means to help mentor and transfer responsibility from senior to junior staff. ([Completed D&I baseline survey](#))

Recommendation 2. As a first step to addressing [succession planning], PMEL should compile statistics on diversity in the lab, including salary equity; investigate/correct any biases and inequities found; investigate possible reasons for lack of diversity, and put into place policies to address deficiencies found in this area.

Response: PMEL's workforce Management Plan examines diversity issues on multiple fronts, and outlines a plan to use available OAR and NOAA resources to address the issue of diversity. PMEL also collects statistics on diversity and provides these for the OAR annual EEO report. ([Workforce Plan has been submitted](#))

Recommendation 6. PMEL should be active in ensuring that proposed new regulations contain sufficient routes for non-United States citizens visiting the PMEL.

Response: Since the September review, there have been some positive developments in this area. First, non-United States citizens are not at risk of not gaining access to PMEL under the current security policy. As long as a foreign national visitor is sponsored by a federal employee and Security is provided with the information they need in advance of the visit, a foreign national in good standing will be allowed on campus provided (s)he produces their passport. While the information sheet from Security did not make this clear, we have ascertained that this is indeed the case, both now and after the implementation of federal Real ID procedures. Second, the State of Washington is making progress towards becoming compliant to the Real ID law and, due to their efforts, the Department of Homeland Security has granted a waiver which allows valid Washington driver's licenses to be used to confirm identification to enter the NOAA campus at least until October, 2015. Real ID, if implemented today, would be much more troublesome for visiting United States citizens than for foreign visitors. Department of Commerce (DoC) Security is working with us to minimize any disruptions to our current access posture. We believe we will be able to maintain that accessibility for all personnel who can meet basic security criteria. ([PMEL continues to adhere to DOC/OSY policy while allowing visitation by our FN guests](#))

3.1.2 General Management Recommendations

Recommendation 3. PMEL should assess the frequency of meetings between the heads of PMEL and JISAO to ensure that communication is optimal. There should be a plan in place to ensure good Fed/JISAO relationships and prevent building an "us and them" division in the lab.

Response: Interactions between PMEL and JISAO are governed by the Cooperative Agreement between the two organizations. Since it is a cooperative agreement, we are constantly working in cooperation with the University and within the boundaries of the statutes, regulations, and requirements affecting both federal and University employees. It is essential that everyone recognize the differences between the two types of employees and work together to satisfy the objectives of the agreement that brings us together to accomplish NOAA's mission.

[We agree that communication is key to improving relationships. PMEL and JISAO leadership have established a calendar of quarterly meetings to improve communication. The first quarterly meeting between the JISAO and PMEL directors was very productive.](#)

Recommendation 4. PMEL should consider setting money aside for competitive seed ideas that might, if successful, turn into larger programs.

Response: We agree that this is a great idea and the director has always encouraged his PIs to apply for AA seed money when it has been offered. However, there is difficulty in implementing a seed fund at the lab level from a fiscal perspective. Base funding primarily covers salaries and little is left over that the Director has discretion to make a meaningful award. However, the Director remains committed to making such awards when he has the flexibility to do so. (PMEL continues to allow risk taking in project selection and allows competition on available funds.)

Recommendation 5. Existing programs should be evaluated periodically to make sure they are still as effective and efficient.

Response: Agreed. The September review plays an important role in this ongoing evaluation whereby external review is presented of all the lab's research programs. This review is augmented annually by the proposal/work plan/progress report process that Primary Investigators (PIs) undergo to either request continued funding for their programs or to initiate new programs. Annually, the Director requires division level work plans are submitted before funding decisions are made. These plans reflect accomplishments of the past year and plans for the coming year. (Ongoing activity)

3.2 Program-specific Recommendations

3.2.1 Ocean Climate Research

Recommendation 7. PMEL needs to play a major role again in controlling the design and operation of the TAO array

Response: NOAA/PMEL routinely participates in the regular cross line office TAO Working Group operations and maintenance discussions; adding advice and support where appropriate. We are also playing a leading role in the international TPOS2020 team to examine and plan for the next generation observing system for the Tropical Pacific. Dr. William Kessler is co-lead of the scientific steering committee for this group, and several PMEL and JISAO PIs are involved in various aspects of the planning activities. (PMEL recently hired a new TAO Project Manager, Ken Connell and continues to invest in human capital for this effort)

Recommendation 8. PMEL management should provide strong support for getting the tropical observing system back on course.

