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National Oceanic and Atmospheric Administration
Silver Spring, MD 20910

OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH

NOV 18 2008

MEMORANDUM FOR: Eddie Bernard, Director
Pacific Marine Environmental Laboratory

FROM: Craig N. McLean *Judith Gray for ...*
Acting Assistant Administrator

SUBJECT: Pacific Marine Environmental Laboratory Science Review

The Office of Oceanic and Atmospheric Research (OAR) has received and reviewed your report on actions taken following the August 2008 science review of the Pacific Marine Environmental Laboratory (PMEL). I am pleased to inform you that your report has been approved, and as a result, we consider all review actions complete.

A copy of this report will also be posted on the OAR intranet and distributed to each review team member who participated in the panel and drafted the initial review report. As a public archive of the review process and actions undertaken, I request that you post a copy of the final report on your review website.

Thanks to you, Eddie Bernard, and the entire PMEL team for your hard work preparing and hosting this recent science review. Reviews are an important opportunity to demonstrate the quality and relevance of NOAA research to the stakeholders, Congress, and the public. Your efforts to implement the changes recommended by the panel are a testament to OAR's dedication to strengthen science throughout the agency.



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Pacific Marine Environmental Laboratory

Science Review Final Report

**Laboratory Response to and Implementation of the Recommendations from
the August 2008 Science Review Report**

Science Review: August 26 – 28, 2008

Review Panel Report: November 23, 2008

Implementation Plan Approved: December 4, 2009

Final Report Approved: November 18, 2010

This report provides PMEL's list of actions and responses to the recommendations in the PMEL Review Panel Report in the form of an Implementation Plan, and provides a final summary of the actions completed as outlined in the Implementation Plan.

Eddie N. Bernard, Director
Pacific Marine Environmental Laboratory
Seattle, Washington

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1. Rationale and outline of the Implementation Plan

The PMEL Review Team developed a list of 46 separate recommendations in their report. We are grateful for the Team's thoughtful consideration of PMEL's programs and needs, based on the material presented at the review. Rather than respond to all 46 recommendations sequentially as they were listed in the report, we categorized the recommendations and, in so doing, have adopted a strategy to utilize them to their fullest value.

We have identified issues that fall into the following five categories: 1) a summary recommendation, 2) recommendations that PMEL can use to move our research objectives forward within NOAA, 3) recommendations which PMEL has already put into motion and, in some cases, has already completed, 4) recommendations that are primarily outside of PMEL's control, but will be offered to the most appropriate NOAA offices, and 5) recommendations that were made concerning the conduct of the review, or for which we judged were made rhetorically. In this way, we account for all the recommendations, even those for which there is no action required on PMEL's part.

It should also be noted that the recommendations of the reviewers are numbered from 1 to 40, with two recommendations having more than one part. (There is a Recommendation 12, 12.2, and 12.5; there is also Recommendation 40, 40.1, 40.2, 40.3, and 40.4, for a total of 46 recommendations.) In this Implementation Plan, we retain the reviewers' original numbering scheme for consistency with the reviewers' report.

This final version of the Implementation Plan addresses updates since the previous version of the Plan was completed on November 25, 2009. For completeness, all recommendations are shown in this report. Those recommendations that have been modified from the earlier version will have the word "UPDATE" indicated before the response.

2.0 List of Reviewer Recommendations

Reviewer Recommendation	Addressed in Section...
1. PMEL should be more aggressive in mounting long-term observation programs of the ocean water column	3.2.1
2. NOAA should consider a more deliberate effort to measure currents and fluxes in selected areas.	3.2.1
3. PMEL climate and carbon cycle groups should have systematic ties to external (modeling) groups and some internal hires with modeling experience.	3.2.2
4. NOAA/PMEL needs to continue communicating with NOAA headquarters on ship time	3.2.4
5. PMEL would greatly benefit from a formal seed-fund to support pilot studies for technology development and higher-risk concepts.	3.2.4
6. PMEL should invest in data management to keep up with existing and anticipated demands for increasing demands for data and for stakeholders.	3.4.3
7. A strong, explicit mentoring program and base of upcoming mid-career leaders needs to be in place within the laboratory for a successful transition plan (succession plan) when the current crop of senior people retire or move.	3.3
8. Whatever you do, don't break it!	3.1
9. It would be useful to present PMEL's roles and responsibilities within NOAA/OAR for purposes of evaluating the Lab's effectiveness.	3.5.1
10. Provide statistics and budgets by research area rather than for the lab at large.	3.5.1
11. PMEL management should reinforce with scientists and technical editors that salinities should not be published in units of PSU.	3.5.1
12. Provide time for writing by the review team and establish an expectation that draft comments be provided before the review team departs.	3.5.1
12.2 PMEL's tsunami program needs to dedicate effort to publishing its research in the scientific literature as well as developing operational products to improve the Tsunami Warning Program within NOAA.	3.2.3
12.5 PMEL's tsunami program needs least one or two additional PhD level scientists.	3.2.3
13. Transfers of climate observation technologies should be followed by institutional cultural and scientific adjustments enabling new technology initiatives (e.g., glider program).	3.4.2
14. PMEL should consider a more aggressive instrumentation activity including a heavier focus in monitoring the water column, for programs such as the Ocean Climate Station program.	3.2.1

