

# **NOAA Research Review Team Data Request**

## **Pacific Marine Environmental Laboratory**

- 1. Please provide a copy of the most recent evaluation of the lab or center in pdf format.**

The most recent review of the Pacific Marine Environmental Laboratory was held on June 23 and 24, 1998 in Seattle, Washington. The Review Team was headed by Dr. James L. Rasmussen, Director, Environmental Research Laboratories . Other members of the Review team were as follows:

Dr. Ronald C. Baird, Director, National Sea Grant College Program  
Dr. David Epp, Program Director, Marine Geology and Geophysics Program,  
National Science Foundation  
Dr. Pearn P. Niiler, Professor of Oceanography, Scripps Institute of  
Oceanography  
Dr. Thomas C. Royer, Professor of Oceanography, Center for Coastal Physical  
Oceanography, Old Dominion University  
Dr. Costas Synolakis, Professor of Civil and Environmental Engineering,  
University of Southern California

Reviewers' comments are provided on the following pages.



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH  
Environmental Research Laboratories  
1315 East West Highway  
Silver Spring, Maryland 20910

December 18, 1998

MEMORANDUM FOR: Eddie N. Bernard  
Director, PMEL

FROM: James L. Rasmussen  
Director

SUBJECT: Pacific Marine Environmental Laboratory Review

I want to commend you and your staff for organizing and conducting a very effective review of Pacific Marine Environmental Laboratory on June 23-24, 1998. The expert reviewers were well qualified to review the Laboratory and the presentation, posters and background materials were well done and thoroughly informative. All reviewers commented on the PMEL use of the internet as the key infrastructure medium for the review especially the availability of the review material before and after the actual review. Using the web capability as the mechanisms for video displays during the review was innovative and allowed for a smooth flow of information. Such presentations will improve as everyone gets used to the system - PMEL's efforts in this regard are truly cutting edge and will be emulated.

By now you have received the written comments from the reviewers and perhaps have begun to act on their advice. In this letter I would like to provide an emphasis on these comments that seem particularly important to me and offer my own comments based not only on the review, but also on my general awareness of PMEL.

First, I want to concur with the unanimous statements of the Reviewers that PMEL is conducting important programs with a high degree of scientific quality. The over-all publication record and international reputation; the strength of the engineering and technician infrastructure; the excellent facilities (with some concern for a growing requirement for office space for scientists); the clear signal that PMEL is truly focusing on carrying out excellent research on a limited set of scientific programs - rather than spreading the effort over a wider spectrum



of possible research themes; the contribution to NOAA's mission and to ocean science and services in general and the quality of your laboratory management were all cited by the reviewers as evidence that PMEL is truly a vital component of ERL, NOAA and the overall ocean/atmosphere science community.

The ocean observations activities of PMEL were highlighted by all of the reviews as a core function of PMEL. The role of the PMEL engineers and technicians in this success was clearly acknowledged. The importance of having the science programs (analysis and modeling) tied closely with the more engineering and operational activities was underscored. The tie here with the University of Washington (JISAO and Hayes Center) seemed to be unclear and bothersome to at least one reviewer. Another felt that joint work sessions or planning workshops of these entities and PMEL would help clarify the situation and develop working relationships that the outside world (and ERL Headquarters) would understand and support. The emergence of Scripps as a player in the NOAA/ERL program should be entrained in the growing ocean observations program and including them in the dialog at some shape would also be useful and constructive.

The importance of PMEL's emergence as a source of real-time ocean data for services and research was also highlighted by reviewers. We need to work to ensure that this highly visible role is fostered and improved. Working in the context of a distributed data quality control and dissemination and archival system and in cooperation with the emerging activities at AOML and with the Joint/Cooperative Institutes should prove to be an exceedingly cost effective way to deliver the data to the broad user community to NOAA's credit and visibility. Extending this effort to the hydrographic, chemical, and marine aerosol data sets was seen as important potential additions to this data distribution function.

Finally the reviews noted the contributions that PMEL scientists are making to national and international science program planning and implementation. In this regard PMEL management is encouraged to get its top-notch scientific staff involved in global science issues - at least as far as the scientific input and planning goes - and not limit itself to Pacific issues alone.

Without exception the external reviewers were pleased and supportive of PMEL - its scientific programs and management. It is gratifying to read the letter reports and to be reminded of the central role PMEL plays in ERL, NOAA and in ocean science on both the national and international levels. I congratulate you and the PMEL staff conducting such a comprehensive, thorough and enjoyable reviews.