Response: We agree. In 2015, PMEL has been actively involved in programmatic and management-level discussions on improving the performance of the TAO Array. For example, PMEL is actively involved in identifying potential options to assist National Data Buoy Center to return the TAO Array to a consistent data delivery rate of 80%. The PMEL Director, along with the OAR AA and the Director of the Climate Observations Division are working together to identify resources to implement Tropical Pacific Observing System (TPOS) (discussed in Recommendation 7 above). (Continuation of Response statement)

Recommendation 9. The Thermal Modeling and Analysis Project (TMAP) work is important and should continue.

Response: PMEL plans to continue the TMAP project, subject to continued funding from the Climate Program Office. (Dr. Harrison recently retired but a JISAO PI is able to continue the investigations)

Recommendation 10. PMEL should attempt an approach similar to the New Guinea Coastal Undercurrent (NGCUC) studies with gliders in another Western Boundary Currents (WBC) region.

Response: Agree. Having shown that gliders are a feasible technology for measuring western boundary currents (e.g. Kessler, W.S., and S. Cravatte; 2013; J. Phys. Oceanogr., 43(5), doi:10.1175/JPO-D-12-0113.1, 956–969), the next target should be the corresponding equatorward WBC in the northern hemisphere (Mindanao Current). While Argo, satellite altimetry and TAO/TRITON (Triangle Trans-Ocean Buoy Network) provide good estimates of the circulation in the interior, none of these measures the western boundary contribution. Adding the Mindanao Current sampled by gliders would complete our picture of the inflows and outflows to the equator. On the other hand, although oceanographically the Mindanao Current would be an easier target than the complex Solomon Sea, politically and practically, this would be a more difficult area to work in due to the unsettled conditions in the southern Philippines. (PMEL experienced similar problems in the western Indian Ocean during the years that piracy was rampant in that area: we were unwilling to risk the safety of our staffs to expand the RAMA array there and we would take similar precautions in the Philippines region due to ongoing civil unrest in this area.) Thus although we should do this, we are unwilling to make the commitment to do this at this time. Another useful target would be the region near 18°S on the coast of Australia where both the equatorward NGCU (that we measure downstream) and the poleward East Australia Current form. Dr. Kessler is exploring funding opportunities to do this. (Dr. Kessler continues to seek and receive funding for this recommendation)

Recommendation 11. Deep Argo measurements are critically important and must be expanded if the community is to have enough data to accurately understand where the heat due to climate change is being absorbed.

Response: Agreed. PMEL, in partnership with the Climate Program Office/Climate Observations Division, has been funded to develop and implement a Deep Argo program. 2015 is the third year of what is now a six-year program. Demonstrated success in this early phase of the program will greatly enhance the likelihood of this program being continued beyond FY2018. (PMEL recently proposed and was awarded funds from the Paul Allen Foundation for Deep Argo investigations)

Recommendation 12. The ocean climate stations are an important member of NOAA's climate array and should continue being supported.

Response: PMEL plans to continue the Ocean Climate Stations project, subject to continued funding from the Climate Program Office. (PAPA and KEO continue to be important

platforms to maintain reference time series and innovative measurements and are used to improve satellite products and forecast models, and improve our understanding of air-sea interactions, and their role within the climate system.)

Recommendation 13. PMEL’s carbon program clearly supports NOAA goal to acquire information about the impact of atmospheric CO₂ on the ocean and should continue being supported.

Response: PMEL plans to continue the Ocean Carbon project, subject to continued funding from the Climate Program Office and other external sources. (We continue documenting the evolving state of the ocean carbon chemistry with high quality measurements on ships and autonomous platforms, studying the processes controlling the role of the ocean in the global carbon cycle, and investigating how rising atmospheric CO₂ and climate change affect the chemistry of the oceans and its marine ecosystems.)

Recommendation 14. There is a clear need to continue measurements of Arctic climate change, and to communicate results and understanding to society.

