Responses for OAR Management to the ESRL Atmospheric Chemistry Reviewers' Comments

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We greatly appreciate the thoughtful comments provided by the Review Panel, and the time reviewers spent in carrying out this Review of Atmospheric Chemistry Research at the NOAA Earth System Research Laboratory.

This document responds to issues raised by the reviewers or provides additional information where warranted by the reviewers comments. This Response responds to the summary written report as prepared by the Review Team lead, dated November 11, 2008. The first section below responds to general comments offered in the report, and the second section responds to specific points made by the reviewers within the six topic areas of the Review. Excerpts from the November 11, 2008 Review Report are shown in italics.

As a supplement to the Response, the attached spreadsheet addresses and cross references numerous additional comments provided by Office of Oceanic and Atmospheric Research Headquarters in a second Review Report file dated February 2, 2009. In this, case the text of the comments and the associated comment numbers are found in the first two columns of the spreadsheet.

We have not listed all of the reviewers' many positive comments in the general section and in the topic areas, but we wish to thank the reviewers for those comments.

Presentations made and other details of the ESRL Atmospheric Chemistry Review are posted at: http://www.esrl.noaa.gov/research/review/2008/

General Comments

We appreciate the very positive comments offered by the reviewers concerning the quality, relevance, and performance of Atmospheric Chemistry research at ESRL.

One general comment: We (ESRL Atmospheric Chemistry) were the first to be reviewed in this sequence. We believed, based on the terms agreed to prior to the Review, that the Review would be solely concerned with science quality and the extent of our scientific accomplishments in the context of the objectives of the agency and the laboratory.

Therefore, our Review presentations and materials were not designed to address some of the issues of collaborations, management, etc., that were subsequently raised by the reviewers in their Review Report. For example, we did not present to our reviewers the connections between the planning and execution. We have used this Response as an opportunity to provide information on these kinds of topics, as requested by the reviewers.

The reviewers identified the two general concerns below. Responses follow.

Concern #1: *"... the demographics of the scientific staff is skewed perhaps too much toward senior personnel, and this raises the question of whether of not ESRL will be able to maintain the exceptional scientific and leadership quality and reputation for excellence in the longer term... This group has a number of extraordinarily talented scientists that are recognized around the world for their scientific productivity and creativity. However, this is reflected in mostly the more senior staff of the laboratory with a number of these individuals now at a mature stage of their career with many now (or soon will be) eligible to retire. A common observation in the discussions and individual reviews comments was a concern that there may be an inadequate infusion of highly talented younger scientists to ensure the maintenance of the scientific stature of the ESRL chemical sciences research in future years. It is recognized that new or open positions have been tight and management is limited in what can be done to obtain this new talent. This problem is addressed somewhat through the use of non-government positions in CIRES, however, the very brightest and most desirable young scientists are opting for positions in academia or other government labs when it appears there may not be a position in ESRL in the near future... A somewhat related point, as mentioned above, concerns the availability of technical support (i.e., technicians, engineers, IT, etc.) for the different scientific groups. In several cases it appeared that the scientific leaders had to spend more time than desirable on activities that could be handled by technical support staff. This means that there is less time for the scientists to spend on the more scientifically challenging issues being addressed by the ESRL atmospheric chemistry scientists."*

Response (ACR-R1): This issue was raised in the reviewers' general comments and again several times in the specific comments within the topic areas. Because this is a systemic issue related to institutional budget and resources, we will address this comment here in a single overarching response.

This point is well taken and is an area of great concern for ESRL, OAR, and NOAA management. The problem has been exacerbated by several years of tight federal budgets, which has made it very difficult to create new federal positions that provide employment opportunities for young scientists. Even so, ESRL is working hard to provide opportunities for young scientists through summer internships, postdoctoral appointments, and hires in the CIRES and CIRA NOAA Cooperative Institutes. Additionally, ESRL will strive to increase its budget for the specific purpose of hiring strong early-to-mid career scientists in existing and new science areas to preserve acquired corporate knowledge and provide the foundation in meeting NOAA's scientific workforce requirements in the future.

