REVIEW REPORT
Atlantic Oceanographic and Meteorological Laboratory
(February 23-24, 2000)

(1) The Atlantic Oceanographic and Meteorological Laboratory is a productive research institution providing information helping to satisfy the broad mission statement of the Strategic Plan. AOML research has many very strong aspects; the quality of science was high and AOML core programs are appropriate to the lab and its location. Its research is of substantial societal importance and contributes to similar national and international research. However, there are a number of issues, both large and small, that may affect the ability of AOML (in parallel with its sister laboratories) to develop and sustain unique programs for the benefit of the operational arms of NOAA. Significant concerns and deficiencies regarding specific emphases, direction, and management need attention and correction; accomplishing that will require addressing the larger issues first.

AOML Research

Scientific Programs

(2) Over the years, the research program has evolved in a fairly logical/natural manner, but this has mostly consisted of gentle fine-tuning, rather than any radical redirection or truncation. There may be a greater future need for more radical changes.

(3) AOML conducts a broad range of research on global to local scales. The NOAA Global Ocean Observing System (GOOS) Center is housed at AOML and a wide variety of data is collected, analyzed, and provided to other scientists. Research includes fundamental studies of the El NiZo-Southern Oscillation that have very direct application to work at other laboratories, including the development of predictive numerical models. Research in the Atlantic includes observations and interpretation illuminating variability over decades. Volunteer observing ships obtain information on upper ocean temperature structure, and chemical measurements are used to understand deep-water formation and the role of the ocean in determining important atmospheric gasses. Regionally, there is considerable interest in the Intra-American Sea (IAS), whose circulation is linked to global phenomena. Off Florida, the circulation, chemistry, temperature, and salinity between the Keys and the mainland are being studied in the South Florida Ecosystem Restoration (SFER). Finally, near the mouth of the Miami River there is an ADCP mooring used to aid in appropriately dumping dredge spoils.

(4) The Hurricane Research Division (HRD) is the clear leader in U.S. hurricane research, partly because of their access to NOAA observational aircraft each hurricane season. HRD mentioned a need for more theoretical work and more modeling; unfortunately, this would come at an exorbitant cost. Increasing laboratory attention to remote sensing is nascent but could be important support for core activities.

(5) Coastal GOOS (CGOOS) is conceived as an observational system encompassing measurements, analysis, and data assimilation of coastal environments from the lower atmosphere to the sea floor. One scenario for its development is to establish regional centers where data are collected and coordinated for science and management. Given the activities and capabilities of AOML, there is no doubt that it could be such a center, but to accomplish this will require significant regional collaboration. Project ACCESS is a start, but could certainly use additional support and stimulation.

(6) Another area of significant innovation by AOML scientists is the development and deployment of new sampling methods. Examples include successful exploitation of ADCP for plankton biomass estimates, estimation of rain using acoustics, and Project EAGLE. These efforts demonstrate a continuing effort to get maximum data from limited resources. Developing access to more ships of opportunity is especially important to enable more complete coastal ocean monitoring. This partial list of the work underway demonstrates the breadth of AOML research.

Specific AOML Research Problems

(7) 1: Measurement of the flow through the Florida Straits using undersea cables has been abandoned, although maintenance of important time-series is a key responsibility of NOAA laboratories. The reason for abandoning this time-series was prohibitive cost, but, in fact, cost was relatively small compared to laboratory base funding; compared to available discretionary funding, it may have been large. Although AOML scientists appear to be seeking research funds and using this work to continue the time series, the Lab should support the collection, analysis, and archival of key time-series data. Identifying key time-series that are the responsibility of AOML is essential, and so is identifying a budget for these activities, including the necessary discretionary spending for unanticipated costs.

(8) 2: If the GOOS Center did not come with sufficient operating funds, support should not involve using research money. Placing the operational GOOS Center within AOML is an excellent plan, but it should not be done at the expense of scarce research funds.

(9) 3: It is clear that a significant fraction of the data collected during HRD flights through hurricanes is not being fully analyzed, nor is it being provided to the larger research community because the HRD budget is too small. These data sets should be available as soon after collection as possible. In addition, past data should be quality controlled and archived (web based?) so it is readily available to the research community. AOML has held some of the better data sets back for their own research, yet, due to a very aggressive field program, they have been unable to analyze these data. Data must be made available and analyzed; doing so may require that the HRD curtail operational activities for certain periods such as starting the season late, ending it early, or even alternating sampling and analysis years. Adopting a “we'll only go if” strategy still diverts the attention of scientists and technicians who must be ready to go.