Response: PMEL plans to continue the Arctic climate change research project, subject to continued funding from the Climate Program Office and other external sources. (In lieu of the President’s request to terminate NOAA’s Arctic research, PMEL will continue Arctic investigations as policy and funding allow)

Recommendation 15. The [atmospheric chemistry] project contributes to NOAA’s goal to improve understanding of atmospheric composition (clouds, aerosols, precipitation) and should be continued.

Response: PMEL plans to continue the Atmospheric Chemistry research project, subject to continued funding from the Climate Program Office and other external sources. (PMEL continues to be dedicated to international field campaigns and long term measurements to determine the impact of atmospheric aerosol particles on climate and air quality)

3.2.2 Marine Ecosystems Research

Recommendation 16. PMEL should explore greater connections between the acoustics group and other projects such as ocean acidification, climate, tsunami and Arctic programs.

Response: We agree with the reviewer’s comment. The Acoustics Program has always looked for ways to connect with the PMEL Ocean Acidification, Climate, Tsunami and Arctic programs and has already been partnering with these groups on projects for a number of years. For example, the Acoustics Program is partnering with the Ecosystems and Fisheries-Oceanography Coordinated Investigations (EcoFOCI) and Arctic programs to build and deploy a sub-ice hydrophone and Conductivity/Temperature/Depth (CTD) mooring for recording ambient sound levels (both natural and man-made) and the physical oceanographic conditions in the northern Bering Sea. This mooring will use winch

technology that can sense when the sea surface is ice-free, then deploy a positively buoyant satellite antenna to the surface to transmit data back to shore in near-real-time.

The Acoustics program has also been working with the Climate Program for the last few years to maintain a hydrophone mooring at Ocean Station Papa. The Papa hydrophone mooring will be used to assess how wind and wave heights affect long-term noise levels in the ocean. The Papa hydrophone is also a key node in the Ocean Noise Reference Station Network the Acoustics Program is now assembling throughout the United States exclusive economic zone (EEZ).

- Ocean acidification research has also long been a priority of the Acoustics Program as exemplified by our work to estimate the amount of magmatic CO₂ gas being expelled by two deep-ocean volcanoes in the western Pacific. We estimate that one of the volcanoes, Northwest Rota-1 in the Mariana Islands, expels 0.4 Tg of CO₂ per year. This is roughly equivalent to 1% of CO₂ gas from subaerial arc volcanoes worldwide, and therefore this one volcano is a significant natural source of CO₂ in the ocean. More work needs to be done, through a stronger collaboration with the OA program, to incorporate our estimates of natural CO₂ into the global models of ocean acidification. Lastly the Acoustics program has for many years studied submarine earthquake and landslide processes, and on numerous occasions has partnered with the Tsunami program to review the pressure records from Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys to analyze the tsunami signals generated by these events. Typically, the submarine earthquake and landslides being studied were relatively small and were only recorded by PMEL hydroacoustic sensors (as opposed to land-based seismic sensors), therefore the DART buoy sensors allow us to see if these kind of events had broader oceanographic impacts and generate regional scale tsunamis. [\(PMEL's Acoustic Program continues to conduct marine acoustics research and technology development under NOAA's mission of Science, Service, and Stewardship, provide acoustic tools and research capabilities for a variety of applications to meet NOAA's research goals and develop "Next Generation" technologies and instrumentation in support of NOAA's Office of Oceanic and Atmospheric Research \(OAR\) objectives.](#)

Recommendation 17. It is recommended that the focus and approach [to investigating Alaska and Arctic Ecosystems] be extended to the Gulf of Alaska and other high priority coastal areas.

Response: PMEL/EcoFOCI conducts research in the Gulf of Alaska, Bering Sea, U.S. Arctic and the Aleutian Islands, focusing on the impact of climate and physical forcing on ecosystems. The regional focus of the research varies from year-to-year dependent on the scientific and management questions that are prominent at the time, and available funds. We have recently expanded, in collaboration with the National Marine Fisheries Service lab at Auke Bay, AK, to southeast Alaska, making baseline measurements to better understand this ecosystem. [\(PMEL continues to look at oceanographic and climate influences, and relationships between trophic levels in a changing ecosystem and will include zooplankton sampling, hydrographic measurements, water and iron sampling.\)](#)

Recommendation 18. It is recommended that PMEL conduct a modeling study and if needed an observational process study to understand the mechanisms of cross-shelf exchange.