15. The Live Access Server should have greater visibility and attention.	3.4.3
16. Bridge across PMEL research groups by connecting the water chemistry studies to ecosystem impacts and the discovery-exploration of CO2 release by underwater volcanic systems.	3.3
17. The PMEL review team should have met with Mike Johnson.	3.5.1
18. PMEL should play a lead role in an OAR determination of how to scale up efforts to operationalize NOAA Climate program activities.	3.4.1
19. PMEL should better demonstrate the importance and utility of the tropical oceanographic data products.	3.3
20. The TAO transition should have involved PMEL in developing a strategy for maintaining climate quality data.	3.4.2
21. PMEL needs an appropriate role in any NOAA Climate Services organization, with clear boundaries between research and operations, prioritization of field efforts and two-way information exchange to translate field observations into decision support tools.	3.4.1
22. The PMEL CLIVAR and carbon programs should be given high priority for NOAA ship time on the Ron Brown or for NOAA funds to charter an equivalent Class I research vessel.	3.2.4
23. The recent ocean carbon survey along the US West Coast should be integrated into the NOAA observational network, with observational rather than research funding, and be repeated on a regular basis.	3.4.1
24. PMEL instrumentation to autonomously measure two components of the ocean carbonate system should be incorporated into a wider network of moorings.	3.3
25. PMEL should have a performance metric to track obtaining and providing ocean observations data to the larger external community (in addition to publications).	3.2.5
26. PMEL's engineering innovation and the science-engineering partnership should continue to be strongly supported.	3.2.4
27. FOCI should consider a more proactive use of Lagrangian techniques to explore, chart and understand the mesoscale dynamics of the Bering Sea/Gulf of Alaska region.	3.3
28. FOCI should consider gliders and/or AUVs for insight into the structure of the circulation, the eddy field, mixing processes and the role of topography to define advective and dispersive processes, which play a major role in fixing the water properties.	3.3
29. NOAA should continue to support FOCI long-term time series for assessing changes in ocean climatology and fisheries.	3.2.1
30. The successful FOCI partnership between PMEL and the National Marine Fisheries Service should be highly commended as an example of strong within-agency cooperation and coordination to address societally relevant goals.	3.5.2

31. Research efforts, such as EcoFOCI, need to build on the approaches developed by program with a single species focus to a broader ecosystem-wide orientation.	3.3
32. FOCI should determine if the current mooring network is adequate through a more thorough observational network design study.	3.2.2
33. EcoFOCI would benefit from greater contact with regional climate modeling groups, for projections of future climate change, climate downscaling products and boundary conditions (atmospheric and lateral) for local numerical models.	3.2.2
34. EcoFOCI should set priorities and research directions to meet the emerging focus on IEAs in support of ecosystem approaches to management.	3.3
35. Base funding should support a higher fraction of FOCI activities. One possible avenue to enhanced base funding is a commitment to shaping IEAs in the Gulf of Alaska and the Bering Sea.	3.2.4
36. PMEL should assure funding for maintenance of the four Bering Sea moorings.	3.2.1
37. FOCI must decide what is planned for transition and what will be supported in the long term, specifically with regard to the four Bering Sea Moorings, which probably should not be transitioned.	3.4.2
38. Why not put the output of an ocean hydrophone on the net?	3.3
39. Consider a hydrophone offshore of a harbor.	3.3
40. In the case of tsunamis, a performance measure other than publications should be used to measure the success of the program.	3.2.5
40.1 PMEL should consider expanding server capability to provide access to tsunami buoy data and forecasts during large earthquake events.	3.2.3
40.2 PMEL tsunami group should publish a paper with the details about FACTS and maintain both FACTS and ComMIT servers.	3.2.3
40.3 PMEL'S tsunami group must maintain the 'branding' of its MOST code vs. other less capable codes marketed by newcomers.	3.2.3
40.4 PMEL should be more assertive in debunking invalid claims made for less capable tsunami models.	3.2.3

3. Responses to the Recommendations

3.1 Summary Recommendation (to NOAA Leadership) (Recommendation 8)

- Recommendation 8 (Whatever you do, don't break it!)

