

**Report of the Review of the
NOAA Earth System Research Laboratory
Global Monitoring Division**

April 3-5, 2013

Review Panel

Dr. Kenneth Jucks, NASA, Chair

Dr. Carl Brenninkmeijer, Max-Planck Institute for Chemistry

Dr. Oystein Hov, Norwegian Meteorological Institute

Dr. Beverly Law, Oregon State University

Dr. Michael McElroy, Harvard University

Dr. Anne Thompson, Pennsylvania State University

(This page intentionally left blank)

**Report of the Review of the
NOAA Earth System Research Laboratory Global Monitoring Division
April 3-5 2013**

Overview

An on-site, expert peer review of the NOAA Global Monitoring Division (GMD) was conducted April 3-5, 2013 in Boulder, CO. The purpose of the review is to ensure that OAR laboratory research is linked to the National Oceanic and Atmospheric Administration (NOAA) Strategic Plan, is relevant to NOAA Research mission and priorities, is of high quality as judged by preeminence criteria, and is consistent with NOAA planning, budgeting, and budget execution.

The review focused on three research areas: Climate Forcing; Ozone and Ozone Depleting Gases; and Baseline Air Quality. The six-member review panel was provided with written materials before the site visit that included guidance to the reviewers, supporting documentation, NOAA’s Strategic and Research Plans, and access to the science presentations to be made during the site visit. During the review, the agenda primarily consisted of presentations on the three research areas, as well as some time allotted for informal discussions with GMD staff and stakeholders. This report summarizes individual panel member evaluations and is not a consensus report.

Summary of Laboratory-Wide Findings and Recommendations

The instructions for this review were to concentrate on the relevance, quality, and performance of the activities being performed at the Global Monitoring Division of the Earth System Research Laboratory of NOAA and to rate the research areas on the criteria outlined in the “Charge to Reviewers” document using the following definitions:

- Outstanding--Laboratory goes well beyond the satisfactory level and is outstanding in all areas.
- Satisfactory--In general, Laboratory meets the expectations of the science criteria.
- Needs Improvement--In general, Laboratory does not reach expectations.

The reviewer will identify specific problem areas that need to be improvement.

	Climate Forcing	Ozone and Ozone Depleting Gases	Baseline Air Quality
Jucks	Outstanding	Outstanding	Satisfactory
Brenninkmeijer	Outstanding	Outstanding	Outstanding
Law	Outstanding	Outstanding	Outstanding
Hov	Outstanding	Outstanding	Outstanding
McElroy	Outstanding	Outstanding	Outstanding
Thompson	Outstanding	Outstanding	Outstanding

The bases of these ratings are summed up with the following statements.

Relevance: The activities of GMD support the “Environmental Security” of the nation and are as essential to the NOAA mission as the rest of NOAA.

Quality: GMD has become a NOAA/ESRL star, carrying on the ever more critical climate mission while pushing the frontiers in Climate, Greenhouse Gases, Ozone Depletion, and Air Quality. Their datasets of changing atmospheric composition and standards are those that will be used by the international community for decades to come.

Performance: The investments into GMD have been well optimized in an underfunded environment. Despite the significant set of responsibilities, the work in the different groups focusing on the themes presented to the panel, is of the highest caliber. The scientific community, nation, and beyond are reaping the benefits, and are heavily dependent on GMD. Now is the time to strengthen the capacity of GMD even further to maintain its global lead in these activities.

All of the areas of focus within the GMD are activities that are highly relevant to NOAA’s goals of understanding the Earth System as it relates to addressing the information the US Government and citizens need to understand the impacts of decisions on many scales. The Climate, Ozone, and Air Quality research at GMD are all key areas of focus for NOAA and Earth System Science.

The quality of the work, as proven by the broad range of researchers who either use data obtained by GMD or extensively collaborate with GMD researchers is at the highest level. The trusted data sets GMD distributes are key to advancing science and reducing uncertainties in the international assessment process. GMD personnel are committed to this goal and are highly recognized for their work (reference “Preeminence” document).