Attachments



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
National Sea Grant College Program  
1315 East West Highway  
Silver Spring, Maryland 20910

June 30, 1998

MEMORANDUM FOR: James L. Rasmussen  
Director, Environmental Research Laboratories

FROM: Ronald C. Baird  
Director

SUBJECT: Pacific Marine Environmental Laboratory (PMEL)

My thanks and appreciation for including me on the PMEL science review. My time was well spent, the trip both enjoyable and informative. There are also several promising areas for Sea Grant collaboration that I will enumerate below.

My comments and observations on the PMEL Program follow:

- a. The review format was excellent. The combination of historical overview with significant time devoted to poster sessions gave reviewers considerable depth of perspective and appreciation of both quality and relevance of the R&D portfolio.
- b. The use of Internet technology in both the presentations and for "on line" access to data is innovative, informative and state of the art.
- c. The R&D portfolio is clearly relevant to NOAA's mission and includes some of the best oceanographic science being done in the world today. d. The investment leverage provided by strategic partnership with other NOAA entities (NMFS, Sea Grant, NURP) and federal agencies (e.g. NSF) has greatly enriched the return on investment in the R&D portfolio in terms of new technology and increased knowledge.
- e. Because of the long range commitment to programs of benefit to NOAA customers, PMEL has established a world



leadership role in ocean instrumentation, and the technology to conduct state of the art monitoring and research on ENSO, deep sea vents and fisheries oceanography, all generating information on issues of high priority to NOAA and the Administration. In fact, I think the most cogent results from these programs are yet to come because of the knowledge and technology momentum these initiatives now have.

f. My only caveat is that there is the potential to diffuse effort as these programs expand in scope. The focus needs to be on the core mission and technology. Indeed, one of PMEL's great strengths in my mind has been its focus on a few high profile areas where it has been able to develop world class "core" technologies that enable the program to produce significant results. That concept of the application of "core" technologies is essential to success.

g. The presentation emphasis on both past and future gave reviewers an excellent perspective on both PMEL's capability and the appropriateness of the future vision and direction.

Finally, there are a number of areas for future collaboration with Sea Grant, primarily in essential fish habitat and in bio-product development from deep-sea vent organisms.

Again, my thanks. PMEL is a national resource, well managed, highly productive and peopled with bright, dedicated individuals. The excitement shows.

cc: E. Bernard  
L. Echols  
A. Thomas

July 21, 1998

Dr. James Rasmussen, Director  
Office of Oceanic and Atmospheric Research  
ERL/NOAA  
1315 East West Highway  
Silver Spring, MD 20910

Dear Jim,

It was a pleasure to participate in the review of PMEL that occurred on June 23 and 24, 1998 in Seattle. This is a written report of my observations, most specifically about the assigned task of reviewing the "Ocean Climate Research Division", headed by Dr. Dennis Moore. First, I will cover the general topics about which you requested opinions in your directive of June 23 rd and then I will add the more specific observations.

PMEL Research Program Review  
by Peter Niiler, Professor of Oceanography  
Scripps Institution of Oceanography  
July 21, 1998

1. General Issues:

a) Relevance, uniqueness and feasibility to NOAA Strategic Plan

PMEL views itself as the principal, ocean-going NOAA research laboratory, with sole interest in the Pacific Ocean. This view can be advantageous when defending turf, but it can be limiting. PMEL's projects are principally in the Pacific, perhaps due to historical accidents and by division of sphere of influence at some higher level of NOAA management. Recently, the TAO project chose to expand its activities to the Atlantic with the deployment of PIRATA. PMEL should now change its mission to the global ocean, just as the ocean climate change is global. PMEL technology is applicable globally.

PMEL's research programs are relevant to the NOAA mission. This is carefully monitored by the mechanism of NOAA instituted peer review and the granting of project funds to scientists who can compete successfully on the national level. It is my contention that relevance is much more difficult to maintain when a program that is directed by a small number of Directors from the top than motivated from the grassroots. A small group has limited experience and tends to end up with a parochial view of what is important in science. Most individual research scientists tend to

be interested most in their Ph.D. thesis topic, revisiting it perhaps too often. The peer reviewed science is a "good thing" for PMEL and it should be fostered by the hiring of scientists who can compete on that open market.