Response: Thank you! We'll take that as a compliment!

3.2 Recommendations Actionable by PMEL

3.2.1 Enhancements to observing/monitoring/research (Recommendations 1, 2, 14, 29, 36)

- Recommendation 1 (PMEL should be more aggressive in mounting long-term observation programs of the ocean water column.)
- Recommendation 2 (NOAA should consider a more deliberate effort to measure currents and fluxes in selected areas.)
- Recommendation 14 (PMEL should consider a more aggressive instrumentation activity including a heavier focus in monitoring the water column, for programs such as the Ocean Climate Station program.)
- Recommendation 29 (NOAA should continue to support FOCI long-term time series for assessing changes in ocean climatology and fisheries.)
- Recommendation 36 (PMEL should assure funding for maintenance of the four Bering Sea moorings.)

Response: (UPDATE) PMEL concurs with these recommendations and will continue to pursue funding support through NOAA and other funding agencies, as appropriate. Observation and monitoring of the ocean and atmosphere have been the mainstay of PMEL research since its inception. The oceans, especially, have been historically undersampled, and as the significance of the ocean's role in climate, and, more recently, climate change, is understood, there is an increasing interest in collecting high-quality scientific data over all ocean regions in support of numerous programs to accelerate our understanding of the oceans' roles in sustaining the planet. As the Nation has expanded its thirst for knowledge, NOAA has tasked its ocean scientists to develop innovative methods in addition to conventional means to collect observations in support of research and PMEL has answered the challenge for many years.

PMEL has been successful in establishing support for three research themes since the 2008 Review: 1) Ocean Acidification, which was established and funded as a new NOAA research

program in 2010 with PMEL providing a leadership role; 2) the PMEL Ocean Climate Stations program, which observes ocean-atmosphere flux parameters, has secured NOAA funding for both the “Ocean Station Papa” mooring and for a new flux mooring to be established in the Agulhas Current off the southeast coast of Africa in early 2011, and 3) baseline ecosystem observations in the Alaska Large Marine Ecosystems. PMEL’s biophysical moorings in the Bering Sea, which are considered cornerstone observations for the eventual development of an integrated ecosystem assessment in that basin, are being supported at least through 2011 from a variety of NOAA and non-NOAA funding sources. PMEL continues to seek permanent support for these platforms from NOAA. Other long-term biophysical time series observations are being maintained with a mixture of PMEL base funds and project funds from the North Pacific Research Board. These include the long-term time series observations on “Line 8” and the Late Larval Survey in Shelikof Strait/Gulf of Alaska and a CTD/bongo time series on an established survey grid in the Bering Sea.

PMEL has also successfully advocated for the expansion of Argo float capabilities to sample the upper two kilometers of the water column and continues to participate in the long-term CLIVAR repeat hydrography program, leading NOAA-sponsored cruises every 1 to 2 years. A highly successful PMEL-led cruise was completed in Spring, 2010 aboard the NOAA Ship *Ronald H. Brown* along Line A13.5 in the Southeast Atlantic Ocean. Finally, PMEL continues to collect valuable observations from the TAO-TRITON, PIRATA, and RAMA tropical moored arrays. PMEL supports NWS/National Data Buoy Center by providing sensors and electronic instrumentation for the TAO Array until NDBC fields its refreshed replacement sensor suite and the RAMA Array continues to expand, with moorings now established at 26 sites in the Indian Ocean.

3.2.2 Modeling (Recommendations 3, 32, 33)

- Recommendation 3 (PMEL climate and carbon cycle groups should have systematic ties to external (modeling) groups and some internal hires with modeling experience.)
- Recommendation 33 (EcoFOCI would benefit from greater contact with regional climate modeling groups for projections of future climate change, climate downscaling products, and boundary conditions (atmospheric and lateral) for local numerical models.)

Response: (UPDATE) PMEL will be bringing an NRC post-doctoral fellow on board in Fall, 2010 to develop a coastal ocean acidification model for the western North America continental shelf region. She will be utilizing the NCAR Community Climate System model v.3.1, in association with Dr. Scott Doney at Woods Hole.

EcoFOCI has been awarded funding through FY13 to utilize ESRL, GFDL, and ROMS ocean models to develop regional ocean models that will drive ecosystem models maintained by NMFS. Drs. James Overland and Muyin Wang are working with climate models and Dr. Al Hermann is leading the EcoFOCI ocean model effort.