Actions (ACR-A1): ESRL will work with OAR and NOAA to recruit scientists at entry levels and appropriate early-career stage levels. ESRL's PHASE program (Practical Hands-On Application to Science Education) has been created to serve as an interface for several programs that foster the hiring of students (high school, college, and graduate) and postdoctoral researchers for short periods. These programs have resulted in successful recruitment and retention of young scientists in the past. ESRL has designated a staff member to lead the organization and implementation of PHASE, and materials have been distributed ESRL-wide to facilitate participation. Annual reports will be provided to lab management describing previous fiscal year PHASE activities and accomplishments. **Timeframe:** Complete. PHASE has developed monthly reports since September 2008 and has provided annual briefings to ESRL Management on progress. The total number of new students and postdoctoral researchers working with ESRL has increased since the inception of this program, and continues to grow.
PHASE program reports can be found at:
http://www.esrl.noaa.gov/outreach/student_programs/.

Concern #2: *"A second concern that was common to the activities being reviewed was the nature of the relationship of the ESRL atmospheric chemistry research to other NOAA groups both internal and external to OAR. It was clear in some cases that very effective partnerships are at play with international and other agency organizations but reviewers felt that it was not clear how effectively ESRL interacted with other NOAA groups doing related and complimentary work. This may simply be the result of an oversight in preparing the materials for distribution and the presentations, but the near total lack of attention to this subject was of significant concern to the reviewers. This is an issue that should be explicitly addressed by both ESRL and the review panel in future evaluations.*
Response (ACR-R2): This issue was raised in the reviewers' general comments and again several times in the specific comments within the topic areas. We will address this comment here in an overarching response, and address the issue again in the specific topic areas where the subject was raised.
ESRL scientists recognize the importance of research collaborations and have worked to build strategic partnerships within ESRL, OAR, NOAA, the U.S. and international research communities. However, as the reviewers correctly point out, many of these collaborative ventures were not emphasized. This was due in part to the limited time available for scientific presentations during the Review. It was also partly because much of our attention in the three years prior to the Review was focused on establishing the new organization of ESRL, created in 2005, and strengthening its internal collaborations. More information on specific collaborations is included below for each topic area. While it is hoped the reviewers will agree that this list represents a significant effort, there is room for improvement. We at ESRL are committed to redoubling our efforts to link to other programs within NOAA and outside as appropriate.
Actions (ACR-A2): As the science demands, we will emphasize more collaboration at both planning and execution stages, including labs of NOAA and other agencies involved in both observations (e.g., PMEL, AOML) and modeling (e.g., GFDL). ESRL participation in large interagency field efforts will be continued and strengthened.

Timeframe: This coordinated planning continues on an ongoing basis though the NOAA planning process, which requires common planning of activities across NOAA organizations on common themes. In this way, the vast majority of atmospheric chemistry work is discussed and prioritized in a single forum with common, agreed-to paths forward and common funding directives.

