Air Resources Laboratory (ARL) Science Review
June 21-23, 2016
Charge to Reviewers

Purpose of the Review

Laboratory science reviews are conducted every five years to evaluate the quality, relevance, and performance of research conducted in the National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research (OAR) laboratories. This review is for both internal OAR/NOAA use for planning, programming, and budgeting, and external interests. It helps the laboratory in its strategic planning of its future science. These reviews are also intended to ensure that OAR laboratory research is linked to the NOAA Strategic Plan, is relevant to NOAA's research mission and priorities, is of high quality as judged by preeminence criteria, and is carried out with a high level of performance. Each reviewer will independently prepare his or her written evaluations of at least one research area. The chair, a federal employee, will create a report summarizing the individual evaluations. The chair will not analyze individual comments or seek a consensus of the reviewers.

Scope of the Review

This review will cover the research of ARL over the last five years. The research areas and related topics for the review are: 1) Atmospheric Dispersion and Boundary Layer Characterization; 2) Atmospheric Chemistry and Deposition; and 3) Climate Observations and Analyses.

Description of ARL Research Areas

Research Area #1: Atmospheric Dispersion and Boundary Layer Characterization

The accidental or intentional release of chemical, biological, or nuclear agents, as well as ash associated with volcanic eruptions, can have significant health, safety, national security, economic, and ecological implications. ARL provides critical modeling and observation data to understand how, where, and when chemicals and materials are transported through the atmosphere. Having this understanding is essential for emergency managers and the aviation industry to respond appropriately and minimize or prevent disaster. A primary tool developed by ARL is the Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling system. HYSPLIT is designed to support a wide range of simulations related to the atmospheric transport and dispersion of pollutants and hazardous materials, as well as the deposition of these materials to the Earth's surface. Some of the applications include tracking and forecasting the release of radioactive material, volcanic ash, wildfire smoke, and hazardous chemicals. ARL regularly improves, tests, and distributes HYSPLIT to hundreds of users around the world. Operationally, the model is used by NOAA's National Weather Service through the National Centers for Environmental Prediction and at local Weather Forecast Offices. It is also used by NOAA's National Environmental Satellite, Data, and Information Service Satellites and the National Ocean Service. In addition, ARL sponsors a web-based system providing rapid access to HYSPLIT dispersion simulations and supporting information.

ARL advances the understanding of atmospheric boundary layer processes that occur on a small-scale within complex environments. Through design, evaluation, and operation of high resolution observing networks and tracer field studies, ARL research improves the accuracy of atmospheric dispersion predictions and the characterization of the boundary layer in support of the dispersion community and for other research applications. The boundary layer has a significant influence on a number of important atmospheric and environmental issues, including the dispersion of airborne hazardous materials; low-level winds and turbulence; convective initiation; evolution of hurricanes; air quality; regional climate changes; the transfer of compounds between land/water and the atmosphere; and the behavior of wildland and agricultural fires and the smoke they produce. ARL conducts dispersion and boundary layer research in various locations around the country and also provides meteorological and consequence assessment support for the safe operation of major U.S. Department of Energy research facilities in Idaho and Nevada.

Research Area #2: Atmospheric Chemistry and Deposition

Pollutants released into the air can impact air quality, as well as terrestrial and aquatic ecosystems when the pollutants deposit to Earth. Effective targeting of air pollution controls depends on having good scientific understanding of which specific pollutant sources and regions are contributing to air and water quality issues. While much progress has been made in reducing releases of harmful air pollutants, many locations in the U.S. continue to experience problems associated with air pollutants and poor air quality. On an annual basis, air pollution contributes to tens of thousands of premature deaths from cardiovascular and respiratory diseases. Chemicals in the atmosphere also damage crops and forests, degrade aquatic ecosystems, and contribute to climate change. ARL evaluates and improves computer models used by the National Weather Service in support of state and local forecasters who predict the occurrence of ground-level ozone and fine particulate matter. These forecasts improve the ability of communities and individuals to respond to anticipated episodes of poor air quality by reducing pollutant emissions (e.g., limiting driving) and by taking personal protective measures (e.g., limiting outdoor exercise).