Research Collaboration

(10) At AOML, research is a matrix formed by the Divisions and crosscutting themes; most projects involve scientists from at least two divisions, and there seems to be a truly cooperative and upbeat feeling among them. This is also true within Divisions; for example, the research projects of the Physical Oceanography Division are directed toward the meridional thermohaline and wind driven heat and freshwater fluxes within the Atlantic Ocean. They are attacking a collection of "connected" prime climate-related topics; results from one component benefit the others ("whole greater than the sum"). Considerable excitement and energy are evident, and there is demonstrable scientific productivity. The scientists involved in this work are also collaborating with respected scientists from other research laboratories and universities. On the whole, AOML research is high-quality, innovative, and relevant. This, in view of the budget pressures, is most impressive. The administration deserves credit for maintaining an excellent working environment. However, improvements are possible and recommended.

(11) It may be opportune now to thoroughly reassess the relationship of AOML to other parts of NOAA (*e.g.*, OGP, NOS, NWS, NESDIS) and, if necessary, adjust it for the future. This recommendation arises, most generally, from AOML's emphasis on long-term monitoring and converting observational systems and diagnostic products to routine operations. It is also prompted by the rather confusing discussion of apparent difficulties in sustaining the long time series of Florida-Bahamas current measurements, possibly the most important measurement for the Atlantic climate system. So, the issue of whether AOML funds (base or reserve?) should sustain the Florida-Bahamas measurements, or whether some dependence on OGP is necessary, provide examples of the need for a NOAA assessment of the relationships between AOML (and its sister Laboratories) and other parts of NOAA.

(12) Although there was ample evidence of collaboration with outside research groups, and growing collaboration with RSMAS was particularly encouraging, closer collaboration between AOML and private and governmental labs at the national and international level should be developed. More attention should be paid to strategic collaborations, particularly in linking observational research to model-based research, and data to operational models. International partners for operational activities are encouraged.

(13) Collaboration with other organizations is a way to obtain expertise the Lab doesn't have. It could be accomplished by inviting more outside researchers to visit or spend sabbatical time at the Lab (or CIMAS). Obtaining quality collaborations through paid invitations is relatively inexpensive, although financial pressures may make this difficult. For instance, a group that specializes in observations (HRD) would naturally collaborate with groups specializing in modeling or simulation. This does not mean that significant collaborative visits don't happen, quite the contrary. But it might be useful to seek ways to further encourage collaborative visits, such as developing and maintaining a funded sabbatical program that would bring university scientists to the Lab for extended visits.

Laboratory Resources

(14) Laboratory resources have clearly been stretched as thinly as possible, but seem to be adequate.

Computers

(15) Computer resources are of some concern; the system appears to be aging rapidly. Staff number seems adequate and may be too large (standardization within the Lab might reduce personnel costs), but there is apparently insufficient funding to replace equipment. If the Lab is to be competitive, and also maintain an adequate computer staff, it needs to replace all its aging systems. Doing so should allow it to reduce expensive computer personnel, make the Lab more compatible to outside collaborations, and ease the stress on new hires trained on more modern systems. The Laboratory Director needs to develop and implement a plan, budget commitment, and a program for continuous upgrading, or the system may quickly become hopelessly outdated. There is difficulty obtaining funding for computers from some of the funding sources. Solving this problem will involve a committed investment by NOAA.

(16) One particular computer concern must be addressed soon. AOML computers are serving as WWW information sources for many people in Florida; these machines are vulnerable to Laboratory shutdowns caused by approaching hurricanes at times when high-quality information is most needed. Therefore, servers should be mirrored (with automatic re-routing), moved inland, or placed in an off-campus site permanently. To do so will require some resources. An alternative is to discontinue using AOML-based computers and move the information to other platforms. A serious public-relations problem is likely to develop if the situation remains unchanged.

Management Issues

Strategic Plan and Vision Statement

(17) We were presented with a "Strategic Plan" that was clearly not really a strategic plan, although it provided very useful material on overall accomplishments for the Lab, a kind of roadmap for the poster sessions, and useful statistical information. It contained little information on the vision and planning for the future. Although each Division provided some forward-looking comments under "A vision for the future," most of those sections were fairly general, set no priorities, and some (HRD's in particular) did not even discuss scientific plans. We heard from the junior scientists that there didn't seem to be a clear vision for the future of the Lab, and there was no clear articulation of priorities other than "everything is important." The Lab needs strategic planning for its future scientific direction, perhaps stated as goals, giving a sense of the most important activities or priorities. If nothing else, this will provide a framework for members of the Lab to understand where their work fits into the overall Lab objectives. Such a planning process ought to involve the entire Lab, not just the Director and Division Directors. This will ensure a result that represents a team effort and general acceptance by the entire staff.