Specific Comments on the Topic Areas

Stratospheric Ozone

Comment: *The tie to the rest of NOAA was not well described in the briefings.*
Response (ACR-R3): Time constraints did not permit us to discuss this extensively during the Review presentations, and we are pleased to have a chance to elaborate here. ESRL's work on stratospheric ozone is often collaborative with OAR's Geophysical Fluid Dynamics Laboratory (GFDL), which has long been a leader in efforts to model the chemistry and dynamics related to the stratosphere and, particularly, ozone depletion. We also work with colleagues in OAR's Air Resources Laboratory (ARL), whose expertise lies in the analysis of observations and trends related to the ozone layer and surface ultraviolet radiation. Our collaborations with other Line Offices of NOAA include the National Environmental, Satellite, Data, and Information Services (NESDIS), which provides satellite data that are used in our analyses of stratospheric processes. NOAA's Atmospheric Composition and Climate Program (ACCP) in the Climate Program Office, co-led by Ed Dunlea (CPO) and Ravishankara of ESRL/CSD, encompasses work with GFDL (modeling of stratospheric ozone and climate) and NESDIS (developing data products from NOAA's satellite observations of ozone and UV [Solar Backscatter Ultraviolet (SBUV/2) and the Ozone Mapping and Profiler Suite (OMPS) instruments]). ESRL's work in providing science and leadership for the international ozone-layer assessments for the Montreal Protocol is done in partnership with NOAA colleagues in GFDL, ARL, NESDIS, and NWS.
Actions (ACR-A3): ESRL will maintain its collaborative efforts with other NOAA labs and programs. **Timeframe:** ESRL continues to pursue collaboration with NOAA labs and programs. This collaboration is enhanced through: common budget planning within the NOAA planning system; continued cross organizational discussions between Lab and Division Directors; and continued identification of opportunities highlighted in the Lab Review process.

Comment: *One reviewer expressed concern that the ozone-depleting substance (ODS)/substitutes environmental acceptability research did not seem to be an obvious responsibility for the federal government (as opposed to, say, the industry that is looking to sell these compounds).*
Response (ACR-R4): NOAA research serves a scientific assessment and evaluation function, which is highly valuable to the nation and the public. While work by industry is very important, complementary examination by government is helpful for the chemical industry, and of course the public. This NOAA role has been highlighted by other agencies, such as the EPA and the State Department. The Congressional authority that

provides for the Federal government and NOAA as a consultant to the Enivonmental Protection Agency is found in the Clean Air Act, Title 42, Chapter 85, Subchapter VI, § 7671k, which states in part "The Administrator [EPA Administrator] shall— (1) in consultation and coordination with interested members of the public and the heads of relevant Federal agencies and departments, recommend Federal research programs and other activities to assist in identifying alternatives to the use of class I and class II substances as refrigerants, solvents, fire retardants, foam blowing agents, and other commercial applications and in achieving a transition to such alternatives, and, where appropriate, seek to maximize the use of Federal research facilities and resources to assist users of class I and class II substances in identifying and developing alternatives to the use of such substances as refrigerants, solvents, fire retardants, foam blowing agents, and other commercial applications;..."
Actions (ACR-A4): No additional actions are required as a result of this comment.

Comment: *The collaboration with NASA has been very effective, but the group should look to build additional connections.*
Response (ACR-R5): We agree that ESRL's collaborations with NASA have been very effective. We continue to value this mutually beneficial partnership and we will pursue opportunities for expanding it. One key area of collaboration is the role of both NASA and NOAA in the leadership of the Scientific Assessment Panel for the Montreal Protocol. In September 2008, A.R. Ravishankara (ESRL/CSD) was asked by the Parties to assume the role of Co-chair that was long held by Dan Albritton (ESRL/CSD, retired). At that time, NASA scientist Paul Newman was also asked to serve as a Co-chair of the panel.
Actions (ACR-A5): The close NOAA/NASA collaboration will be key in the coming stratospheric ozone assessments (and the planning for the 2010 assessment is already underway). Joint work with NASA is now emerging that makes use of unmanned aircraft systems (UASs). The GloPac (Global Hawk Pacific) mission, for example, is slated for late winter/early spring of 2010. The mission will provide observations of stratospheric trace gases in the upper troposphere and lower stratosphere from the mid-latitudes into the tropics, and of polar stratospheric air and the break-up fragments of the air that move into the mid-latitudes. An ESRL scientist (David Fahey) is co-project scientist for GloPac. **Timeframe: FY10 Q3 GloPac Mission Complete**

