# NOAA ARL Monthly Activity Report

## November 2004

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**Air Resources Laboratory**

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**Highlights**

***1. Highlight – ARL Core Competencies Review in progress.*** Initial interactions with the team appointed to conduct a Review of ARL Core Competencies began on November 3 at ARL Headquarters. Following a broad overview of ARL's work, division directors focused on the work at the various ARL field locations. Site visits to the Divisions and interviews with individual scientists will follow, probably in January.

In preparation for the review, a number of summaries of ARL programs have been prepared. These will be appended to these Monthly Activities Reports over the next few months. Appended to the present report is the documentation relating to the Air Quality ARL Core Capability, as summarized in the ARL Strategic Plan.

**Silver Spring**

***2. AMS Committee on Climate Variability and Change.*** Dian Seidel of ARL chairs the AMS Committee on Climate Variability and Change, for 2003 - 2006. Currently proposed activities include the 16th Conference on Climate Variability and Change (to be held in conjunction with the AMS Annual Meeting in January 2005); the 17th Conference on Climate Variability and Change (to be held as a joint conference with the Committees on Middle Atmosphere and on Atmospheric and Oceanic Fluid Dynamics, in Cambridge, MA in June 2005); and a short course on climate to be offered at the August 2005 Conference on Broadcast Meteorology. For more information, see the committee's web site at
http://www.ametsoc.org/stacpges/CommitteeDisplay/CommitteeDisplay.aspx?CC=CLIMVAR
dian.seidel@noaa.gov

***3. Analysis of Measurement Requirements for Climate Monitoring.*** In preparation for the February 2005 NOAA/GCOS Workshop on Defining Climate Requirements for Upper-Air Observations, a study of requirements for upper-air temperature measurements for monitoring climate variations and change has been initiated. A variety of different measurement protocols are being tested using the 6-hourly data from the NCEP/NCAR reanalysis for 1948-2003. The goal is to determine the measurement precision, accuracy, long-term stability, and sampling frequency required to faithfully reproduce the "true" climate statistics of the reanalysis. dian.seidel@noaa.gov

**Boulder**

***4. SURFRAD/ISIS.*** Three SURFRAD pyrgeometer standards were sent to the World Radiation Center's Physikalisch-Meteorologisches Observatorium in Davos, Switzerland for calibration. These three instruments are used to calibrate SURFRAD monitoring instruments. A description of SURFRAD - The GCOS surface radiation budget network for the United States – has been completed. A manuscript based on this will be submitted to the *Journal of Atmospheric and Oceanic Technology*. john.a.augustine@noaa.gov

***5. Aura Validation Experiments Campaign.*** Extensive support has been provided to the AVE (Aura Validation Experiments) campaign. The aircraft field experiment to validate measurements from the Aura satellite took place in Texas from October 27 through November 12, 2004, and was sponsored by NASA/Goddard (http://cloud1.arc.nasa.gov/ave-houston/dataprotocol.cgi). Dr. Petropavlovskikh used actinic flux measurements to retrieve partial ozone column above and below the aircraft. The actinic flux was measured using the WB-57 aircraft. Results are currently being evaluated and finalized. Preliminary data were provided to the AURA validation team to compare against total ozone column product derived from the OMI (Ozone Monitoring Instrument) measurements on board the AURA satellite. Irina.Petro@noaa.gov

**Oak Ridge**

***6. Canaan Valley.*** A series of meetings were held with Canaan Valley Institute science staff to discuss science goals for a proposed long-term ecological study area on CVI property. Through collaborations with researchers in academia, an integrated multi-media approach is planned. Atmospheric deposition studies will play a prominent role in the proposed research. Also, meetings were held among CVI affiliated investigators to plan a new state-of-the-art research laboratory on

the CVI property. The proposed design is closely linked to the needs associated with the long-term ecological studies. Long-term monitoring associated with the GEWEX, AMERIFLUX, and CRN efforts is continuing. (Vogel and Meyers)

***7. University of Alabama Airborne Measurements Collaboration.*** The University of Alabama Sky Arrow has made its first actual environmental measurements. Atmospheric boundary layer profiles were measured at sunrise, midday, and sunset as part of the course: "CE 591 - Aircraft Environmental Studies in the Planetary Boundary Layer" being taught by Dr. Steve Brooks of ATDD. All systems functioned well except for intermittency in the GPS signal during the last flight. This fault was later traced to a bad connector, and was fixed. (Dumas, Brooks, J. French, and Senn)