- Recommendation 32 (FOCI should determine if the current mooring network is adequate through a more thorough observational network design study.)

Response: (UPDATE) The existing Bering Sea mooring array design is not optimum; EcoFOCI plans to conduct a thorough array design study using the ROMS model to identify “pulse points” in the Bering Sea and Gulf of Alaska where observations are critical to model performance. PMEL will utilize the outcome of the Buoy Recap Plan to request funding for a mooring design study of the Bering Sea array; it is estimated that \$40K would be needed to fund this study.

3.2.3 Tsunami Research (Recommendations 12.2, 12.5, 40.1, 40.2, 40.3, 40.4)

- Recommendation 12.2 (PMEL’s tsunami program needs to dedicate effort to publishing its research in the scientific literature as well as developing operational products to improve the Tsunami Warning Program within NOAA.)

Response: (UPDATE) PMEL's primary mission is to serve NOAA and the nation. Recent advances made by the PMEL tsunami research team have resulted in eagerness to upgrade NOAA’s tsunami warning capabilities in the shortest amount of time possible. PMEL has responded to this need by focusing its tsunami resources on developing the models and delivery system. With funding support to the NOAA Tsunami Program provided through the Warren Act from 2009 through 2012, PMEL will enhance its research capability, which will lead to an increase in publications. Looking beyond 2012 and the expiration of funds made available through the Warren Act, PMEL submitted an alternative through the Tsunami Program to continue the research program initiated in 2009. The FY12 Program Decision Memorandum targets the Tsunami Warning Program for an increase to maintain the momentum provided by the Warren Act in FY 13. This increase would include new funding for PMEL research, since research is viewed by NWS as critical to the improvements being made to the warning system.

- Recommendation 12.5 (PMEL’s tsunami program needs at least one or two additional Ph.D. level scientists.)

Response: The PMEL Tsunami Program currently has 12 Ph.D. scientists on board, approximately half of the program total staff. The funding of a Tsunami Research Program by NOAA will allow PMEL to reapportion its scientific talent so that NOAA's operational needs and the publication of research results will benefit the broader tsunami community.

- Recommendation 40.1 (PMEL should consider expanding server capability to provide access to tsunami buoy data and forecasts during large earthquake events.)

Response: (UPDATE) As a result of the February 2010 Chilean tsunami, the NOAA Tsunami Program is undertaking several changes to centralize operational processing of tsunami events and for research purposes. 2011 funding is provided to establish separate operational and research nodes at the National Center for Environmental Prediction (NCEP) computing facility to support the tsunami forecast program. Tsunami data and model outputs will be provided to the Tsunami Warning Centers while, in parallel, the research node will

receive the same data for use by PMEL/National Center for Tsunami Research and its academic, state, and international partners. The establishment of the NCEP nodes is expected to be completed by the end of FY 11. These changes are foreseen as benefitting both the operational requirements and the research aspects of the tsunami program.

- Recommendation 40.2 (PMEL tsunami group should publish a paper with the details about FACTS and maintain both FACTS and ComMIT servers.)

Response: (UPDATE) The functionality of FACTS, run under PMEL's Live Access Server, has been replaced by a new application called WebSIFT. WebSIFT is in development and will support the needs of the tsunami modeling research community. ComMIT will continue to be maintained as before to access the pre-computed propagation model database. Model output is also available directly through OpenDAP. User manuals are available for the MOST model and ComMIT software. FACTS has a user manual and a similar support documentation is envisioned for WebSIFT.

- Recommendation 40.3 (PMEL'S tsunami group must maintain the “branding” of its MOST code vs. other less capable codes marketed by newcomers.)
- Recommendation 40.4 (PMEL should be more assertive in debunking invalid claims made for less capable tsunami models.)

Response: Publications using the NOAA tsunami forecasting models will continue to establish the accuracy and performance of the models. We cannot control other publications, but we hope the peer review process will filter out unfounded claims.

3.2.4 Resources (i.e., Laboratory funding, Shiptime funding) (Recommendations 4, 5, 22, 26, 35)

- Recommendation 4 (NOAA/PMEL needs to continue communicating with NOAA headquarters on ship time.)