Response: While our presentations at the site review did not focus on it, for well over a decade modeling has been an integral component in EcoFOCI. Models are used to better understand physical mechanisms including how climate might impact these high latitude systems. Our physical models usually provide the physical component for the individual species and ecosystem models we work on in collaboration with Fisheries. We appreciate the review team identifying the importance of modeling studies in this region; we recognize that there are several physical mechanisms, including cross-shelf fluxes, that require further investigation and we plan to attempt to secure funding to expand our work in that direction. (We continue to seek funding for modeling studies in EcoFOCI)

Recommendation 19. PMEL is well-positioned to play a leadership role in the Arctic, and that the time is right to make a significant investment toward this goal. Coordination with other Arctic research groups will be critical to ensuring success.

Response: PMEL is actively involved in the planning and execution of a number of Arctic missions from atmospheric research to ocean processes to marine mammal studies. The lab actively collaborates with other NOAA line-offices, especially National Marine Fisheries Service (NMFS) in the Arctic Ocean and Bering Sea. While continuing time-series observations that go back as far as 40 years, PMEL is leading and collaborating on new initiatives such as the Distributed Biological Observatory (DBO) as well as the development and deployment of autonomous vehicles to the Arctic. To facilitate these activities and enhance future collaborations, Drs. Mathis, Stabeno and Overland all take an active role in serving on working groups and science steering committees that address components of Arctic research. Dr. Mathis is the OAR representative to the newly formed Arctic Executive Committee that reports directly to the NOAA Administrator. The coordination that this group provides should allow for greater integration of future activities between programs such as Ocean Exploration, Ocean Acidification, and the Climate Program Office as well as other line offices such as the National Ocean Service and National Weather Service (NWS). (In lieu of the President's request to terminate NOAA's Arctic research, PMEL will continue Arctic investigations as policy and funding allow)

Recommendation 20. PMEL should consider working with coastal ocean observing communities to design regional ocean acidification network.

Response: The PMEL Ocean Acidification project is already extensively linked with the coastal ocean observing communities and plays a leading role in seeking to create broader connections across a diverse field of research and monitoring groups as well as other stakeholders. We collaborate locally both directly and through larger networks with several IOOS regional associations (RAs), including NANOOS (Northwest Association of Networked Ocean Observing Systems), CeNCOOS (Central and Northern California Ocean Observing System), SCCOOS (Southern California Coastal Ocean Observing System), AOOS (Alaska Ocean Observing System), and PacIOOS (Pacific Islands Ocean Observing System), both through real-time dissemination of OA mooring data and partnerships with stakeholders. We played a founding role in the C-CAN (California Current Acidification

Network), which serves to facilitate these linkages among scientists, agencies, resource managers, industry, tribal nations, and others with an interest in coastal ocean health. We are somewhat less directly, involved with the development of similar networks on the NE-CAN (Northeast Coastal Acidification Network), SOCAN (Southern Ocean and Coastal Acidification Network), as our East Coast counterparts at the Atlantic Oceanographic and Meteorological Laboratory (AOML) primarily fill that role. However, PMEL also has been collaborating at the global level through our contribution to the Global Ocean Acidification Observing Network, which includes all of the regional networks. (In FY16 PMEL conducted the most integrated West Coast Ocean Acidification cruise to date, with physical and biogeochemical measurements designed to assess the status of multiple ecosystem stressors — ocean acidification, temperature, and oxygen concentrations — throughout West Coast waters as the upwelling season commences.)

Recommendation 21. PMEL should also investigate whether high-resolution data now obtainable from Greenland and Antarctica ice cores could be combined with modern ocean acidification effects to compare and contrast similar episodes in the recent past for better understanding of the evolution of our climate.