**Research Triangle Park**

***8. Wildfire Emissions and Air Quality Forecasting***. As one of several ARL activities addressing forest fire smoke and chemical plumes, work has started on a first-generation estimate of biomass burning using satellite-derived fire pixel locations. Initially, the HYSPLIT Hazard Mapping System (HMS) product will be used as input into the first-generation system. The HMS product is derived from interactive processing by trained satellite analysts in the NOAA/NESDIS Satellite Analysis Branch (SAB), within the Satellite Services Division (SSD), who manually integrate data from various automated fire detection algorithms with GOES, AVHRR, and MODIS products, with additional input from Defense Meteorological Satellite Program/Operational Linescan System (DMSP/OLS)) images. The result is a quality-controlled display of the locations of fires and significant smoke plumes detected by meteorological satellites. The Division is continuing to work on integrating a fire plume rise algorithm with this first-generation estimate and a preliminary run with an off-line version of the Eta-CMAQ system is planned later this month. (George Pouliot, 919 541 5475)

For the upcoming 2005 ozone season, updates to the emission processing for the Eta-CMAQ air quality forecast system were begun. Planned changes include the replacement of the SMOKE code from version 1.4 to version 2.1 and the inclusion of the temporal module from SMOKE to eliminate the need to create daily emission files. Instead, daily emission files will be created in real-time. (George Pouliot, 919 541 5475)

***9. Air Quality Forecasting.*** Work has begun on the development of a tightly-coupled air quality forecast system employing the Weather Research and Forecast (WRF) model and CMAQ. One key component of this integration will be the creation of spatial surrogates for emission processing on a rotated latitude-longitude coordinate system. Preliminary discussions indicate that emission processing should be performed on all grid points across the meteorological grid rather than on a subset. (George Pouliot, 919 541 5475)

***10. Data Analysis Preparations for the $NO_x$ Initiative Project***. The $NO_x$ Initiative data analysis sub-team has built analysis data sets based on the Clean Air Status and Trends Network (CASTNet) and Aerometric Information Retrieval System (AIRS) databases. These data sets include relevant measures of ozone levels such as daily 8-hour max and daytime average ozone values. A listing of relevant meteorological variables at the CASTNet sites is also being compiled. Having both AIRS and CASTNet ozone data included provides both urban and rural representation in the analysis. These data have been shared with data analysts from both the ASMD and Emissions, Monitoring,

and Analysis Division (EMAD) teams. In addition to assessing needs for observational data, the group is outlining and organizing analysis approaches, including methods for trend detection and stochastic modeling. (Jenise Swall, 919 541 7655; Jerry Davis, 919 541 0833; Brian Eder, 919 541 1334)

Continuous Emission Monitoring (CEM) emissions data from 1995 through 2003 have been posted on the anonymous FTP site along with the AIRS and CASTNet data described above. The team is currently working with the USEPA Clean Air Markets Division to obtain 2004 CEM data for the analysis. (Alfreida Torian, 919 541 4803)

***11. Aerosol Optical Depth Studies.*** Aerosol Optical Depth (AOD) has been estimated using CMAQ concentration outputs and using two published methodologies. These AOD data values were compared with the satellite-derived AOD's on two days when a wildland fire was at peak intensity in Lafayette County, Florida. (May 24-25, 2001). Comparisons between Satellite AOD estimates and Surface $PM_{2.5}$ data obtained from the IMPROVE network are being performed for the wildland fire cases in the Florida region (May 2001) and for the Northwest (Washington, Oregon, and California) region for August 2001. (Biswadev Roy, 919 541 5338; Alice Gilliland, 919 541 0347)

***12. NOAA-EPA-NASA Proposal for Climate and Air Quality.*** A joint proposal was developed by scientists within NOAA, EPA, and NASA to expand the current Climate Impacts on Regional Air Quality (CIRAQ) project. The proposed work would use the NOAA Global Fluid Dynamics Laboratory and the Goddard Institute for Space Studies (GISS) climate and chemistry models as global drivers for regional scale climate and air quality predictions. The linked modeling applications would be used to study the potential impact of climate change on air quality with multiple global model drivers from an ensemble perspective. The proposal was prepared following discussions with NASA scientists, in response to a NASA Research Announcement on climate variability and change. (Alice Gilliland, 919 541 0347)