ARL also conducts a variety of research on the exchange of pollutants between the air and the Earth's surface, which improves understanding and guides policy concerning air quality management and ecosystem health. ARL focuses on pollutants, such as mercury, reactive nitrogen, and sulfur compounds, which can have significant impacts on the environment and—in the case of mercury—human health. ARL activities include a) developing and applying a specialized HYSPLIT modeling system that tracks mercury emissions and links these emissions to atmospheric transport, transformation, and deposition; b) conducting long-term, intensive ambient air monitoring of mercury, c) conducting short-term, process-level field studies for mercury and reactive nitrogen compounds; and d) supporting long-term, research-grade monitoring of acids and nutrients in precipitation.

Research Area #3: Climate Observations and Analyses

Changes in the climate can influence economic prosperity, human and environmental health, and national security. Citizens, communities, businesses, governments, and international organizations are requiring climate information and products to cope with climate variability and to adapt to and mitigate climate change. ARL's Climate Observations and Analyses research provides essential information for decision-makers to understand how and why climate has changed and what changes might occur in the future. ARL's activities focus on advancing the quality and quantity of reference observations; evaluating selected observing systems for their ability to satisfy ongoing and evolving climate requirements; improving the understanding of air-surface interactions; and analyzing long-term observational datasets and models to understand climate variability and change.

ARL provides high quality, reference-grade measurements of critical climate parameters, such as air temperature, precipitation, winds, land surface temperature, and solar radiation. As a key participant in climate observing networks, both nationally and internationally, ARL develops methods for measuring climate parameters with high accuracy and reliability. ARL designs, evaluates, and maintains the instrument suites and the infrastructure for the U.S. Climate Reference Network, which provides the Nation with a climate-quality benchmark observing system that meets national commitments to monitor the climate of the United States for the next 50-100 years. ARL also conducts long-term field studies to improve the understanding of interactions between the atmosphere, the land surface, and plants, which leads to better climate and weather predictions. Additionally, ARL conducts energy, water, and greenhouse gas flux measurements and analyzes their relationships. A predictive understanding of the surface energy budget and related feedbacks is critical to the understanding of climate forcing factors at the land surface and the ability to credibly predict future conditions, especially those related to water resources.

Evaluation Guidelines

For each research area, each reviewer will provide one of the following overall ratings:

- *Highest Performance*--Laboratory greatly exceeds the Satisfactory level and is outstanding in almost all areas.
- *Exceeds Expectations*--Laboratory goes well beyond the Satisfactory level and is outstanding in many areas.
- *Satisfactory*--Laboratory meets expectations and the criteria for a Satisfactory rating.
- *Needs Improvement*--Laboratory does not reach expectations and does not meet the criteria for a Satisfactory rating. The reviewer will identify specific problem areas that need to be addressed.

Reviewers are to consider the quality, relevance, and performance of the laboratory.

1. **Quality:** Evaluate the quality of the laboratory's research and development. Assess whether appropriate approaches are in place to ensure that high quality work will be performed in the future. Assess progress toward meeting OAR's goal to conduct preeminent research as listed in the "Indicators of Quality, Relevance and Performance."

- **Quality Rating Criteria:**
  - *Satisfactory* rating --Laboratory scientists and leadership are often recognized for excellence through collaborations, research accomplishments, and national and international leadership positions. While good work is done, laboratory scientists are not usually recognized for leadership in their fields.
- **Evaluation Questions to consider:**
  - Does the Laboratory conduct preeminent research? Are the scientific products and/or technological advancements meritorious and significant contributions to the scientific community?
  - How does the quality of the laboratory's research and development rank among Research and Development (R&D) programs in other U.S. federal agencies? Other science agencies/institutions?
  - Are appropriate approaches in place to ensure that high quality work will be done in the future?
  - Do Laboratory researchers demonstrate scientific leadership and excellence in their respective fields (e.g., through collaborations, research accomplishments, externally funded grants, awards, membership and fellowship in societies)?
- **Indicators of Quality:** Indicators can include, but not be limited to the following (note: not all may be relevant to each laboratory)
  - A Laboratory's total number of refereed publications per unit time and/or per scientific Full Time Equivalent scientific staff (FTE).
  - A list of technologies (e.g. observing systems, information technology, numerical modeling algorithms) transferred to operations/application and an assessment of their significance/impact on operations.
  - The number of citations for a laboratory's scientific staff by individual or some aggregate.
  - A list of awards won by groups and individuals for research, development, and/or application.
  - Elected positions on boards or executive level offices in prestigious organizations (e.g., the National Academy of Sciences, National Academy of Engineering, or fellowship in the American Meteorological Society, American Geophysical Union, or the American Association for the Advancement of Science etc.).
  - Service of individuals in technical and scientific societies such as journal editorships, service on U.S. interagency groups, service of individuals on boards and committees of international research-coordination organizations.
  - A measure (often in the form of an index) that represents the value of either individual scientist or the laboratory's integrated contribution of refereed publications to the advancement of knowledge (e.g., Hirsch Index).
  - Evidence of collaboration with other national and international research groups, both inside and outside of NOAA including Cooperative Institutes and universities, as well as reimbursable support from non-NOAA sponsors.
  - Significance and impact of involvement with patents, invention disclosures, Cooperative Research and Development Agreements, and other activities with industry.