Response: The NOAA fleet's support for ocean and climate research (principal OAR activities) has decreased dramatically in the past 15 years. Three Class I vessels which were dedicated to OAR activities were retired in the 1990s and were replaced by the *Ronald H. Brown* and the *Ka'imimoana*; the latter is now supporting National Weather Service (NWS) requirements. A charter fund was intended to replace the loss of Class I time with UNOLS charters; however, this fund has become inadequate as the size of the charter fund in real dollars has decreased; it has now been made available to address non blue-water research carried out by Sea Grant, NURP, and GLERL; and the cost of shiptime has risen dramatically. PMEL management and researchers continue to work within NOAA to voice concern about our deteriorating ability to conduct at sea operations and, at the same time, we have heavily leveraged our associations with foreign nations and other partners to make up for NOAA's lack of support for shiptime. Although we will continue to pursue shiptime through the traditional NOAA ship request process, and use the NOAA budget planning process to push for additional fleet funding, we will also develop technology to reduce PMEL's dependency on large, expensive ship time. Current and projected research

requirements for ship time, including those of PMEL, will be considered in the next phase of the NOAA Ship Recapitalization Plan. PMEL is actively participating in the NOAA Buoy Recapitalization Plan and is investing in the development of advanced mooring technologies that hold promise for reducing the need for shiptime in the future.

- Recommendation 5 (PMEL would greatly benefit from a formal seed fund to support pilot studies for technology development and higher-risk concepts.)

Response: In the past, such seed funding was provided by various sources: PMEL itself, AA discretionary funds, NOAA Ecosystem Goal Team, and Ocean Exploration, to name a few. There is currently no regular NOAA funding source available for such high-risk, high reward projects, particularly for longer than one-year terms, although the OAR AA and DAA/LCI considers the availability of such funding a high priority. PMEL will continue to pursue opportunities as the funding climate allows.

- Recommendation 22 (The PMEL CLIVAR and carbon programs should be given high priority for NOAA ship time on the *Ron Brown* or for NOAA funds to charter an equivalent Class I research vessel.)

Response: (UPDATE) The inadequacy of funding for vessel operation (NOAA fleet or charter) is apparent across all NOAA programs, but perhaps most acutely seen in the ocean research community. There is currently only one NOAA vessel to support a large and growing research demand, and as charter funds for replacement vessels shrink, shiptime costs increase dramatically. PMEL is participating in the NOAA Fleet Recapitalization Study, now underway. Additionally, PMEL makes its needs known and is supported to the extent possible by the Climate Program Office in fleet and charter fund allocation discussions. PMEL has requested charter fund support in FY2011 to support the West Coast coastal Ocean Acidification cruise, which is tentatively scheduled on the UNOLS R/V *Wecoma*.

- Recommendation 26 (PMEL's engineering innovation and the science-engineering partnership should continue to be strongly supported.)

Response: PMEL will continue to challenge the Engineering Development Division to develop new and innovative methods for measuring ocean parameters. Furthermore, PMEL will leverage project funds with possible other funding sources, such as those addressed in Recommendation 5 above.

- Recommendation 35 (Base funding should support a higher fraction of FOCI activities. One possible avenue to enhanced base funding is a commitment to shaping IEAs (Integrated Ecosystem Assessments) in the Gulf of Alaska and the Bering Sea.)

Response: (UPDATE) While not base funding, PMEL has been successful in securing multi-year research funds for both the Gulf of Alaska Integrated Ecosystem Research Program through the North Pacific Research Board and for the Chukchi Sea from the Department of Interior's Minerals Management Service. Both grants will support NOAA Ecosystem objectives in Alaska's Large Marine Ecosystems through 2012. NOAA's limited funding for

IEA's is earmarked for the California Current IEA for the coming years. Any significant funding for an Alaskan IEA is likely not available until 2013-14 at the earliest.

3.2.5 Performance Management (Recommendations 25, 40)

- Recommendation 25: (PMEL should have a performance metric to track obtaining and providing ocean observations data to the larger external community (in addition to publications).)

Response: (UPDATE) PMEL does report to NOAA and the Department of Commerce on metrics related to the number of platforms deployed and/or maintained. NOAA and DoC have several corporate performance measures and Government Performance Management Act (GPRA) measures on which PMEL routinely reports its accomplishments. We have not, however, routinely reported on the quantity of data made available to others, as NOAA has not expressed an interest in metrics of this type. Within PMEL, the most significant and most often used performance metric for all scientists is their publication record. Publications have been a long-standing metric within OAR for many years and are directly applicable across observationalists and modelers in all disciplines.

- Recommendation 40: (In the case of tsunamis, a performance measure other than publications should be used to measure the success of the program.)

Response: This recommendation complements Recommendation 12.2 (see section 3.2.3, above). In the case of the Tsunami Program, performance measures at the program level focus on the completion of forecast models and the implementation of the operating system, which supports the model forecasts. Publication totals are important measures for the lab as a whole, but variances between programs within the lab affect publication totals. PMEL does not use publications alone to judge how individual programs are performing.