PMEL[']s] mission is feasible because PMEL has great engineers and technicians.

b) Accomplishments, recognition and quality in community.

PMEL's reputation in physical oceanography and climate studies today relies heavily on the seagoing operations in the Pacific (and more recently in the Atlantic). These sea-going operations should be carefully fostered and supported, especially at a time when program managers in Washington find it easier to fund analysis of community data. But someone has to gather this community data, and PMEL is the leader here. In the community, PMEL's instrumental measurements have the highest reputation for quality, and the analysis is not far behind. An effective modeling component in relation to this data is not as evident. Modeling is just as difficult as observations and it requires just as much commitment and personnel. PMEL has decided that it will concentrate on the observations, which is wise for the moment.

A significant modeling program could be accomplished at PMEL, is always an opportunity and it would make eminent sense. But that would require a significant change of priorities at the top NOAA management's level. At the moment, NOAA's modeling of annual to interannual climate change is distributed in eight or nine national centers, all of which operate on a sub-critical level, working on identical problems. This sad state of affairs appears is further complicated by heavy congressional meddling, instigated by the scientists who wish to maintain their separate empires. I believe that the best mode of scientific interactions is where modelers and observers are concentrated in the same physical location. That scenario could well occur during the next millennium at PMEL. Since it is easier to install a roomful of workstations than to build a new harbor, PMEL should keep a pulse on the funding directions of modeling which are the most relevant to its observational programs.

It is the perception of the academic community that NOAA research laboratories have a specific responsibility to provide innovative technologies and methodologies to the operational arms of NOAA. At PMEL there is a much closer connection to the university laboratories than to the more operational side of NOAA. This is a NOAA wide phenomenon. Dr. Ants Leetmaa has explained to me several times that, for example, GFDL, busy in their academic research, does not support the model development that he needs for modernizing the ENSO prediction model. This course of action leaves NDBC and perhaps also the Fisheries (and NOS and etc.) floundering in age-old technologies, serviced largely by relatively inefficient and very greedy industrial firms. It was very clearly explained to me at PMEL that there are great chasms between various NOAA line organizations, which appear have nearly identical objectives at sea as, for example, long-term deployment of marine data buoys in the Pacific Ocean. NDBC has not benefited, or has perhaps rejected, the low-cost and innovative TAO approach, which I estimate to be at least six times more efficient. The solutions to this perceived problem rests perhaps at higher levels than ERL: It may be as simple as more clearly delineating the role of ERL in these matters or as difficult as actually working with NDBC.

### c) Resource distribution.

The several year average distribution of the resources was presented at the review clearly and concisely. But the mechanisms and rationale of the distribution of core research funds and the permanent government scientific FTEs was not discussed in an open forum. Distribution of competitive grant funds requires no explanation. Privately, Dr. Bernard was very forthcoming about limitations and opportunities of resource allocations and was appreciative of my advice to support permanent science positions associated with the TAO and North Pacific climate change (see the discussion below).

### d) Infrastructure

The infrastructure of PMEL is excellent in its library, computing, general grounds, etc. No scientist complained about administrative support. Several scientists wondered why the director's office takes such personal interest in the travel plans of the senior scientific staff, but that is obviously related to government strictures which they perhaps do not understand. The principal facilities need is to expand PMEL office space within Building 3. Some wonder why routine drawing of maps by NOS has to occupy precious research space. Most JISAO employees assigned to PMEL have to share offices, two to three together. It is not clear what the rationale which governs the allotment of space is. Perhaps that is too difficult to explain, as it certainly is at the universities.

### e) Minimum mission

PMEL existence depends on more than a half dozen missions, each of which are larger than would be required for the continuance of a NOAA Laboratory (or any excellent oceanographic laboratory for that matter). PMEL remains flexible, molds itself to the funding opportunities and carries the torch for significant ocean research with a global reputation (see the physical oceanographic review below). Within NOAA (and US) ocean science planning framework, PMEL scientists sit on a number of important panels that define the future and goals of ocean science. While it might appear that PMEL is opportunistic by following the money, a more careful assessment of the dynamics of science planning comes up with a somewhat different interpretation. Through national and international science planning committees, PMEL scientists actually steer the funding of future programs into directions which are viable and which they perceive results in the best science of the future for them at PMEL and for US in general. Here again, the importance of grassroots science participation in this process comes into play. I tend to trust this proletariat method, as that is how great leaps forward were made in the past fifteen years in, for example, annual to interannual climate prediction and observations. The very minimum mission for PMEL is to maintain a first class group of scientists, have them to vigorously participate in the science planning process and for the administration to listen to what the scientists perceive to be the best science for NOAA and PMEL to accomplish.