- Other forms of recognition from NOAA information customers such as decision-makers in government, private industry, the media, education communities, and the public.
- Contributions of data to national and international research, databases, and programs, and involvement in international quality-control activities to ensure accuracy, precision, inter-comparability, and accessibility of global data sets.

2. **Relevance**: Evaluate the degree to which the research and development is relevant to NOAA's mission and of value to the Nation.

   - **Relevance Rating Criteria:**
     - *Satisfactory* rating --The R&D enterprise of the laboratory shows linkages to NOAA's mission, Strategic Plan, and Research Plan, and is of value to the Nation. There are some efforts to work with customer needs but these are not consistent throughout the research area.
   - **Evaluation Questions to consider:**
     - Does the research address existing (or future) societally relevant needs (national and international)?
     - How well does it address issues identified in the NOAA strategic plan and research plans or other policy or guiding documents?
     - Are customers engaged to ensure relevance of the research? How does the laboratory foster an environmentally literate society and the future environmental workforce? What is the quality of outreach and education programming and products?
     - Are there R&D topics relevant to national needs that the laboratory should be pursuing but is not? Are there R&D topics in NOAA and OAR plans that the laboratory should be pursuing but is not?
   - **Indicators of Relevance:** Indicators can include, but not be limited to the following (note: not all may be relevant to each laboratory)
     - Results of written customer survey and interviews.
     - A list of research products, information and services, models and model simulations, and an assessment of their impact by end users, including participation or leadership in national and international state-of-science assessments.

3. **Performance**: Evaluate the overall effectiveness with which the laboratory plans and conducts its research and development, given the resources provided, to meet NOAA Strategic Plan objectives and the needs of the Nation. The evaluation will be conducted within the context of three sub-categories: **a) Research Leadership and Planning, b) Efficiency and Effectiveness, and c) Transition of Research to Applications (when applicable and/or appropriate)**.

   - **Performance Rating Criteria:**
     - *Satisfactory* rating --
       - The laboratory generally has documented scientific objectives and strategies through strategic and implementation plans (e.g., Annual Operating Plan) and a process for evaluating and prioritizing activities.

- The laboratory management generally functions as a team and works to improve the operation of the laboratory.
- The laboratory usually demonstrates effectiveness in completing its established objectives, milestones, and products.
- The laboratory often works to increase efficiency (e.g., through leveraging partnerships).
- The laboratory is generally effective and efficient in delivering most of its products/outputs to applications, operations or users.

A. Research Leadership and Planning: Assess whether the laboratory has clearly defined objectives, scope, and methodologies for its key projects.

➢ **Evaluation Questions to consider:**

- Does the laboratory have clearly defined and documented scientific objectives, rationale, and methodologies for key projects?
- Does the laboratory have an evaluation process for projects: selecting/continuing those projects with consistently high marks for merit, application, and priority fit; ending projects; or transitioning projects?
- Does the laboratory have the leadership and flexibility (i.e., time and resources) to respond to unanticipated events or opportunities that require new research and development activities?
- Does the laboratory provide effective scientific leadership to, and interaction with, NOAA and the external community on issues within its purview?
- Does laboratory management function as a team and strive to improve operations? Are there institutional, managerial, resource, or other barriers to the team working effectively?
- Has the laboratory effectively responded to and/or implemented recommendations from previous science reviews?

➢ **Indicators of Leadership and Planning**

Indicators can include, but not be limited to, the following (Note: Not all may be relevant to each laboratory).