Carbon Dioxide, Methane, and Climate

Comment: *The reason for use of European Centre for Medium-Range Weather Forecasts (ECMWF) winds in Carbon Tracker (as opposed to winds from a NOAA-produced product) was not well explained.*
Response (ACR-R6): The use of ECMWF winds was mostly for reasons of expedience. The TM5 transport model had been developed in Europe, and Wouter Peters brought the model with him when he joined ESRL. We have access to continuously updated ECMWF transport fields.
Actions (ACR-A6): We plan to incorporate GFS fields, and develop CarbonTracker to run a multi-model ensemble, but can only move slowly in that direction without some

additional resources or support from other parts of NOAA. In fact we have begun some effort to do that already, by enlisting some of the capabilities of other ESRL Divisions (i.e., PSD and GSD). There is a real possibility, given the conservative nature of CO_2 in the atmosphere, that we may learn something about the simulation of transport in that case. **Timeframe:** Very limited resources have been made available for the CarbonTracker project since the Atmospheric Chemistry Review. As such the development to incorporate GFS fields into the CarbonTracker has not occurred. There have been limited efforts to run experimental multi-model ensembles of the CarbonTracker, but these are being performed only as resources are made available, so no new target date for completion can be provided. Funding requests for enhancement of the CarbonTracker model continue to be submitted through the NOAA planning process, but have not yet obtained sufficient priority to be resourced.

Comment: *The connection to other activities, including those within NOAA and outside, was not as well described as one might have expected.*
Response (ACR-R7): ESRL plays a leading role in the WMO Global Atmosphere Watch Programme. These efforts include serving as the World Calibration Centre for carbon dioxide, methane, and nitrous oxide; providing leadership of (Ed Dlugokencky, ESRL/GMD) and additional membership on the Scientific Advisory Group for Greenhouse Gases; and maintaining leading roles in the biennial WMO/IAEA Meetings of Experts on Carbon Dioxide Concentration and Related Tracer Measurement Techniques. ESRL scientists also serve on the GCOS (international) Atmospheric Observation Panel for Climate with NOAA scientists from NESDIS and OAR/PMEL and on WMO Committee for Atmospheric Sciences with NOAA staff from NWS/NCEP. In addition to providing reference standards, ESRL scientists maintain active, ongoing comparisons of measurements with 13 international labs and we use the GFDL ocean models and pCO_2 measurements from AOML and PMEL to help constrain air-sea fluxes in CarbonTracker. CarbonTracker itself is a collaborative effort among scientists from several agencies and countries. Finally, ESRL scientists are active in the CCSP Carbon Cycle Science Program, particularly North American Carbon Program (NACP), which is an interagency effort to improve surface flux estimates through synthesis and reanalysis.
Actions (ACR-A7): Since the Review, ESRL has begun taking the lead in developing carbon cycle science as a comprehensive activity within NOAA. ESRL scientists are now working with those from PMEL, AOML, GFDL, ARL, CPO, NESDIS, and NWS to develop a NOAA-wide carbon cycle research plan. The plan will address atmospheric and oceanic measurements made by NOAA, needed model and analysis improvements, and verification of satellite measurements and their potential incorporation into models like CarbonTracker. The plan will involve contributions from and partnerships with other agencies, something that will lean heavily on our NACP partners. **Timeframe:** A NOAA-wide carbon cycle plan has been under serious development starting in September 2009. As mentioned above, we have been engaging a broad array of NOAA labs (primarily in OAR) in crafting a plan. The Plan is currently now about 60% done and it is expected the plan to be complete before the end of FY10.