**Idaho Falls**

***13. Smart Balloon Developments.*** A new cut-down mechanism has been designed for the smart balloon and is presently undergoing testing. The new cut-down mechanism is based on cutting a hole in a diaphragm that is mounted in the top plate of the balloon. When a cut-down command is sent to the balloon, a voltage is applied to a resistance-wire, sufficient to melt the polyethylene film around the perimeter of the adaptor. This design will save significant weight, simplify deployment, and eliminate unintended cut-down during a balloon flight. (Randy Johnson, 208 526 2129)

***14. Extreme Turbulence Probe.*** Analysis continues on the ET probe data collected during the 2004 hurricane season. The data are first passed through a series of checks to flag any problems, and is then stored in the commonly used NetCDF format. All of the ET data collected at Sebastian, Florida during Hurricane Frances have now been processed, and about half the data collected at Vero Beach are complete. The Hurricane Ivan data are still awaiting processing. (Richard Eckman, 208 526 2740)

***15. New Tracer Sampler Boxes***. Twenty new plastic corrugated boxes of four different wall thicknesses are being tested in a search for a replacement for the 14-year old wax coated corrugated tracer sampler boxes. The new boxes will be used along side the old waxed cardboard boxes over the next year or so to determine which of the four alternative designs works best. The new boxes should offer better operation during field experiments, especially in cases subject to rain. (Randy Johnson, 208 526 2129)

***16. Tracer Sampler Controller Program Upgrade.*** Initial work began on changing the FRD tracer bag samplers to accommodate different time periods. The firmware in the hand-held TimeWand II's has been modified to support the upgrade to the so-called PIGS (Programmable Integrating Gas Samplers). Now the PIGS will sample for different times on different bags, pause for specified times between bags, and even begin filling bags according to a preprogrammed order. This upgrade should allow the PIGS to meet the special needs of specialized atmospheric tracer experiments. The TimeWand II's are used to load timing information into the PIGS during field experiments at the same time they collect information about the location and time of each sample. The TimeWand II firmware required extensive modifications to support the more complex timing information. The most difficult problem was optimizing the code so it would run in a reasonable time. The initial version of the code required about 18 seconds to load timing information into a sampling system. The code was rewritten and optimized and the download time reduced to about 7.5 seconds, which should be practical for field use. A significant effort remains to integrate the modified PIGS data into the tracer analysis software. (Roger Carter, 208 526 2745)

***17. Joint Urban 2003.*** Progress has resumed on the preparation of the final JU 2003 report. Sections on the tracer dissemination and tracer sampling with bag samplers and real-time analyzers has been written. The remaining sections, including the introduction and results and discussion sections are being prepared by a FRD contractor who was part of the field deployment in 2003. It is envisioned that the report will be ready for ARL review in January 2004. (Jason Rich, 208 526 2328)

***18. INEEL Mesonet Narrow Band Radio Transition.*** The FRD mesonet transition to the new narrow band radio system and new data collection software has been completed. During the month of November, the remaining 29 stations were switched to the new system, bringing the total to number of stations to 38. Although the transition is complete, we are continuing to work out the bugs in the system. When we added our 30$^{th}$ station we started observing problems in the collected data. Dates and times were showing up in the wrong place. We think we have isolated the problem to the storage buffer in the RF base station. When the data flow became too high, the RF prom began mangling the incoming data packets by allowing data to overflow into the storage buffer. We burned a new RF prom thereby doubling the storage buffer size. We think this should correct the problem. In the meantime we are continuing work on improving the RF communications and in collecting, storing, and distributing the incoming mesonet data. (Brad Reese, 208 526 5707)

**Las Vegas**

***19. Preparations for a Las Vegas urban testbed.*** In collaboration with ARL Divisions in Oak Ridge and Research Triangle Park, steps have been initiated to study the inflow of ozone and ozone precursors into the Las Vegas valley. The study is in collaboration with CIASTA., and has been

designed in reaction to modeling studies that appear to show that the Las Vegas ozone exceedance problem is due almost entirely to the effects of emissions from within the valley, rather than due to chemicals transported into the valley from sources upwind. In parallel with this, it is planned to extend the Nevada mesonet into the Las Vegas urban area, again in collaboration with CIASTA. (Darryl Randerson, 702 295 1232)

## ARL Core Capability – Air Quality

### Overview

For forty years, ARL has served as the focus NOAA's air quality work. The activity started with the recognition that the then emerging air quality concerns of the nation required attention using numerical models. A collaborative program was set up between the Public Health Service and ESSA's Air Resources Laboratories, which remains the centerpiece of ARL's air quality research to this day.