The GMD has assembled a very skilled team that takes their obligations very seriously, and this shows in how they achieve their mission. They work tirelessly to establish connections to ensure that all of their partners worldwide meet the performance standards of GMD as well. As a result, data, products, and scientific analysis that ensue from GMD activity are quite high, especially with the constraints on resources in which they currently operate.

The long-term observatories and distributed observations of GMD are essential for the monitoring of key atmospheric parameters. There is no redundancy in these data. Reinforcing infrastructure at the current observatories is essential. Equally important is *expanding* capacity to support monitoring in regions where new problems may erupt that affect the US and international partners (e.g., new oil and shale-gas activity, GAW-type locations affected by intercontinental pollution).

The team reports five Findings and associated Recommendations. These are further spelled out our individual findings. These are summarized below. Note that each

Finding touches on one or more of the 3 Review metrics (Relevance, Quality, Performance). Each Finding and Recommendation pair is followed by important evidence and background.

Finding #1

The NOAA GMD Mission is on target, well aligned with the needs of many stakeholders and supporting the activities of other science and regulatory agencies (state, national, and international). The lab is an environmentally strategic asset of the US that has been carefully optimized to conduct highly successful science in the areas of Climate Forcing, Ozone and Ozone-depleting substances and Air Quality.

Recommendation #1: The science GMD carries out to support other science and regulatory agencies (state, national, and international) should be expanded rather than contracted to accomplish NOAA's mission.

Background and Evidence:

GMD activities and researchers address essential "processes" in the "Earth System" that are only understood with long-term, systematic, quality-assured observations. In many cases no other organization has the capability to do this kind of work. GMD has evolved into a distinguished "scientific" national asset.

No single agency or organization doing global Earth System science has the financial or personnel resources to sufficiently achieve the tasks they have defined as priorities. Most localized Earth Science problems are tasked to State agencies (within the US) to monitor/regulate, and they rarely have the appropriate scientific expertise to sufficiently follow through on their mandates. GMD fully recognizes this and works hard to establish both global and local connections and collaborations to help them achieve their goals and those of their partners.

The work with international partners, especially those connected with WMO, ensure that GMD's "climate" and "ozone" related observations are truly global, which is required to answer the science questions related to these fields. Even with these efforts, the spatial and temporal coverage of the resulting data sets is adequate at best. More, not less, effort is required to advance the science in these areas. GMD is the main international coordinator in enhancing and expanding these coordination activities. The strong, central, and internationally leading role for GMD is essential to US interests and must be sustained.

The work with local US partners primarily relates to Air Quality activities, many of which are delegated to the states, and coordinated with the EPA. The recent work by GMD with some western states for understanding the impacts of emissions from gas and oil extraction is a clear example of how NOAA expertise allows regional

policy makers to understand the implications of activities in their individual states that would simply not be possible with their own resources.

Finding #2

The combination of GMD activities and priorities, with a mixture of operations, science and technology is an essential element of its successful approach to carrying out its mission.

Recommendation #2: All three components of GMD work, operations, scientific analysis and technological development, are required for its mission and must be sustained.

Background and Evidence

The term “monitoring” may imply activity that is routine or not important to understanding the basic “mechanisms” of the Earth System. However, it is a synthesis of short term and long term observations that are required to quantify changes and uncertainties in the system as a whole. Both monitoring and process data require interpretation by scientific experts within GMD.

Monitoring implies “operational” in the eyes of many managers within the US government. However, the monitoring activities of GMD require significant scientific and technological expertise that is the foundation of mission success. The types of observations performed by GMD require unique instrumentation, many of which are developed in-house. The operation, upkeep, and improvement of these instruments require a high level of specialization. Having people in-house who are on the forefront of using and interpreting the data scientifically is also critical and makes an internally consistent system. Top- quality scientific data require the full understanding of how random and systematic uncertainties propagate to scientific conclusions and assessments. This requires that GMD scientists who are actively involved in the analysis and interpretation of their data *direct* the operation, upkeep, improvement and deployment of their instrumentation.