## II. Ocean Climate Research Division

PMEL is one of the most outstanding physical oceanographic research laboratories in the United

States. It has excellent sea-going facilities, outstanding scientists and stable, long-term funding from several NOAA project offices to carry out both fundamental and practical research programs. Physical oceanographers at PMEL are in the possession of the most comprehensive data set of the tropical Pacific climate change ever assembled. This is due to the strong commitment of ERL sending a major research vessel to the equatorial Pacific at least twice a year for the past twenty years. It is in the analysis and wide distribution of this data with which PMEL physical oceanographers have left an indelible mark on our science.

Since 1995, at the end of EPOCS and TOGA, PMEL has become truly the Mecca of tropical oceanography data distribution in the US. My research staff and I access this rich data file by electronic means on a frequent weekly basis. With the continuation of the remarkable TAO array, PMEL has also become the global operational data center for the real-time description of El Nino (the Pacific equatorial ocean phenomena) and for the verification of the prediction of ENSO (the global ocean/atmosphere response). This latter position is quite lofty because of the enormous commercial or financial implications of PMEL's real-time data. It is a credit to the wise management of ERL that the El Nino data is free to the global community, unlike the trend in our sister institutions in Europe. PMEL is the global leader and the stand alone facility in maintaining TAO and the PIRATA array in the Atlantic.

The second area of critical interest to the climate community is the hydrographic and ocean water chemical data sets maintained at PMEL. Here, in contrast to the tropical ocean data sets, the cooperation of the larger ocean community, both academic and government, is most important. In order for this portion of the research group to stay healthy, active and productive, PMEL needs to assure that this cooperation is fostered and that hydrographic, and especially the chemical data (specifically CO<sub>2</sub>, CFCs and nutrients), is continued to be sampled on a Pacific wide basis.

Thirdly, the marine aerosol data gathered at PMEL is of critical importance in the assessment of marine processes in global warming. The satellite remote sensing community is spending considerable resources on this issue and insitu marine data from the Pacific is of very much an integral part of evaluating the satellite data. The marine science community in this area is small and they as a group tend to work in one ocean at a time. It is important that, besides having a head start on the Pacific data, the PMEL group have the opportunity of participating in marine aerosol studies in other oceans as well.

The overall recommendations in the Ocean Climate Research Division area are:

- 1) Careful attention should be paid to the fact that each area of sea-going observations continues to have the physical presence of and core salary support for first rate scientists in each discipline. For example, a program the size and reputation of TAO should have at least 5-6 principal scientists associated with the analysis of the data right at PMEL (there are a very much larger number using this data in other research and operational institutions). Presently, the strength of analysis is in the water column, and the air-sea interaction part could use help. Unless a healthy science program exists within TAO, there is a danger of PMEL/TAO becoming another NDBC.
- 2) Successful implementation of plans for expansion of the instrumental time series into the

North Pacific requires grassroots, principal investigator leadership comparable to that of TAO. Presently there are some ideas on how to proceed, but the leader who needs to be in contact with and enjoy the respect of the North Pacific climate observing community is not yet identified.

3) The remarkable success of the instrumental observations at PMEL depends on the health of the engineering group (who also have a healthy international reputation). These very able technicians and engineers are now severely taxed with ever increasing requests for aid in instrument development, testing and maintenance at sea. The impression among the senior scientists at PMEL is that there is now the danger of loading this group down with too many new projects, course which always results in unfortunate inattention to some of the existing projects. A careful and systematic look at the schedule and plans for the next several years of the engineering group would perhaps be a valuable guide by which to set priorities.

4) The "Hayes Center" has been funded by OGP at the University of Washington with the mission that is perceived at PMEL to be the support the analysis and modeling of TAO and other climate observations at PMEL. There is a significant disconnect between that view and what the University of Washington scientists view as the role of this center. In the atmosphere of, tight and very competitive funding, it is not enough for the University to simply hire the "best persons working on the best science" at this center. A clearly enunciated and understood detente is needed. It was rather surprising at the review not to have a presentation from JISAO, as they employ a very large number of climate technicians and scientists who essentially reside at PMEL. How the U of W relationship is progressing and how to make it better are questions perhaps worth revisiting on a more continual basis than the 5-year cycle.