Comment: *Some details of the measurement approach (e.g., rationale for measurement locations, any use of Observing System Simulation Experiments (OSSEs) to optimize measurement distribution) were not well spelled out.*
Response (ACR-R8): We have recently performed several OSSEs to quantify the influence of certain existing sites as well as potential sites. Tower footprints calculated through several approaches suggest a need for a greater number of tall towers, but also for improved meteorology and reanalysis to incorporate these data effectively. Since the ESRL Atmospheric Chemistry Review, we subsequently subjected CarbonTracker, and the observation system supporting it, to an independent review that included panel members and formal observers from several agencies and universities, but also from within other components of NOAA (http://www.esrl.noaa.gov/gmd/ccgg/carbontracker/review.html). The upshot of that review was that CarbonTracker needed substantially more observations to support its gridded output, ensemble reanalysis and transport, and much more computing capacity.
Actions (ACR-A8): Through internal and external (e.g., NACP) activities, ESRL will continue to evaluate tall tower and aircraft footprints in different terrains. We are working toward making the recommended improvements from the CarbonTracker review. In part, this is why ESRL is taking the lead in developing a NOAA-wide carbon cycle research plan. As such improvements are made, we expect to see OSSE's yield better information for locating additional observation sites. **Timeframe:** ESRL has continued to evaluate tall tower and aircraft footprints and is working toward objectives identified in the CarbonTracker review. As described in the response to Action ACR-A6, resources for improvements are limited. ESRL's John Miller continues to lead the development of the NOAA-wide carbon cycle research plan. Progress on that plan is described in response to Action ACR-A7.

Non-CO_2 Climate Gases

Comment: *Group's ability to work on multiple platforms (aircraft, unmanned aerial vehicles, balloon) is a strength, although care should be taken not to overly rely on Altair and to be able to articulate strategy for use of platforms (NOAA and other).*
Response (ACR-R9): We are aware of relying too much on one platform in our aircraft program and look to see that systems we develop can be applied on a range of platforms. For example, the Unmanned Aircraft Systems (UAS) Chromatograph for Atmospheric Trace Species (UCATS), originally designed for Altair, an unmanned aircraft system (UAS), has successfully operated on NSF's HIAPER aircraft (Gulfstream V).
Actions (ACR-A9): In winter/spring of 2009/10, ESRL instrumentation will operate on the NASA Global Hawk UAS during the GloPac mission (Dr. Fahey is co-project scientist). ESRL instruments in the payload include UCATS and a new ozone instrument developed at ESRL specifically for UAS deployments. **Timeframe: FY10 Q3 GloPac mission complete.**

Comment: *The tie to the rest of NOAA was not well described.*
Response (ACR-R10): The connection to other parts of NOAA was briefly discussed in the introduction and summary of this topic area's presentations. Time did not permit us to elaborate during the Review, but we appreciate the opportunity to provide more

information here. The "Non-CO_2 Climate Gases" is a major theme of NOAA/ESRL and is tied to the rest of NOAA through NOAA's Climate Program Office under its Atmospheric Composition and other Climate Programs. OAR colleagues in the UAS work include ESRL/PSD, ESRL/GSD, PMEL, AOML. Other Line Offices of NOAA, namely the NWS, National Ocean Service, NESDIS, and National Marine Fisheries Service, are involved as well. We have extensive ties to every NOAA organization in Alaska, in our work to provide them with climate data from Pt. Barrow, Alaska, and Summit, Greenland.

Actions (ACR-A10): We are committed to explore the use of UAS platforms, which are a major component of NOAA's Science and Technology and Infusion Program (ST&I), a program designed to bring research into NOAA's operations. **Timeframe:** We have initiated projects to experimentally include new atmospheric sensing instruments on several UAS, through NOAA's UAS program. For example, GSD and CSD instruments are currently being used and tested onboard the high-altitude Global Hawk and several low-altitude platforms. Placement of sensors on UAS platforms is being coordinated during development of flight schedule planning.

Comment: *Concern was expressed about limited current staffing and the need to avoid any reductions that might be contemplated.*

Response (ACR-R11): As noted in the response to general comments, this is a problem that is not limited to the research topic of non-CO_2 gases. ESRL maintains a strong commitment to the study of non-CO_2 gases, because they play significant roles in almost every area of study in which we are involved. We recognize the critical nature of ESRL measurements to the overall scientific understanding of these species' roles in climate change, ozone depletion, and air quality, and consider maintaining these capabilities a high priority.