(18) AOML Management should develop a *succinct* Vision Statement and associated, prioritized, 5-year Strategic Plan. The Vision Statement should include measurement, analysis of those measurements, and long-term environmental monitoring, the mainstays of AOML research. It should distinguish between basic and applied research and operational programs. The 5-year Strategic Plan will provide a firm guide for priority setting, realistic budget development, hiring strategy, infrastructure planning, and form a basis for understanding the "system" and expectations for all of the research staff, particularly new hires. It must define what is the proper ratio of effort between these three lines of activities for AOML (NOAA might want to do this for all of its OAR labs). It will serve as a blueprint for starting new programs, terminating accomplished ones, and converting others to operational status. Finally, it will set priorities allowing adjustment of the research program to budget realities. Clarifying the Laboratory's unique emphases, both ongoing and future, will help management better "sell" AOML to NOAA and outside customers; it will guide the annual assessment of the "contribution to mission" of AOML scientists; and it will prepare AOML to "fall back" to a smaller but better funded (per employee) laboratory if that should become necessary.

(19) The Strategic Plan focuses on what the laboratory is doing now, but does not identify an explicit goal or investments and staffing plans to accomplish it. It may be necessary for the Laboratory to become a smaller, but better per capita funded, organization to achieve its goals. NOAA must provide the flexibility to achieve this, and a clear plan must be developed to guide hiring and investment. If undertaken quietly, this activity should not erode AOML morale, and certainly not to the extent that will occur if the Laboratory is unprepared for any downsizing that might become necessary.

(20) NOAA HQ/OAR needs to define the missions of the laboratories and provide appropriate guidelines and funding mechanisms so they may achieve them. Although OGP funding has allowed OAR to guide laboratory investment and build stronger programs with more outside collaborations, it doesn't cover salary or computer equipment, there is no "atmosphere" equivalent, and the size of the marginal or competitive funds may be inappropriate for the long-term health of the laboratories. When entire base funding for a laboratory does not cover salaries and building operations, then a program that doesn't support participant salaries is inappropriate and damages key lab functions. It also damages morale if key lab divisions are ineligible for special programs, thus requiring large disparities in base funding between divisions.

<u>What Distinguishes AOML from a University?</u>

(21) What are the role and mission of AOML and the NOAA laboratories in general? This important question was asked frequently during the review. There is considerable pressure from private industry and from large research universities, through their congressional representatives, challenging the very existence of Federal laboratories, so these issues need to be addressed carefully. It is a matter that needs constant attention in the life of each OAR laboratory, for the labs must retain unique emphases that cannot be easily duplicated in other organizations. To some extent, AOML satisfies this need: *e.g.*, the emphases on observations (especially long-term monitoring), analyses of the resulting time series, and the conversion of observational systems and routine diagnostics to the

operational arms of NOAA. These and similar activities should be maintained and fostered in the future. It is this ability to accomplish long-term observational activities and transition research results to operational and application activities that distinguishes OAR laboratories from academic research, even though the research is collaborative with university labs. OAR labs have primary responsibility for continuity and attainment of the final product. Many of AOML's climate and ocean observational programs, including those for long-term monitoring, would also be difficult, and perhaps impossible, to do in a university. AOML has created a clear niche for itself. This special and necessary role should be clearly stated in the mission (or vision or strategic plan) statement. There are three fundamental precepts for all Federal laboratories, namely:

1: To function as honest brokers for the government in dealing with science and technology issues, investment, and policy;

2: To manage long-term investments requiring funding stability not suited to universities and private industry; and,

3: To provide a clear transition path for science and technology to government and to private industry.

(22) NOAA's (HQ/OAR) current laboratory management mechanisms are causing many of its laboratories to default on these precepts. AOML is a clear example of this:

Honest brokers (advisors): to function in this role, the Laboratory must have a small cadre of nationally and internationally recognized leaders in its core excellence areas. It must manage carefully to give these leaders national visibility and opportunities for recognized research, carefully select and groom replacements, and be perceived as not competing for funding (*i.e.,* biased) when advising government agencies. Other NOAA Line Offices must also be willing to call upon these advisors without fearing competition by them for funding. However, Laboratory personnel feel that they have been "concept donors" in NOAA program development meetings. For instance, in CGOOS, AOML personnel participated in development of objectives but were not allowed to compete for funding. If Laboratory personnel are used as advisors, then they should be adequately funded to participate without competing.