I would be glad to discuss any or all of these observations verbally in more detail. Thanks for your hospitality.

Sincerely yours,

signed

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# CENTER FOR COASTAL PHYSICAL OCEANOGRAPHY

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July 17, 1998

Dr. Eddie Bernard  
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Dear Eddie,

I thank you and others in NOAA for providing the opportunity to review the program at PMEL. I found the presentations to be informative and interesting. Interactions with the PMEL personnel provided insight into their impressions of the work there and visions for the future. It was especially satisfying for me to be able to see the development of PMEL from my initial work with the organization in the first stages of the Alaska OCS program up through my present work in the Northeast Pacific GLOBEC project. We have all changed over the years and PMEL has developed many worthy programs in the past 25 years.

PMEL's crown jewel is the TAO program, particularly with last year's ENSO event. Many aspects of that program should be repeated in other future programs at PMEL. These include long term ocean measurements, real time data availability and public outreach efforts. PMEL should decide those niches in marine science that it wants to occupy in the future. How does or will PMEL differ from an oceanography department in a major university or an academic research institute? I see an important role for PMEL in long term ocean measurements throughout the North Pacific. PMEL is afforded the opportunity to have a longer vision than an academic department and has the infrastructure to carry out the work. PMEL's ability to deploy surface moorings and current meter arrays is particularly impressive. Such capabilities are becoming rare in the oceanographic community so it is important for them to sustain this capability.

I sense that there is presently a conflict between lab directed research and the PI initiated research that is funded through the proposal process. While I am a strong advocate of peer review, mission oriented research should always be an important component of PMEL's research program. The level of proposal supported research should be carefully considered. Higher levels of such research might be inappropriate or incompatible with the PMEL's science mission.

The presentations during the review program demonstrated PMEL's abilities to use Internet technology and to develop public outreach programs. Such programs can play an important role in the oceanographic community to gain wider acceptance of scientific programs. While the TAO/ENSO work is well known, other PMEL programs can be presented to the public in a similar manner, as these presentations demonstrate. PMEL can play an important role in the K-12 educational process with their WEB work and other interactions with the public.

In the next decade, important oceanographic research issues will include determination of the global freshwater budget and changes in fisheries. The freshwater (and heat) budget work will require long term salinity (and temperature) measurements throughout the ocean. The TAO

work has demonstrated their ability to carry out these measurements in a limited region. While PMEL cannot cover the globe, they should continue to address high latitude fisheries oceanography problems where they have initiated programs over the past decade. This will continue to be tougher than the El Niño problem since the field programs must be conducted in a harsher environment with longer time scales (at least decadal), shorter space scales, and it must deal with biological interactions that are probably nonlinear with anthropogenic influences. The convergence of the ocean climate and high latitude fisheries problems will enable PMEL to provide leadership in both topics.

The ability of PMEL to provide leadership in North Pacific climate and fisheries studies in the future would be greatly enhanced through improved cooperation/coordination with other NOAA divisions, the National Ocean Survey (NOS), the National Data Buoy Center (NDBC), the National Weather Service (NWS) and the National Oceanographic Data Center (NODC). Globally, the resources available to make ocean measurements are very limited and the outlook for expansion is bleak. Therefore, while these divisions have different missions, long term ocean measurements would benefit from joint efforts of these units. PMEL should also continue to work with other national and international science programs such as CoOP, GLOBEC, PICES and CLIVAR. The cooperative institutes are very good mechanisms to have NOAA scientists interact with the academic scientists. There is a sense, however, among many in the academic community that these are unequal partnerships, with most of the funding and intellectual property going to PMEL. The solution to this is unclear, but enhanced communication such as program planning workshops might help. However, the apportionment usually occurs in the proposal, funding and publication aspects of the work.

PMEL is in a unique position to continue to provide leadership in the oceanographic community. They have been working on and have developed the expertise to address many of the significant problems in the next decade. Their personnel and facilities are well prepared to meet these future challenges.