The dispersion processes that dominated much of ARL's research during its early years were recognized as being the factors that controlled much of the air quality regimes downwind of pollution sources. There was, at that time, an independent specialty addressing air chemistry. Air quality was seen as a combination of air chemistry and meteorology.

The meteorology of relevance was primarily that of the lower atmosphere. In the early days of air quality studies, meteorological models were mainly not adequate, because they focused on the parts of the atmosphere where synoptic changes occurred and lacked the fine attention to the surface layer that air quality considerations demanded. For many years, the air quality community, led by ARL, led the move to develop mesoscale meteorological models. It is now not well acknowledged that the development of the MM-series of models at Pennsylvania State University was funded by ARL, as a step towards improving air quality simulation.

The acid rain debate of the 1980s focused attention on the major ions – sulfur and nitrogen compounds. In parallel with this, work on ozone expanded greatly. Research on the meteorology affecting air quality was conducted at Oak Ridge and Silver Spring. The development of related models (Lagrangian as well as Eulerian) took place at both of these locations, but eventually became dominated by development at Research Triangle Park of fully Eulerian assessment capabilities in which many alternative descriptions of air chemical processes were available. These developments initially led to the Regional Acid Deposition Model (RADM) and have now culminated in the Community Multiscale Air Quality (CMAQ) model. These models are the foundations of the national air quality regulatory process. CMAQ is now the basis for the new NOAA air quality forecasting system.

ARL is a research laboratory, with a superb track record for transferring research products into operations. The development of RADM and CMAQ constitutes an operationalization of the research conducted by ARL and under ARL sponsorship during the 1980s and 1990s. Ozone is a major pollutant addressed in CMAQ; it is not addressed in RADM. The transfer to operations of ARL air quality research (both meteorological and air chemical) during the 1980s and 1990s has taken about a decade to accomplish. Today, the related focus is on refining the models for major ions and ozone, and on extending understanding so that pollutants of special interest (such as mercury and the consequences of forest fires) can be addressed.

The ARL Groups

Five ARL groups are heavily involved in dispersion research and model development.

**ARL, Silver Spring** concentrates on hybrid approaches to air quality modeling, with HYSPLIT-chem as the flagship. The first ARL air quality forecasts were made available in the early 1990s, for areas of Texas and using reduced form chemical methods (that had proved successful elsewhere). Today, HYSPLIT-chem incorporates a fully expanded Eulerian chemistry capability, coupled with the

operational hybrid dispersion scheme. The resulting system is being used in studies of forest fire plume chemistry.

**ARL, Oak Ridge** focuses on situations where topography and other surface conditions influence air quality. The East Tennessee Ozone Study (ETOS) has grown into a major program, following widespread recognition that air quality in the Great Smoky Mountains National Park is rapidly deteriorating, along with air quality in eastern Tennessee in general. The dominating issue is the extent to which long range transport at high elevations influences ozone concentrations affecting tourism in the Great Smokies.

**ARL, Las Vegas** will be a major player in the Urban Atmospheric Research program now being initiated with the Cooperative Institute for Atmospheric Sciences and Terrestrial Applications and a number of federal and state agencies. The study will center on Las Vegas. As a first step, ARL will instrument a number of locations with ozone monitors to demonstrate the importance of inflow of ozone and ozone precursors into the Las Vegas valley. All ARL groups are involved.

**ARL, Research Triangle Park** is the main ARL group addressing air quality issues. In the past, the effort has been directed towards needs of policy and assessment. Today, this historic effort is paralleled by a joint EPA/NOAA program to institutionalize air quality forecasting. ARL/RTP leads in the generation of emissions inventories, both natural and anthropogenic. The recent air quality models developed at RTP are genuine community products – they are frameworks which a user can configure to employ a variety of specialized modules. Today, these models are being refined to address a wide range of air pollutants other than the conventional species (SOx, NOx, and O3). Airborne particles are a major target for development. In addition, the air quality models are being coupled with models of transport and chemistry in other media, so that a new generation of multi-media capabilities is being developed.

Work at RTP has extended to physical modeling, and is currently focusing on urban issues.

**Some History**

The ARL development of dispersion models led to a rapid extension to address air quality issues, initially associated with emissions from specific point sources. The Public Health Service and ESSA entered into an agreement that predated the more formal partnership of later years, forming a collaborative endeavor at Cincinnati, later to be relocated to Research Triangle Park, North Carolina. The goal was to develop and operationalize models for assessing air quality and for developing related policy and regulations.