Actions (ACR-A11): Support for long-term monitoring of the non-CO_2 greenhouse and ozone-depleting gases has been recently augmented with two new hires and a recent reassignment of duties for another. Nevertheless, we continue active participation in potential recruitment through the Practical Hands-on Application to Science Education (PHASE) program and other educational and training opportunities, as well as through our national and international partnerships. Annual reports will be provided to lab management describing previous fiscal year PHASE activities and accomplishments. **Timeframe:** Complete. Details of the PHASE program status can be found in the answer to action ACR-A1.

Regional Air Quality

Comment: *Has apparently made important contributions to the assessment of emission inventories which suggest that there are still inadequacies that must be addressed to establish realistic regulatory policy, although there was no indications given as how this might relate to broader emissions inventories such as the International Global Atmospheric Chemistry (IGAC) Global Emissions Inventories Activity (GEIA) or EPA national emission inventory programs.*

Response (ACR-R12): NOAA's efforts to evaluate U.S. air quality emission inventories are coordinated with the broader national effort. NOAA scientists meet periodically with

representatives from industry, the states, and EPA to discuss the results of our assessments and to seek ways to improve the inventories. NOAA scientists have presented their work at specialty conferences focused on inventory development and evaluation. In addition, a NOAA scientist was a lead author in the recently completed NARSTO scientific assessment entitled "Improving Emission Inventories for Effective Air Quality Management Across North America." This document featured much of NOAA's recent work on "top-down" emission inventory evaluation.
Actions (ACR-A12): A growing focus of NOAA's work is on improving U.S. emission inventories. Two ESRL scientists, Claire Granier and Jean-Francois LaMarque, are leading the development of global emission inventories. Dr. Granier is the International Geosphere-Biosphere Program (IGBP) Global Emissions Inventory Activity (GEIA) Co-chair, and Dr. LaMarque is a member of the Steering Committee of IGBP-GEIA.
Timeframe: Drs. Granier and LaMarque, affiliated with ESRL, continue to make significant contributions to the development of the global emissions inventory in their respective roles in the GEIA.

Comment: *In some cases there appears to be a lack of connection with other relevant groups, e.g. NOAA Air Resources Laboratory and National Weather Service, EPA, and in the case of ozone lidar development NASA laboratories.*
Response (ACR-R13): There was not sufficient time to discuss all of NOAA/ESRL collaborations related to air quality. An ESRL scientist is the Air Quality Matrix Program Manager for all of NOAA, responsible for integration of research and operational (e.g., daily air quality forecasts) activities across NOAA. ESRL scientists are working closely with scientists from ARL and NWS in the development of improved air quality forecast models.
ESRL has very close interactions with NASA counterparts on technology and measurement issues, and ESRL scientists have been external reviewers of the NASA program on more than one recent occasion. ESRL also works closely with NASA's Langley and Goddard laboratories in the conduct of our lidar research. The ESRL ozone lidar includes a new laser design originally demonstrated and funded through a NASA Langley SBIR. In developing the specifications for our instrument, we had close interaction with Ed Browell and others at NASA Langley involved in the original SBIR. We routinely share research and technology results.
Actions (ACR-A13): While recognizing these ongoing activities, we agree that there is room to improve collaboration across NOAA and with our colleagues at NASA and we will strive to do that in the future. **Timeframe:** Ongoing.

Chemical Transformation and Long Range Transport

Comment: *There may be a need for improved coordination of atmospheric chemistry transport modeling activities with other NOAA units e.g. NWS, GFDL.*
Response (ACR-R14): To develop a fuller understanding of intercontinental transport of air pollution in the Northern Hemisphere, the Executive Body of the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP Convention) established the Task Force on Hemispheric Transport of Air Pollution (TF HTAP). ESRL and GFDL are key

partners in the work of this task force. For example, two ESRL scientists and one GFDL scientist were coordinating authors of chapters of the 2007 Interim Report on the Hemispheric Transport of Air Pollution (http://www.unece.org/env/eb/Air.Pollution%20Studies.No.16.Hemispheric%20Transport.pdf). In addition, scientists from ESRL and GFDL have jointly participated in field campaigns in 2002 and 2004 that focused on quantifying intercontinental transport into and out of the United States.