3.3 Recommendations Already Implemented (in various stages of completion) (Recommendations 7, 16, 19, 24, 27, 28, 31, 34, 38, 39)

- Recommendation 7 (A strong, explicit mentoring program and base of upcoming mid-career leaders needs to be in place within the laboratory for a successful transition plan (succession plan) when the current crop of senior people retire or move.)

Response: There are a number of junior level scientists within the lab who are being mentored by senior staff. PMEL views the scientific staff like a pyramid: a small number of senior scientists, with a larger number of junior scientists (some federal, but more from the Cooperative Institutes), and a still larger number of technicians. PMEL has produced two PECASE (Presidential Early Career Awards for Scientists and Engineers) junior scientists in the past 10 years, and has had several junior scientists depart for opportunities at other institutions and universities.

- Recommendation 16 (Bridge across PMEL research groups by connecting the water chemistry studies to ecosystem impacts and the discovery-exploration of CO₂ release by underwater volcanic systems.)

Response: (UPDATE) PMEL's CO₂ scientists are actively engaged with both the PMEL Vents program and the EcoFOCI programs: a research proposal has been accepted to conduct CO₂ monitoring studies in the Bering Sea in the summer of 2011 and funding for CO₂ research in the Vents Marianas Arc study region has been proposed to the Office of Ocean Exploration and Research beginning in 2011.

- Recommendation 19 (PMEL should better demonstrate the importance and utility of the tropical oceanographic data products.)

Response: PMEL believes that the utility of the tropical oceanographic data products has been demonstrated adequately. As an illustration of this point, through 2008, 676 peer-reviewed publications have appeared in the scientific literature utilizing tropical oceanographic data from the TAO-TRITON, PIRATA, and RAMA Arrays. In 2008 alone, 28.8 million web hits were registered on PMEL's and NDBC's tropical moored buoys web sites, indicating that these datasets are being heavily used by the research and operational communities.

- Recommendation 24 (PMEL instrumentation to autonomously measure two components of the ocean carbonate system should be incorporated into a wider network of moorings.)

Response: (UPDATE) The PMEL Ocean Climate Station mooring established at Ocean Station Papa (50°N, 145°W), originally supported by the National Science Foundation, the Canada Department of Fisheries and Oceans, and NOAA, is the first (and only) "ocean acidification" mooring deployed where two components of the ocean carbonate system are being measured: pCO₂ and pH. Beginning in FY 2010, this site is supported financially by the Climate Program Office. FY10 Ocean Acidification funding includes a monitoring component that will provide funds to outfit from five to seven existing pCO₂ monitoring buoys with both pCO₂ and pH sensors to monitor ocean acidification. Funding in FY11 and beyond will permit the deployment of similar numbers of ocean acidification moorings into the monitoring network.

- Recommendation 27 (FOCI should consider a more proactive use of Lagrangian techniques to explore, chart, and understand the mesoscale dynamics of the Bering Sea/Gulf of Alaska region.)

Response: Surface drifters and ARGO floats have been used in the Gulf of Alaska and Bering Sea regions in the past (focused studies were supported by NOS/GLOBEC, the Steller Sea Lion research effort, and other programs in the early 2000's), and they have been very useful in describing transport, especially in the vicinity of the Aleutian passes. Lagrangian methods are a valuable tool in the EcoFOCI toolbox and will continue to be utilized as observing requirements demand.

- Recommendation 28 (FOCI should consider gliders and/or AUVs for insight into the structure of the circulation, the eddy field, mixing processes, and the role of topography to define advective and dispersive processes which play a major role in fixing the water properties.)

Response: (UPDATE) Gliders have been employed successfully in the Gulf of Alaska basin, in partnership with Dr. Charles Eriksen of the University of Washington. Funding is currently not available to continue this effort. Geographical focus for EcoFOCI has shifted to the Eastern Bering Sea, where the shallow depth (approximately 70 meters) and a very active fishing fleet most of the year in this region make glider operations problematic. With EcoFOCI's move into the Chukchi Sea to support the DoI/Minerals Management Service, EcoFOCI has initiated a collaborative effort with Dr. Tom Weingartner of the University of Alaska-Fairbanks, who is employing gliders in the Chukchi Sea.

- Recommendation 31 (Research efforts, such as EcoFOCI, need to build on the approaches developed by the program with a single species focus to a broader ecosystem-wide orientation.)