Sincerely,

signed

Thomas C. Royer  
Slover Professor of Oceanography

From: "depp@nsf.gov" 7-JUL-1998..05:36:23.5  
To: James.Rasmussen@noaa.gov", "Bernard@pmel.noaa.gov"

Comments for PMEL review

July 7, 1998

PMEL has a strong group of scientists and a balance of 'scientific expertise that is suitable to NOAA goals. It is clear that the science done at PMEL is of high quality and is a significant contribution to NOAA's mission, and to broader scientific efforts to understand the ocean environment. PMEL programs have achieved an excellent balance of cutting-edge research and applying that research to NOAA goals.

A second strength is PMEL's leadership in the use of technology. Particularly important are PMEL's abilities in instrumentation and observation technologies. The instrumentation and the resultant observational databases are a critical part of PMEL science programs, and are a significant contribution. Leadership in use of information technology was demonstrated in the on-line presentations during the review, and is also apparent in on-line databases and home pages.

A third strength is a management that takes a long-term view. The commitment of PMEL, and NOAA, management to long-term observations and monitoring, combined with excellent scientists and strength in observation and monitoring technology allows PMEL to contribute significantly, and perhaps uniquely, to understanding ocean processes. There is a compelling need for long-term time-series measurements, and PMEL's contribution in this area is a necessary part of the overall science and must be continued.

I am concerned that maintaining PMEL's commitment to long-term observations may be compromised by short-term funding commitments. The centrally-held program money (in OGP, COP, ESDIM and HPCC) has fostered ties between OAR and other line organizations, and the benefits are apparent in, for example, the FOCI program. The centrally-held project funding is, however, very much like academic funding and does not provide the continuity in funding necessary for long-term time-series measurements. There is (apparently) no mechanism for evaluating whether time-series observations begun with project funding need to be continued beyond the life of the project funding, and for continued support of these observations. It is important for NOAA to recognize the importance of their contribution in this area, and that NOAA has perhaps a unique ability to provide the necessary long-term commitments.

There are a couple of personnel issues that are of concern. First is the status of people in the joint and cooperative institutes. The people in different institutes undoubtedly have different career and tenure linkages with NOAA and the associated universities. In some cases, however, the people do not have a firm position in either NOAA or the university. Unless the rewards offered in such positions are commensurate with the risks in job security, it will be difficult to get and keep good people. These institutes provide an important contribution to PMEL's activities, and an important linkage with the academic community, and it is important that they continue to attract quality people.

The second issue that deserves some consideration is how to judge and reward people who contribute significantly to monitoring efforts. The effort required by the monitoring and the time necessary to accumulate sufficient data may not be reflected in the publication rate of the individual. Thus, publications may not be a suitable measure of the individual's contributions.

I have two minor suggestions related to the science programs. Climate-change research has benefited from the linkage between observations (and real-time observations in particular) and modeling. While PMEL should not divert its focus on observations, the strength to be gained from linkages to modeling should be recognized and fostered by other science programs. Finally, NOAA should recognize that some of the most innovative science happens at the boundaries between disciplines and may not always fit nicely into the Strategic Plan. Interdisciplinary research is difficult, both scientifically and programmatically, and it is important to recognize and to foster such research.

David Epp  
National Science Foundation  
Marine Geology & Geophysics

Dr. James Rassmussen  
Office of Oceanic and Atmospheric Research  
ERL/NOAA  
1315 East West Highway,  
Silver Springs, Maryland 20910

September 19, 1998

Dear Dr. Rassmussen,

I am writing to submit the PMEL review proforma, and to apologize for the inordinate delay. Shortly after the review I traveled to Japan for two weeks and immediately upon my return to the US, the Papua New Guinea tsunami hit, and the subsequent filed investigation put me back considerably, in terms of my earlier commitments. I do hope however, that this review arrives in sufficient time to be considered by the NOAA administration.

The PMEL program review was conducted on June 23 and 24. The objective was to assess how well is primary mission of conducting interdisciplinary investigations supporting NOAA's overall strategic plan. The review was structured around the internet technology allowing participants and reviewers access to information about PMEL scientific programs before, during, and after the review. The review consisted of a few selected oral presentations followed by a poster session for each of PMEL's three major science divisions: Ocean Climate, Fisheries Oceanography, and Seafloor Spreading Research.

Overall, I was very impressed with the scope of PMEL's work, with how well it meets NOAA's goals and national scientific and economic priorities, and with the morale of the scientists and staff of the lab. PMEL runs efficiently and, without any exception, the budgets for most programs are a fraction of what the same program would cost if run by an institution of higher education. NOAA-PMEL is one of the crown jewels of NOAA and it should be nurtured and supported to continue its mission. NOAA-PMEL brings badly needed visibility to NOAA among the lay public which often regards the agency as a poor step-cousin to other more visible federal agencies. This reviewer was an earlier quiet observer of PMEL's tsunami work, but this review made me an enthusiastic convert and fan of its entire spectrum of activities.