With the foundation of EPA and NOAA, the existing agreements were extended to make use of NOAA science to support the meteorological and air quality needs of the EPA. The group at Research Triangle Park became one of the Air Resources Laboratories, and later a Division of the Air Resources Laboratory.

At the same time, the air quality aspects of dispersion were increasingly recognized to have high-altitude ramifications and global-scale relevance. The global monitoring components of ARL evolved during his period and grew into the program now constituting the Climate Monitoring and Diagnostics Laboratory. Analysis of the air chemistry data obtained was historically by the ARL teams at Silver Spring and Oak Ridge. After the separation of CMDL from ARL, these extra-Boulder activities served as the foundation of a continuing ARL climate and global air quality program. This will be addressed separately.

**International Aspects**

ARL provides the NOAA linkage with many international programs addressing various aspects of air quality. For example . . . .

- NATO air quality activities are under ARL leadership
- ARL participates as a member of the Air Quality Board of the International Joint Commission
- ARL participates in discussions with Canada under the Air Quality Accords
- ARL provides one of the joint chairmen of the North American Agreement on Environmental Cooperation effort to rationalize monitoring across North America
- ARL provide US input to international discussions of mercury in the environment

**Forest Fire Plume Chemistry**

ARL is strongly linked with USFS, NASA, EPA, NESDIS and NWS in the development of forest fire plume products. There are two different products required – one that concentrates on smoke and visibility, and the other that focuses on the downwind air chemical consequences of the emissions from the fires.

There are two paths being followed at this time, both in collaboration with USFS. The first is related to plume and air quality forecasting, the second to assessment and scenario development. The former is being driven by NOAA, the latter by EPA. Both activities rely on the USFS for source term information. Both involve the Air Resources Laboratory. The figure below shows the programmatic approach being taken within NOAA. There is an immediate need, being addressed by bringing together capabilities that already exist and coupling them with new experimental source term quantification techniques. At the same time, improvements are being made in the systems involved, leading to the development of an improved intermediate product. The long-term goal couples with the development and implementation of the Weather Research and Forecasting model – WRF. The two pathways (forecasting and assessment) are shown in blue and grey respectively. The time scales are not rigid. By "immediate" we mean what is now happening and will be available within months. By "intermediate," time frames of the order of two to three years are contemplated. "Long term" is associated with five to ten year fruition.

Smoke plume forecasting received a big boost with the emphasis placed on this kind of product in the oil fires emergency of Kuwait in 1991/92. Most of what is being done today is derived from that experience. In the late 1990s, ARL became heavily involved with forecasting the smoke plumes from fires, primarily in southeast Asia. This was the PARTS program. The program was constructed on the expectation that satellite information would reveal the sources of smoke, but that little source term information would likely be forthcoming. Hence, satellite measures of aerosol optical thickness were proposed as a means to calibrate the plume forecasts. In practice, the forecasting of plume dispersion appears to have worked well, but the use of satellite data to calibrate the outputs failed to work. The reason was that the area in question is dominated by high stratus that defeats the ability to extract accurate aerosol optical depth data from routine surface radiation observations. (In later years, satellite capabilities have been improved, and might offer a workable methodology. It is believed that workers in Singapore are continuing studies along these lines, with HYSPLIT as one of their dispersion capabilities.)

Also in the late 1990s, there was extensive development of forest fire smoke dispersion forecasts for North America. These products appeared routinely on the READY system. In some instances, the activity was operationalized through the direct involvement of NCEP. This involvement led to a number of subsequent activities. Satellite data from NESDIS were subsequently incorporated with the plume forecasting system. The resulting capability (developed by joint work among NWS, NESDIS and OAR/ARL) awaits transfer to operations, at this time. Note that NESDIS is becoming a strong player, with relevant products now being derived from geostationary satellite observations. These products are developmental but some of them are already being incorporated in some of the predictive models.

In the early 2000s, USFS started focusing attention on the need to forecast the chemistry of the plume as well as its smoke content. Following formative meetings among scientists from USFS, NOAA/ARL, and NASA, a program, led by Wei Min Hao (USFS, Missoula), was developed to forecast air quality and pollutant levels downwind from large fires. The goal is to use satellite data and information on land surface vegetation coverage to produce estimates of the production rates of key chemical species. A MODIS receiving station was set up at Missoula in early 2002 for this purpose. The USFS group is using a real-time MODIS burn area algorithm and a fire behavior model to derive the emission rates of key chemical species from forest fires. Developments at NESDIS (primarily using products from geostationary satellites) are being watched with great interest.