Response: EcoFOCI began the shift from a single-species research effort based on Pollock to a multi-species ecosystem focus in 1999-2000, when NOAA was directed to address the Steller Sea Lion population declines in the Aleutian Islands. Since that time, PMEL and the Alaska Fisheries Science Center (AFSC) of NOAA's National Marine Fisheries Service have become increasingly focused on ecosystem approaches to management of the Alaska fisheries issues.

- Recommendation 34 (EcoFOCI should set priorities and research directions to meet the emerging focus on IEAs in support of ecosystem approaches to management.)

Response: (UPDATE) As indicated above, EcoFOCI research migrated towards an ecosystem-based approach before this became a popular concept in NOAA. EcoFOCI has been participating in the NSF/North Pacific Research Board's BEST/BSIERP study since 2008. BEST/BSIERP is an integrated ecosystem approach that will form the basis of an IEA in the Bering Sea. Similarly, EcoFOCI has been funded by the North Pacific Research Board to participate in a Gulf of Alaska Integrated Ecosystem Research Program, which will begin field studies in 2011, supporting IEA development in that basin.

- Recommendation 38 (Why not put the output of an ocean hydrophone on the net?)
- Recommendation 39 (Consider a hydrophone offshore of a harbor.)

Response: Data from a cabled hydrophone established on the Pioneer Seamount in 2001 was made available on the web in real time until its failure in September, 2002. PMEL also established a hydrophone in Yaquina Bay, Oregon (Newport) as part of an exhibit on underwater sound at the Hatfield Marine Science Center in Newport in 2008.

While there are obvious outreach and education benefits from making these sounds available, PMEL does not have a requirement to provide these data on line in real time. Rather, PMEL's

approach is to include samples of sounds in the sea from geophysical events, marine mammals, and ambient ocean noise which have been extracted from recovered moored hydrophones on our acoustics web site (<http://www.pmel.noaa.gov/vents/acoustics.html>).

3.4 Recommendations Outside PMEL's Sphere of Influence

3.4.1 *Climate Services (Recommendations 18, 21, 23)*

- Recommendation 18 (PMEL should play a lead role in an OAR determination of how to scale up efforts to operationalize NOAA Climate program activities.)
- Recommendation 21 (PMEL needs an appropriate role in any NOAA Climate Services organization, with clear boundaries between research and operations, prioritization of field efforts, and two-way information exchange to translate field observations into decision support tools.)

Response: This is a part of the discussion surrounding the evolution of the present day Climate Program within NOAA to a NOAA Climate Services organization. A great deal of discussion has occurred over the past year or so at several levels inside and outside of NOAA as to how to make Climate Services more relevant to the American people. Selected PMEL scientists and leaders have and will continue to be involved in this discussion.

- Recommendation 23 (The recent ocean carbon survey along the U.S. West Coast should be integrated into the NOAA observational network, with observational rather than research funding, and be repeated on a regular basis.)

Response: (UPDATE) PMEL relies on non-base funds from the Climate Program Office (CPO) (eventually, the NOAA Climate Service or, possibly, the Ocean Acidification Program Office) to fund the West Coast ocean carbon survey cruises. The planned 2011 West Coast cruise has been approved for funding by CPO. Shiptime funds to support this cruise are currently being negotiated through the 2011 OAR charter fund process. As the development of a NOAA Climate Services capability evolves, the distinction between climate research and climate operations may become more distinct and this issue can be resolved at that time. Alternately, other technology, such as gliders, may prove to be suitable alternatives or enhancements to an extended cruise in this region. PMEL has recently acquired two gliders for test and evaluation purposes related to this and other PMEL research efforts.

3.4.2 *Transition from Research to Operations (Recommendations 13, 20, 37)*

- Recommendation 13 (Transfers of climate observation technologies should be followed by institutional, cultural, and scientific adjustments enabling new technology initiatives (e.g., glider program).)

Response: PMEL has “let go” of transitioned projects and is focused on other research goals. The TAO Array, for instance, was transferred to the National Data Buoy Center (NDBC), operated by the NWS. PMEL continues to provide the sensors for the array while NDBC procures and integrates new sensors into a replacement buoy system. PMEL has moved forward to addressing scientific issues in the Indian Ocean. NOAA Management determines the process and schedule of transition activities.

- Recommendation 20 (The TAO transition should have involved PMEL in developing a strategy for maintaining climate quality data.)

Response: PMEL was involved with the development and implementation of the TAO Transition Plan following NOAA’s decision to transfer the TAO Array from PMEL to NDBC. As part of the transition, PMEL transferred its entire software suite used to quality control and manage the data stream. PMEL remains closely involved with TAO today, providing all the sensors for the Array until such time as NDBC is able to provide a “refreshed” sensor suite. As users of the data, PMEL remains highly attentive to data quality issues and shares any concerns with NDBC personnel.