Response: PMEL is collaborating with our academic colleagues who compare present-day acidification conditions with the geological past by making appropriate physical and chemical data from our data archives available for comparisons of present-day conditions and corresponding biological responses to compare with past conditions utilizing sediment trap and sediment samples from the regions we are studying. The research is usually sponsored by NSF with PMEL scientists in supporting roles. (PMEL continues to support this line of investigation)

Recommendation 22. The [Earth-Ocean Interactions] group should actively pursue linkages associated with natural acidification laboratories, drug discovery, and the future opportunities and challenges of deep ocean mining.

Response: Agreed. The Earth-Ocean Interactions (EOI) program has identified several sites of high volcanic-CO₂ output as natural laboratories where the impacts of ocean acidification on ecosystems can be studied. EOI is also collaborating with PIs in the College of Pharmacy at Oregon State University on drug discovery research at hydrothermal vents. EOI's collaborations with economic geologists and biologists help characterize the mineral and biological resources at newly discovered vent sites, providing key information needed for the assessment of any future seafloor mining activities (see response under recommendation #27). (PMEL hired a Genomics expert hoping to expand EOI's ability to understand further the environment around vents)

3.2.3 Research Innovation

Recommendation 23. PMEL should conduct an internal review of the engineering group with the primary aim of assessing and prioritizing core engineering competencies and staffing levels required to support projected science needs.

Response: Agreed. The first step to plan for a properly staffed engineering group in a science driven Lab is to prioritize the science requirements and sustained funding level available for additional development work. A second step is to then review the capacity, scope and skills of the scientific technicians for the above priorities. The engineering competencies can then dovetail into those competencies and the proper engineer staff can be determined and budgeted for. Challenges include sporadic funding for engineering development type work, making it difficult to hire top-notch talent in an ad-hoc manner. These issues will be addressed in the PMEL Workforce Management Plan that is being developed. (PMEL continues to work on strengthening our EDD staff and matching our perceived future needs with reality of workforce planning)

Recommendation 24. The [research IT, data management, and data telemetry] group should take advantage of the standardized framework it has been helping to develop and deploy it for the benefit of PMEL research, building tools, portals and clients that utilize standardized web services for search and access to PMEL data.

Response: Agreed. These recommendations, and feedback received from reviewers, are among the motivations for the development of a PMEL-wide Data Integration Strategy. A core tenet of this strategy is to leverage, for PMEL's benefit, the standardized framework the Science Data Integration Group (SDIG) has pioneered, and deployed through other projects. Our expectation is that this project will provide a testbed to develop a portfolio of tools and protocols that can be transitioned to other line offices, including the NOAA data centers, as appropriate. SDIG has been funded by the PMEL Director to begin building this infrastructure at PMEL, and SDIG members will work with PMEL PIs and the data centers in the coming years toward this implementation. This framework will provide improved data documentation, discovery, access and archival of PMEL's public data. In addition, through projects such as the Unified Access Framework, SDIG is committed to working closely with the NOAA-led IOOS office to promote data integration and interoperability frameworks in partnership with their regional association members. (PMEL is reorganizing the SDIG group in a more formal manner to better allow matrixed service delivery across all of PMEL)

Recommendation 25. Exploring communication alternatives to avoid reliance on a single network would be a wise investment.

Response: Agreed. Advancing satellite communications technology will bring new telemetry options and PMEL engineers actively seek information on promising new technologies that could prove beneficial for ocean measurements. We are presently using Iridium and Argos and have used Orbcomm and Geostationary Operational Environmental Satellite(GOES) in the past. Our Iridium use is growing rapidly because of its low power requirements, flexibility, coverage, high bandwidth, and favorable pricing. We've evaluated Inmarsat and Argos-3 for other system designs, but they were a poor fit for the particular systems. (PMEL constantly pursues new promising new technologies while maintaining high level of success in our observing systems)

3.2.4 Ocean and Coastal Processes

Recommendation 26. The tracer group should increase collaboration with modeling groups that use the tracer data.