In my view, the unique strength of PMEL is the delivery of end-to-end ocean systems including designing, engineering modeling, implementing and disseminating information. This integration of field and modeling results allows for the best understanding of the evolution of environmental systems and it more than adequately addresses NOAA's vision of becoming the authoritative voice on environmental assessment and prediction of weather/ climate and ocean resources and of water resources. I can think of a few other federal laboratories that match as well the parent's organization mission. Another excellent strength of the laboratory is that interdisciplinary research is fostered and conducted without the confines and the jargon of the politics of subfields of subfields.

In terms of accomplishments, clearly the cornerstones are the development of the ATLAS buoys and their deployment in the Tropical Atmosphere Ocean(TAO) and the TSUNAMI programs, and the VENTS program. The TAO array's ability to measure

surface and subsurface parameters to 500 meters and the real time transmission of the data easily qualify as one of the top 10 engineering achievements in environmental monitoring of this century. The TAO array provided valuable data during the recent El Nino which helped mitigate substantially its impact on the west coast of the US, and the measurements will "feed" for years climate, atmospheric and oceanic modellers as they assess intrinsic physical mechanics of the ENSO. I highly recommend the extension of TAO into the program known as PIRATA for the tropical Atlantic.

VENTS is a program that effectively couples innovative technology development with innovative science of lucrative commercial potential. The discovery of the episodic thick lens of volcanically heated water rapidly injected above the active hydrothermal venting and its correct association with submarine eruptions is surely the "right stuff" for the nineties. The terrestrial seafloor is known in many locales less well than the surface of Venus, and for good reason, most agencies do not have the leadership or imagination to dedicate resources in what they probably perceive as a hum-drum field of research. Of course, chance favors the prepared mind, and the VENTS's discovery of hyperthermophilic bacteria and their unusual and unexpected biological attributes for pharmaceutical polymerases creates incredible commercial opportunities for American science. A toff of the hat to those who imagined and implemented this program. Oh, yes, incidentally, the associated SOSUS hydrophone array program is one of the best application of dual-use technology in practice today.

The Deep Ocean Assessment and Reporting of Tsunamis (DART) is an incredibly successful and cost-effective program which has provided the first nuggets of the holly grail of geophysical submarine research, i.e., the deepwater signature of tsunamis close to their generation. To this date, geophysical models of seafloor deformation are quite crude and can not provide adequate definition of the three-dimensional distribution of vertical seafloor displacement, of any practical use for real time for tsunami warnings. Even the best hydrodynamic models (such as PMEL's MOST which is the leading code in the world), these codes routinely underpredict the tsunami coastal inundation, primarily because of this difficulty with the definition of the initial seafloor deformation; only when nearshore, and only when massive amounts of nearfield seismologic data are available can the initial condition be sufficiently well-defined to produce quantitatively correct hydrodynamic predictions, as NOAA's MOST did for the Okushiri, Japan event, where it produced better quantitative results than the state-of-the-art Japanese codes, not to mention spectacular visualizations. Because of this difficulty with the initial condition, deep-ocean measurements are the only "hope" of getting quantitatively correct real-time predictions. This was the unanimous conclusion of an NSF sponsored workshop last year as published in SCIENCE in 1997, in a perspectives article which made specific mention of PMEL's DART program. DART will reduce the potential of false-tsunami warnings in coastal areas of the US, where false warnings not only reduce substantially the credibility of the warning centers, but they also cost upwards of \$30million per false-alert.