Actions (ACR-A14): The coordinated work of ESRL and GFDL on the Task Force of HTAP provides a key linkage for continuing work. The NWS is involved in CalNex, the 2010 field mission to study air quality in California, especially in the modeling and forecasting aspects of the research. **Timeframe:** FY10 Q4.

Aerosols and Climate

Comment: *Work appears to be a diffuse (but important) set of "aerosol" focused activities and while all are of high quality they seem to lack coherence and are pursued pretty much independent of each other.*

Response (ACR-R15): We agree that there is benefit to coordinating the aerosol research programs. Without the mandate or resources to conduct *comprehensive* studies of aerosol climate interactions, we at ESRL focus our efforts on two niches: long-term monitoring (GMD), and intensive process studies (CSD). Some examples of integration between these foci that were not highlighted in the Review are:

- CSD and GMD researchers are co-authors of the study relating aerosol hygroscopic growth to the organic mass fraction (along with PMEL);
- CSD and GMD researchers, also along with PMEL, met regularly for more than six months to brainstorm approaches to addressing aerosol-climate interactions, inviting colleagues from PSD and NCAR to join in as time permitted;
- CSD and GMD researchers collaborated on analysis and publication of remote-sensing and in-situ measurements of aerosols and clouds at Point Reyes, CA.

Actions (ACR-A15): Joint research activities like these will continue as a natural result of the different strengths and foci of the aerosol groups within ESRL, for example:

- calibration of filter-based instruments for measuring aerosol light absorption coefficient at the long-term sites, using advanced instrumentation developed for intensive field campaigns;
- evaluation of results from WRF-Chem (CSD and PSD) using long-term data from the GMD surface sites.

In addition, coordination is growing between observations groups within ESRL and NOAA, and between modeling groups (GFDL + CSD, GFDL + GMD). **Timeframe:** Ongoing.

Comment: *It may be productive to have additional connection and coordination of the surface aerosol observational programs of ESRL and the climate relevant space based observational programs.*

Response/Actions (ACR-R16) (ACR-A16): We agree that coordination with space-based observation programs is important and hope to pursue that more in the future. One objective of the ESRL aerosol vertical profiling project in Illinois is to evaluate the vertical profiles of aerosol light extinction derived from the CALIOP lidar on the CALIPSO satellite. To that end, 43 of the 273 research flights conducted between June 2006 and September 2008 were aligned with CALIPSO overpasses, and an additional 27 were aligned with TERRA overpasses, for comparison with MODIS and MISR. Another example is recent analysis connecting field data from ground sites and the GoMACCS study to satellite estimates of the indirect effect. **Timeframe:** During actions initiated as described above and during the development of field experiments, we consistently consider possible collaborations and the common use of data collected from space-based instruments.

Comment: *The effectiveness of the laboratory might be improved through the development of additional working relationships with additional climate modeling groups both within and external to NOAA.*

Response/Actions (ACR-R17) (ACR-A17): We agree and will pursue this more in the future. Since the time of the Review, we have initiated collaborations with Paul Ginoux at NOAA/GFDL and with Stefan Kinne of the Max Planck Institute for Meteorology. Both of these collaborations involve comparing ESRL's long-term measurements of aerosol optical properties with model predictions. We have also discussed making similar comparisons with other groups. In addition, since the Review we have worked with the NCAR model to explore the use of weekly aerosol cycles as a preliminary model diagnostic. **Timeframe:** Action initiated in FY08 as described above, and ongoing efforts to expand working relationships with modeling groups.