- Laboratory Strategic Plan.
- Program/Project Implementation Plans.
- Active involvement in NOAA planning and budgeting process.
- Final report of implementation of recommendations from previous laboratory review.

B. Efficiency and Effectiveness: Assess the efficiency and effectiveness of the laboratory's research and development, given the laboratory's goals, resources, and constraints and how effective the laboratory is in obtaining needed resources through NOAA and other sources.

➢ **Evaluation Questions to consider:**

- Does the laboratory execute its research in an efficient and effective manner given the laboratory goals, resources, and constraints?
- Is the laboratory organized and managed to optimize the conduct and planning of research, including the support of creativity? How well integrated is the work

with NOAA's and OAR's planning and execution activities? Are there adequate inputs to NOAA's and OAR's planning and budgeting processes?
- Is the proportion of the external funding appropriate relative to its NOAA base funding?
- Is the laboratory leveraging relationships with internal and external collaborators and stakeholders to maximize research outputs?
- Are human resources adequate to meet current and future needs? Is the laboratory organized and managed to ensure diversity in its workforce? Does the laboratory provide professional development opportunities for staff?
- Are appropriate resources and support services available? Are investments being made in the right places?
- Is infrastructure sufficient to support high quality research and development?
- Are projects on track and meeting appropriate milestones and targets? What processes does management employ to monitor the execution of projects?

➢ **Indicators of Efficiency and Effectiveness:** Indicators can include, but not be limited to, the following (Note: Not all may be relevant to each laboratory).
- List of active collaborations
- Funding breakout by source
- Lab demographics

C. Transition of Research to Applications: How well has the laboratory delivered products and communicated the results of their research? Evaluate the laboratory's effectiveness in transitioning and/or disseminating its research and development into applications (operations and/or information services).

➢ **Evaluation Questions to consider:**
- How well is the transition of research to applications and/or dissemination of knowledge planned and executed?
- Are end users of the research and development involved in the planning and delivery of applications and/or information services? Are they satisfied?
- Are the research results communicated to stakeholders and the public?

➢ **Indicators of Transition:** Indicators can include, but not be limited to, the following (Note: Not all may be relevant to each laboratory).
- A list of technologies (e.g. observing systems, information technology, numerical modeling algorithms) transferred to operations/application and an assessment of their significance/impact on operations/applications.
- Significance and impact of involvement with patents, Cooperative Research and Development Agreements (CRADAs) and other activities with industry, other sectors, etc.
- Discussions or documentation from laboratory stakeholders.

Proposed Schedule and Time Commitment for Reviewers:
The on-site review will be conducted June 21-23, 2016, in College Park, Maryland. Two teleconferences before the review are planned with the Deputy Assistant Administrator for OAR,

who will be the liaison with the review team and for the completion of the report. The goal of the first teleconference, in May 2016, will be to discuss the charge to you, the reviewer, as well as the scope of the review, focus areas for the review questions to be addressed, and initial information provided to reviewers that addresses the questions. In the second phone call, to be scheduled for June 2016, the Deputy Assistant Administrator will discuss the draft review agenda and the reporting form for reviewers to use for their evaluations. During this call, we ask that you as a reviewer identify any additional information needs. All relevant information requested by the review team will be provided on the review website at least two weeks before the review and prior to the second pre-review teleconference with the review team.

Each reviewer is asked to independently prepare their written evaluations on each research theme, including an overall rating for the theme and provide these to the Chair with a copy to Philip Hoffman in OAR headquarters. The Chair, a federal employee, will create a report summarizing the individual evaluations. The Chair will not analyze individual comments or seek a consensus of the reviewers. We request that within 45 days of the review, the review team provide the draft summary report to the Deputy Assistant Administrator, OAR. Once the report is received, OAR staff will review the report to identify any factual errors and will send corrections to the review team. The final individual evaluations and the summary report are to be submitted to the Assistant Administrator, OAR.

Review Team Resources:

OAR will provide resources necessary for the review team to complete its work.

1. Review Team Support: Information to address each of the laboratory's research themes to be reviewed will be prepared and posted on a public review website. Preliminary information will be compiled and posted before the first teleconference meeting and the second major update, which includes final review presentations and materials, will be provided prior to the second teleconference. A copy of all the information on the website will also be provided to reviewers at the review.

2. Travel arrangements for the onsite review will be made and paid for by OAR.