Finding #3

GMD “leveraging” of activities done by others is extensive and integral to the scientific mission of GMD and is often an appropriate and required strategy. Although national and international partnerships partially compensate for limited NOAA resources, the continued US leadership role in monitoring and scientific assessments is at risk due to declining budgets!

Recommendation #3: NOAA must put additional resources into all aspects of GMD operations, scientific analysis and innovation.

Background and Evidence

This finding is related to Finding #1 and is illustrated with reference to NOAA's role in the assessment process. NOAA at large makes significant contributions to these mandated assessment activities both within the US Government and in partnership with international organizations where the US Government is a significant contributor. The personnel within GMD play an integral role in many of these assessments and the data sets produced by GMD are at the core of many key findings within these assessments.

- National Climate Assessment
- IPCC assessments
- WMO/UNEP Ozone assessments

Due to the complexity of science and the global scope of GMD research and observations are the backbone of the WMO/GAW, ICOS, and GCOS, especially in the ozone and greenhouse gas areas. Without GMD continuing its leadership role in standards, measurements and reporting, those programs would fall apart and the assessments would be incomplete. The same holds for the collaborative activity within the US agencies where GMD data perform a unique function in integrating climate, ozone and air quality programs. Although NASA and DOI (USGS, USFS) are partners in certain earth observations, no other agency has the expertise, ability, or budget to perform the roles played by GMD within the USGCRP, NACP frameworks nor in connecting air quality to regional composition and climate changes.

The US needs to be prepared for possible future international agreements regarding climate and mitigation. The US Government will need observations from GMD in order to better assess and document how well the US and international partners are meeting their agreed-upon metrics. Only GMD has the multi-decade records and interpretive capability to take on the challenge that such agreements will present.

Finding #4

The scientific capacity of GMD is at risk due to a disproportionately senior workforce, including possible near-term retirements of some of its pre-eminent leadership, and little succession planning for major programs. Most junior and some mid-career scientists with leadership potential in GMD are employed through CIRES, with limited opportunity to advance.

Recommendation #4: Recruitment of new talent and conversion of suitable CIRES staff to NOAA positions are imperative for keeping projects strong.

Background and Evidence

GMD has gathered significant talent within the early and mid-career ranks but most of these individuals are CIRES (the University of Colorado's Cooperative Institute for Research in Environmental Sciences) employees. This limits their ability to advance to leadership positions within GMD. The future of GMD requires that many current CIRES employees be converted to civil servants and assume more active roles in setting direction of GMD activities. Avenues should be put in place now to facilitate development of future GMD leaders.

Finding #5

The GMD observatories are national treasures and strategically located to support their highest priority national and international measurement programs. However, their current number is barely sufficient and NOAA cannot respond to emerging environmental problems with new stations.

Recommendation #5: NOAA should ensure the continued support for the observatory system.

Evidence and Background.

All of the observatories maintained by GMD are in critical locations, and even doubling the number of related observatories would not lead to redundancy. The current set of observatories provides minimal coverage for most of the parameters being observed. There is a need for additional investment in the human resources at the observatories that supporting GMD's measurement program.

Maintaining the current set of GMD observatories is the absolute minimum investment that should be applied to the observatories and should be one of the highest priorities within GMD.

Summary of Findings and Recommendations

- 1.** The GMD mission is strategically aligned with NOAA's mission and stakeholder requirements. Supporting the activities of other science and regulatory agencies (state, national, and international) should be expanded rather than contracted to accomplish NOAA's mission.
- 2.** GMD's programmatic priorities are the "right ones" and are supported by a well-optimized mix of monitoring, science and technology. All of these components of GMD must be sustained.
- 3.** Leveraging national and international partnerships is an integral part of conducting GMD's work, but US leadership in the science and the assessment process is threatened by the current funding environment. Funding for all of GMD's activities must be increased.
- 4.** GMD's pre-eminence in monitoring and science are at risk with a very senior workforce and little succession planning. To remedy this, recruitment of new talent and conversion of suitable CIRES staff to NOAA positions is recommended.

5. The GMD record and scientific output depend heavily on the infrastructure of its observatories. NOAA must ensure continued support for the observatory system.