Currently, ARL is also using both NASA and NESDIS satellite products to map the temporal and spatial location of major fires over large regional or continental domains. Using this information, emission models such as BlueSky can be applied to estimate smoke emissions. ARL is adjusting the HYSPLIT-chem model to accept the source term information yielded by the Wei Min module (RTFEI), and to simulate the way in which the chemical plume(s) interact with the background atmosphere. The intent is to provide guidance to managers who fear causing downwind areas to experience ozone (and particle) exceedances due to the fires that are under their control.

The reliance on a hybrid Lagrangian system follows from the need to address many different sources with different input specifications, in parallel. It is acknowledged that in the end a fully Eulerian approach will be employed. Development of this is already well advanced, in ARL.

Recent interest by the NWS has resulted in the transfer of the already-existing Blue Sky wildfire emission algorithm (from Seattle) to ARL to incorporate into the current NESDIS demonstration system for a crude PM2.5 estimate. NWS plans to support a contactor at NESDIS to help get the HYSPLIT-based capability operational there. NWS is also supporting the development of a wildfire emission algorithm for CMAQ, at Research Triangle Park. In the end, it is anticipated that the Missoula emissions algorithms (see item 5 above) will be used, after their testing in the context of HYSPLIT.

A fully Eulerian product is being developed at Research Triangle Park, resulting from interactions between USFS and EPA. The guiding purpose of this development will be the assessment of potential risk related to the needs of planning and management within USFS and EPA. At this time, initial steps are being taken to facilitate the integration of this effort with the NOAA programmatic needs for related air quality forecasting. This system will make use of a source term algorithm independently developed from the USFS/NOAA process outlined above and other USFS/EPA interactions.

**Urban Air Quality**

The need to provide forecasts to people where people need the forecasts is well recognized. The new Urban Atmospheric Research program of ARL is designed to combine the various aspects of the problem – dispersion, air quality, and weather forecasting.

Following on from initial work in Washington, DC, the ARL focus now anticipated will be on Las Vegas, where there is an urgent need to understand the reasons for local ozone exceedances. The Las Vegas study will build upon the existence of the ARL mesonet in southern Nevada, which will be extended into the Las Vegas urban area.

At the present time, plans are being made to deploy a number of air quality monitors upwind of Las Vegas and at some locations within the Las Vegas valley, to provide data for use in conjunction with the fine-grid modeling activity already under way by ARL and CIASTA. The intent is to provide direct evidence of the relative role of long range transport in determining local air quality.

**Mercury in Air**

Concerns about the bioaccumulation of mercury in fish and marine mammals started during the mid 1990s, and ARL scientists quickly became involved. The sources of the mercury are now well known to be the burning of coal and a number of other sources such as incineration and mining, but coal combustion dominates. The mercury enters the air mainly as gaseous elemental mercury that has a very long residence time in the atmosphere. This atmospheric elemental mercury does no deposit quickly. It remains in the air for a long time, until it is transformed into reactive chemical species that are then more readily deposited. The mechanisms by which this reactive gaseous mercury is generated are presently contentious. A minor part of the emission is as reactive gaseous mercury, which is then available for deposition more locally.

A series of aircraft measurements was conducted in the late 1990s, over the Florida coast where the question of local versus distant sources is politically charged. At the time of these studies, measurement capabilities were not well advanced, and the results were considered indicative of a major role of local sources rather than as direct evidence of this.

In collaboration with EPA and Oak Ridge National Laboratory, a study of mercury behavior at high latitudes was then initiated. (At high latitudes there is known to be a major burst of mercury deposition every spring, for reasons that were not initially known.) The ARL studies indicated that there is a significant role of bromine in the reactions by which atmospheric elemental mercury is transformed into RGM. This has subsequently been supported by studies conducted in Antarctica, again by ARL scientists.

There are two modeling efforts currently under way – one fully Eulerian and the other quasi-Lagrangian. These two efforts are primarily intended to satisfy the needs of two different communities, the first being the policy and assessment community, and the second the community identifying where best to focus emission controls in order to minimize deposition. Both activities are internationally recognized. In essence, the two groups involved (Silver Spring and Research Triangle Park) dominate the US mercury modeling scene.

At this time, ARL is leading NOAA efforts to generate a multi-line office program to address mercury in the environment, from sources to eventual intake by people. This program features prominently in NOAA plans for ecosystem research.