Long-term investments: investments that can't be sustained by grappling with yearly or even triennial proposal processes, such as long-term developments, large observing technology developments, long-term monitoring, and maintaining a science presence in currently out-of-fashion research areas. NOAA must identify these critical activities and provide adequate funding, including adjustments for inflation, or failures such as the loss of the telephone cable monitoring of the Gulf Stream will occur again.

Transition path: The difficulty of this activity varies with laboratory focus. AOML technology is less likely to "transition" in the hardware sense of the word, because it provides more knowledge, techniques, and data.

Funding Process

(23) Its financial history has significantly stressed AOML. The need to compete for research funds is good in some ways for the Laboratory and for the individual scientists, but has created problems maintaining Laboratory focus and cohesiveness. Changes in the funding process may also cause difficulties with equipment procurement. The long-term lack of base funding enhancement for AOML (despite mandated salary increases and other expenditures), and the tendency to centralize new monies in Headquarters, have raised serious and legitimate concerns among AOML management and senior scientists about whether the Laboratory will receive appropriate returns on its "contribution of concepts" to NOAA. The high value to NOAA of previous "concept contributions" by AOML is illustrated by its important role in the development and execution of EPOCS and STACS which played major roles in positioning NOAA to deal operationally with seasonal-to-interannual and decadal-to-centennial climate variability. If (as now) the laboratories must fight for funding, then they should be allowed full access to all NOAA funding opportunities. It would be very detrimental to NOAA's long-term health if Headquarters' policies (or perceptions of them) stifle the creativity of its Laboratory managers and senior scientists.

(24) Level budgets have severely limited flexibility in AOML programs. One way to address this problem is to find ways to increase the available funding for the Lab by developing coordinated community programs that have goals of national interest. It is not sufficient any more to just wait around for someone to recognize that you do good work and can produce wonderful things and, therefore, funds you. The Lab should and does participate in these types of community planning activities; they have been very active in the USWRP. However, there are signs that they view it as a legislative process only, but they must take a broader view. AOML and other OAR labs should take the initiative in promoting the monetary, scientific, and societal value of their research and operations to NOAA headquarters and the public, and should point out what will be lost if budget pressure forces deletion of a research or operational endeavor.

(25) There must be separate budgets for research and operations and they should not be in competition, leading to budget erosion of one by the other. Research and operations line up sequentially, not in parallel: successful research leads to essential operational projects. To insure progress, these two activities must be viewed as a whole, not competing parts.

(26) AOML should have a discretionary budget component that could serve as "venture capital" to explore new research initiatives. Perhaps the Director could establish a Director's Reserve to address small emergencies such as the recent problems with the "cable." Given the size of the Lab, this might be on the order of $100K.

Career Development

(27) Most scientists agree that the competitive funding process leads to higher quality research, and it has done so at AOML. A second advantage of competition is that AOML scientists will have comparable experience to that of University researchers and will be better prepared for opportunities to leave the Laboratory. This should be identified as a

positive aspect of the Laboratory when recruiting scientists. Associated with this is the Director's policy of reviewing scientists based on their publication record, with relatively little weight given to "service" activities, to which they should devote very little time. Such activities should be encouraged and rewarded, but only when conducted in addition to continuing high-quality research. This policy should continue: it strengthens the scientific staff and increases the respectability of AOML as a research institution. However, see "personnel" below for a potential problem with this approach. In discussions, junior scientists expressed a feeling that there is more pressure on them to obtain external funding than on the senior staff. If this is true, it is the reverse of the optimum where the senior staff who have established reputations can be most effective in obtaining external funding.

The Proposal Process

(28) The negative side of the competitive funding process is that the objective becomes research dollars rather than research associated with the mission of the Laboratory. Three strategies address this problem. First, the Director should develop and maintain a process for identifying and communicating appropriate funding opportunities to AOML scientists. Significant funding opportunities have been missed in the recent past because of a lack of information. Second, there should be a significant level of management guidance in the proposal process, probably including notifying the Director or relevant Division Director of the intent to propose. Proposal-supported projects must be consistent with the AOML mission and vision statement. Administration support is needed for preparation of proposal budgets. Third, every proposal that leaves AOML must be reviewed by a Division Director or by the Laboratory Director. Absence of this process results in unreviewed proposals leaving the building; the university model would be an appropriate start for developing these procedures. Mixing base and proposal-funded projects can cause stress within the system, which the administration should act to alleviate. Funds raised by proposals from individuals must not be raided for base support (some fear that can happen).