- Recommendation 37 (FOCI must decide what is planned for transition and what will be supported in the long term, specifically with regard to the four Bering Sea Moorings, which probably should not be transitioned.)

Response: We agree. Within NOAA, decisions on whether or when to transition research projects to operational status are made by the relevant Line Office Transition Managers. PMEL would not be supportive of transitioning the Bering Sea moorings or the EcoFOCI program to another organization at this time. We believe that EcoFOCI is a research effort and the Bering Sea moorings are research moorings. The parameters measured continue to evolve as knowledge is gained on the indicators of ecosystem health in the region. If and when NOAA considers transitioning these moorings to an operational status, PMEL will be involved in the development of a transition plan to ensure that the transition is successful.

3.4.3 Data Management (Recommendations 6 & 15)

- Recommendation 6 (PMEL should invest in data management to keep up with existing and anticipated increasing demands for data and for stakeholders.)
- Recommendation 15 (The Live Access Server should have greater visibility and attention.)

Response: Data management activities are supportive of the research environment of PMEL. Activities such as LAS that have been developed here are the result of specific projects that are the outgrowth of research activities. Because of PMEL's obvious interest in maintaining access to high quality oceanographic datasets, PMEL will continue to provide data management and visualization support for NOAA's data managers.

3.5 Recommendations Not Part of the Scientific Program

3.5.1 Recommendations related to the Conduct of the Review (Recommendations 9, 10, 11, 12, and 17)

- Recommendation 9 (It would be useful to present PMEL's roles and responsibilities within NOAA/OAR for purposes of evaluating the Lab's effectiveness.)

Response: A description of the OAR Laboratories' planning and priority setting activities will be included in future lab reviews.

- Recommendation 10 (Provide statistics and budgets by research area rather than for the lab at large.)

Response: This could be attempted for future reviews; however, a significant portion of staff and resources support all the Lab's programs generally and as such, it would be arbitrary to define the level of support to any particular research area. This is particularly true with respect to the lab's base funding. Attribution of publications by program area is much more clear-cut and could be easily accomplished.

- Recommendation 11 (PMEL management should reinforce with scientists and technical editors that salinities should not be published in units of PSU.)

Response: Agreed.

- Recommendation 12 (Provide time for writing by the review team and establish an expectation that draft comments be provided before the review team departs.)

Response: We will pass this recommendation on to OAR Headquarters for future reviews.

- Recommendation 17 (The PMEL review team should have met with Mike Johnson.)

Response: We will pass this suggestion on to OAR Headquarters. Other laboratories might benefit from similar arrangements in forthcoming reviews.

3.5.2 "Recommendations" that are not Recommendations (Recommendation 30)

- Recommendation 30 (The successful FOCI partnership between PMEL and the National Marine Fisheries Service should be highly commended as an example of strong within-agency cooperation and coordination to address societally-relevant goals.)

Response: We agree. Thank you.

Appendix. Acronyms Used in this Implementation Plan

AA	Assistant Administrator (of OAR)
AFSC	NMFS Alaska Fisheries Science Center
AUV	Autonomous Underwater Vehicle
CLIVAR	Climate Variability Program
ComMIT	Community Model Interface for Tsunami
EcoFOCI	Ecosystem-Fisheries Oceanography Coordinated Investigations
FACTS	Facility for the Analysis and Comparison of Tsunami Simulations
FOCI	Fisheries Oceanography Coordinated Investigations
GLERL	OAR's Great Lakes Environmental Research Laboratory
HYCOM	Hybrid Coordinate Ocean Model
IEA	Integrated Ecosystem Assessments
LAS	Live Access Server
MOM	Modular Ocean Model
MOST	Method of Splitting Tsunami
NDBC	National Data Buoy Center
NMFS	NOAA's National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	NOAA's National Ocean Service
NURP	OAR's National Undersea Research Program
NWS	NOAA's National Weather Service
OAR	NOAA's Office of Oceanic and Atmospheric Research
OER	OAR's Office of Ocean Exploration and Research
PECASE	Presidential Early Career Award for Scientists and Engineers
PMEL	OAR's Pacific Marine Environmental Laboratory
PPBES	NOAA's Planning, Programming, Budgeting & Execution System
PUMP	Pacific Upwelling and Mixing Physics Program
TAO	Tropical Atmosphere Ocean Array
WebSIFT	Web-based Short-term Inundation Forecasting (System) for Tsunamis