NOAA-PMEL has taken leadership to organize the preparation of inundation maps for the Pacific States through the TIME program. As PMEL scientists realized the potential for quantitatively correct real-time warnings were possible through the application of efficient algorithms in the ATLAS buoy real-time data, the natural next step was the preparation of inundation maps for the Pacific States. Long before tsunamis became a favorite subject of science documentary producers, NOAA-PMEL quietly orchestrated the appropriation of funds and the raising of the awareness in the science and emergency

services community for coastal hazards mitigation. This program's director managed exceedingly well to build sustainable collaborative projects with investigators in all the affected Pacific States, thereby disseminating PMEL's MOST technology effectively and with redundancy built in. This was not an easy task, as most individual investigators had their own pet-projects, yet NOAA-PMEL managed to bring the community together and agree on a consistent methodology to address the issue. In terms of bang for the buck, the tsunami program is the most leveraged, with only 20% NOAA basefunding. Not only the number of buoys needs to be increased by a factor of five at least, but also more resources need to be dedicated to the TIME project, particularly since NOAA is the only agency charged by Congress with tsunami hazards mitigation. As an added bonus, the TSUNAMI program appears to be the most visible program in the media, and the PMEL director, and the program scientists are quoted in newspapers around the Pacific almost daily when there is a tsunami disaster, not to mention that all tsunami documentaries filmed in the past five years, they all feature PMEL's work; one of these documentaries has been airing weekly on cable in the last year, and it has brought tremendous visibility to NOAA at large.

I also want to mention the Fisheries and Oceanography Coordinated Investigations (FOCI) program with a goal to understand the recruitment of pollock in the Gulf of Alaska in the Bering Sea. It does show promise of saving the Pacific walleye pollock from the fate of the cod and swordfish in the Grand Banks in the Atlantic. More importantly it promises the development of a methodology for a notoriously difficult problem.

Finally, Ferret is a very effective tool for analysis and visualization of data was developed at PMEL and it appears at least as good or better than commercial packages such as Spyglass or ImageLab. NOAA should invest resources in producing a user's manual and then consider making it more widely available than it already is.

In terms of difficulties, the aging of the population of senior scientists in the laboratory is a problem which -coupled with the tendency toward soft-funding positions replacing permanent positions-, this does affect the morale of some senior investigators. The PMEL leadership is aware of this, and interestingly the morale of the more junior people is high. One factor is the serene location and the well-maintained physical plant of the laboratory which is an attraction all of its own, and the culture of innovation which permeates the lab. Spending two days among PMEL people was like reading an Ayn Rand book, quality is its own reward. Another feeling I had was that I was surfing with the lab the crest of the wave, amazing, as I am by nature a cynic. It is very refreshing that the lab still attracts top entry level people, despite the level of government salaries and the state of the economy which generates numerous other options for these entry-level staff. Nonetheless, this is an area that NOAA needs to address in its strategic planning, the lab needs to accelerate the rate at which it is adding people in advance of the retirement of its senior scientists, to provide continuity and mentorship to continue its innovative work well into the next century. Also, PMEL needs more base-funding to assist in public dissemination and "promotion" of its results in the FOCI and TAO programs, to match the visibility of the DART, TIME and VENTS programs.

Another difficulty is the leveraging of the laboratory and its increasing dependence on peer-reviewed funding. Even though peer-review helps the best science to get done, several of PMEL's programs are of strategic importance to the nation, and they should not be interrupted because of the political problems that sometimes individual investigators fall into with changes in personnel in funding agencies. The continuity of time series in ocean data is paramount, or else the value of the existing results diminishes drastically. NOAA should carefully consider a venue to ensure that key PMEL programs

have a cushion of funding to carry them through in lean years. This of course is the problem in many federal laboratories, but PMEL may fall a victim of its own success because of how highly it is leveraged with NOAA external funding. I recommend a minimum of 50% base funding in all programs, and that NOAA have a formula to reward the lab's successes in attracting NOAA-external funding, such as matching in base funding in the following FY all external funding of the prior year that exceeds a threshold, say 10% of the total. This will allow for more stable funding, and it may be a good scenario for the expansion of the laboratory.

As a final note, if PMEL is a crown jewel of NOAA, the director Dr. Eddie Bernard is the crown jewel of the laboratory. He leads by example, and I am certain that the high morale in the laboratory is to an extent due to his energy and vision. His work in tsunami hazard mitigation is exceedingly well known worldwide. More importantly, he is internationally recognized as the leader of the US scientific community in this field, and he is now the undisputed spokesperson of the international community as well. Through his own individual efforts, he has advanced the field significantly in the past fifteen years, both in terms of innovation and in terms of bringing in funding for the entire US scientific community in tsunami detection and tsunami hazards. Overall, his tenure at PMEL has enhanced NOAA's standing in world science.

I want to thank you and NOAA for allowing me this opportunity to participate in this review.

Sincerely yours,

signed

Costas Synolakis  
Professor of Civil and Environmental Engineering