(29) AOML scientists need to be involved in the national planning process, to which their expertise will contribute substantially. By participating, they will improve their ability to generate successful proposals. Although AOML scientists actively participate in planning some programs, especially within NOAA, other opportunities, especially participation with University researchers, should be encouraged. NOAA must recognize that the laboratories are a resource requiring cultivation; by including them at all levels of the organization, they will be better prepared to respond to NOAA needs.

Joint Institutes

(30) The joint institutes, *e.g.*, CIMAS, are excellent in that they provide flexibility for the OAR Labs in meeting their objectives; joint institute visitors bring fresh ideas into the OAR labs. But, while joint institutes are to be encouraged, they should not become the drivers of OAR research. Growth at CIMAS seems much more modest than at other NOAA joint institutes, and although the new young scientists being hired by CIMAS

should be made to feel they are a part of AOML, there seems to be a feeling that they need to "graduate" to AOML to be full members of the organization. This might be partially addressed by making CIMAS an integral part of the hiring plan for AOML. These issues, and the CIMAS/AOML/RSMAS relationship, would bear closer examination and comparison with those at other joint institutes. AOML should develop a "Visitors Program" (probably in collaboration with CIMAS) that will help it compensate for its current lack of expertise in the theoretical (especially concerning hurricanes) and modeling areas.

Personnel

(31) AOML has many senior staff, especially in civil service positions. Although it seemed as though the Lab is not concerned, the panel was. A "top heavy" staff tends to slowly diminish in productivity over the years, and future vitality resides in junior staff. More opportunities must be made to bring high quality junior staff into secure positions, but how this can be done within the context of government positions is unclear. In addition, more attention needs to be taken in replacing scientists in key areas. Because almost half of 31 PhDs are age 56 or older, AOML needs a clearly articulated plan to systematically replace key scientists, including identification and priority ranking of critical positions required to maintain Laboratory core expertise. Thus, the most important replacements could be acquired as funding and billets became available.

(32) The new personnel review process appears to have some serious drawbacks. Whether these drawbacks are a reality or only represent fears of employees, corrective action needs to be taken. A review of the process is needed, including a truly anonymous survey used to identify staff concerns. Improved communication regarding this issue may be required: staff expressed concern that there was not enough emphasis on, or recognition for, contributions directly to NOAA such as developing systems for transfer to operations. The emphasis is on paper count and that is often compromised in programs that lead to a transfer of research results to operations. Given NOAA's mission, recognition of these activities ought to be an important part of performance evaluation.

(33) Junior researchers at AOML seem to be treated like junior university researchers. While this is good in sharpening their competitive skills and promoting productivity, it may not be entirely effective in building the next generation of government scientists, whose mission toward applied and operational objectives is (or should be) somewhat different from the university researchers. Junior scientists want to have more effective mentoring, especially in preparation of proposals, but also with regard to career development. New scientists are brought on with little support, are not provided start up funds, and are not assigned mentor scientists in any organized way. They do not receive information on funding opportunities in a timely or organized manner. Universities are much more aggressive in ensuring their tenure-track hires get started off on the right foot and feel loyal to the organization. Although it is easy for senior staff to forget their responsibilities to junior scientists, perhaps they need to be reminded. The Lab needs to provide much more nurture for its future scientists by establishing mentors for critical hires, providing initial, stable, funding supplements, and ensuring that young scientists are directed toward appropriate funding opportunities that build on the Lab's core areas.

(34) Finally, the Director maintains an open-door policy that encourages the staff to communicate and believe that she cares about their careers. This is a strength of the current management team. However, there is uncertainty within AOML and for CIMAS scientists who hope to move to AOML as positions become available. This uncertainty takes two forms. First, will retiring or departing scientists be replaced? The ongoing budget squeeze puts the Director in a difficult position in which she may not be able to implement recruitment plans, and this is obvious to the junior scientists. Second, laboratory direction is unclear; a constructive Strategic Plan would help solve this problem.

Concluding Remarks

Review Process

(35) The review format was superb, the overall process was very good and seemed to include suggestions from other reviews. Presentations were at about the right level of detail and content, and the comprehensive set of posters was especially informative and convincing. It is an efficient way of seeing the breadth of the Lab's science and makes it possible to focus on parts about which more information is wanted. Management was well prepared for the review; the review format and read-ahead material provided a description of the Laboratory in as much depth as possible in a two-day review. It was valuable having the AA there, especially in the beginning, to provide a context and a focus for the review.

(36) The meetings with staff, including the Division Directors and the junior scientists of the Lab were valuable. Discussions with the junior staff were very valuable and interesting. It was unfortunate not to have a chance for direct discussion with more of the senior staff, and many of them did not seem to be at the meetings, and only a few were part of the poster discussions.