Response: We agree with the importance of the tracer group collaborating with modeling groups. All of the observational data collected by the PMEL Ocean Tracer Program are archived and made publically available within 6 months of collection at major data centers. These data are assimilated into globally-gridded products (e.g. Global Ocean Data Analysis Project (GLODAP) which facilitates their use in model-data comparison studies. We have been active with modeling groups from Germany, Johns Hopkins, Lamont (Columbia), Princeton/Geophysical Fluid Dynamics Laboratory (GFDL), U.C. Irvine, and plan to continue these efforts. At present, however, opportunities to obtain funding from NOAA sources to continue and expand these efforts are very limited. Through JISAO and with the National Science Foundation (NSF) derived-funding, we are planning to recruit a postdoc in 2015 to work with the latest generation of 3-D ocean models' tracer and CO₂ fields in an evaluation of basin-wide patterns of CO₂ uptake at the sea surface and subsequent transports in the ocean interior. This project in particular will involve extensive collaboration with GFDL modelers. (PMEL continues to seek stable funding to support collaborative modelling efforts using tracer data)

Recommendation 27. PMEL scientists are world leaders in seafloor hydrothermal systems, and should make the transition to enable them to be world leaders in understanding related mineral deposits and their possible exploitation.

Response: Agree. The opportunities and challenges of seafloor mining are likely to become an important issue in the coming years. The Earth-Ocean Interactions Program will seek out opportunities to collaborate with other investigators and institutions to advance our knowledge of both the potential mineral resources and the potential environmental impacts of resource extraction. When we have the opportunity to hire new staff, we will consider this emerging issue in our decisions. (PMEL continues to observe seafloor mining activities for awareness and possible exploration management strategy test beds within NOS Sanctuaries)

Recommendation 28. The on-going technology and forecasting innovations at PMEL appear well-planned and should be completed.

Response: Agree. PMEL plans to continue tsunami forecast improvements using modeling and technology innovations in 2015 and into the future. This program will include development and implementation of new tsunami detection capabilities coupled with faster model assimilation and forecast technology. These innovations will allow for much faster and more accurate tsunami forecast technology that provides real-time tsunami impact estimates from both, long-distance and near-field tsunami sources. For successful implementation, this activity will be coordinated with operational NWS Tsunami Warning Centers (TWCs). The coordination is achieved by the Tsunami Testbed activity that will coordinate priorities of TWCs with scientific development at PMEL. In 2015, PMEL and NWS have agreed to: develop two additional high-resolution forecast models to expand forecast coverage of Short-term Inundation Forecasting for Tsunamis (SIFT) (Bermuda and British Columbia), develop methodology for including tides into real-time flooding

forecasts, implement computational parts of SIFT into the National Centers for Environmental Prediction for faster computation of flooding, test deployment of two DART 4G systems offshore Chile (in collaboration with the Chilean Navy), and develop tsunami-induced current forecasts. (PMEL continues to provide high quality tsunami detection hardware and software both domestically and in collaboration with our international partners)

Recommendation 29. PMEL should study whether coastlines at high risk and vulnerability could benefit from shallower water sensors on deployed at depths of order a hundred meters to confirm incoming tsunami signals and facilitate more reliable model inundation forecasting for target coastlines.

Response: Agree. Additional sensors closer to high-risk shores can provide the “last-line-of-defense” measurements for confirmation of the forecast and/or forecast adjustment for higher accuracy of impact estimates. The experience of the Japan Tsunami Warning System during the 2011 Tohoku tsunami showed the potential for the addition of such a sensor network. The development of such a system will require initial research efforts including the testing of existing near shore measurements and/or development of new systems and development of modeling capability to use the measurements for improved forecasts of high-risk coastal areas. This development fits well into the OAR/NWS Tsunami Testbed activities. (PMEL continues to provide high quality tsunami detection hardware and software both domestically and in collaboration with our international partners)

3.3 Recommendations to OAR on the Conduct of the Review

- Recommendation 30a. OAR should ensure there is sufficient time for reviewer questions and discussion during the presentations.
- Recommendation 30b. The roles of the laboratory and its cooperative institute partner should be explained more at the very beginning of the review.
- Recommendation 30c. The panel’s interviews of the stakeholders should probably be extended from 12 minutes to 20 minutes each.
- Recommendation 30d. It would be useful to have a separate discussion with early career scientists.

Response: OAR appreciates the suggestions and has made adjustments in the review process to address these issues.