# NOAA ARL Monthly Activity Report

## March 2004

**Bruce B. Hicks, Director**
**Air Resources Laboratory**

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**Highlights**

***1. Pentagon Shield***. A small atmospheric tracer study at the Pentagon has now expanded into a large study that will involve 8 of ARL's 10 real-time $SF_6$ analyzers and all 100 of our bag samplers. The study now includes an indoor component that will use both real-time analyzers and bag samplers. The changes in scope occurred with very short lead time. This has required FRD staff to increase the focus on preparations. We are on schedule and the deployment will be May 1-10. kirk.clawson@noaa.gov & staff

Preparations for the Pentagon Shield project have been extensive. The $SF_6$ continuous analyzers have been upgraded, tested, and conditioned. Special lab carts will be used to deploy the analyzers inside the Pentagon. Gas Lab personnel are testing the Programmable Integrating Gas Samplers (PIGS) and conducting an aging study to verify that the samples will not be compromised during shipping from Washington, D.C. to Idaho. Planning for the project has been challenging because of changing requirements and a tight schedule but preparations are proceeding smoothly. roger.carter@noaa.gov, Debbie Lacroix

In collaboration with the National Center for Atmospheric Research (NCAR) and the Department of Defense's (DOD) Defense Advanced Research Programs Agency, a wind tunnel study of the flow and dispersion around the Pentagon building is being started. Simulations with a 1:200 scale model of the Pentagon and its immediate surroundings will be conducted at the Meteorological Wind Tunnel facility in the late spring and summer of 2004. Wind tunnel measurements will include mean flow and turbulence fields, smoke visualizations, and mean tracer concentration fields for a continuous, near-surface, non-buoyant tracer release approximately one side width upwind of the building exterior. Additionally there will be measurements of pressure fields along the surfaces of the building. Data will be collected for two wind directions. (Steve Perry, David Heist, George Bowker, 919 541-1896)

***2. EPA-NOAA Scientist-to-Scientist Meeting on Air Quality Research***. During March 2-3, 2004, the Environmental Protection Agency (EPA) in Research Triangle Park, North Carolina, hosted the first in a series of scientist-to-scientist meetings between research Divisions of EPA and the National Oceanic Atmospheric Administration (NOAA)/Oceanic and Atmospheric Research (OAR) as required by the MOU between the Department of Commerce and the EPA. More than 100 EPA and NOAA scientists and managers met to discuss *Air Quality Research to Guide National Policy and Programs*. The meeting focused on air quality; what research is on-going between the two Agencies, and what were areas of potential collaboration. After an opening plenary session at which the organizations' leaders presented overviews, several concurrent break-out sessions were conducted on process research, model evaluation, emissions research, air quality forecasting, and homeland security. Many ASMD members participated in the Workshop and its break-out sessions, and several helped facilitate the sessions.

This series of meetings are in accordance with the EPA-NOAA Memorandum of Understanding (MOU) on Air Quality Research and the parallel Memorandum of Agreement (MOA) on Air Quality Forecasting signed by the Deputy Secretary of Commerce and EPA Administrator on May 6, 2003. Future meetings are planned on *Linking Air Quality Models to Climate Change Models* (September 2004 in Boulder, Colorado), and on *Multimedia and Transboundary Exchange* (February 2005 in Annapolis, Maryland). These meetings will lead to the *Golden Jubilee Celebration of 50 years of EPA-NOAA Partnership on Air Quality* (September 2005 in Research Triangle Park).

The purpose of these meetings is to ensure that the two agencies work together to improve existing air quality assessment and prediction capabilities. The major agreement at the first meeting was to focus future collaborative research on the *urban atmospheric environment*, addressing the myriad of air quality and health issues with the urban environment, and coordinating major field studies. To facilitate implementation of this program, field studies would be targeted for such key urban test beds as Houston, DC/Baltimore, New York City, Philadelphia, Denver, Las Vegas, ands Los Angeles. There is an opportunity to build upon the Texas field study in the Houston area in 2006. Whereas some NOAA funds to support this program appear to be in place, EPA needs about $10M to ensure effective EPA participation.

To facilitate collaboration, coordination, and communication between the EPA and NOAA scientists, EPA agreed to establish a science portal for exchange of information and data. The first products on this electronic portal will be the presentations from this meeting. It was also noted that personnel exchanges for special assignments would be beneficial. In summary, the meeting was successful in setting the stage for increased collaboration in this already productive scientific relationship between EPA and NOAA and identifying research needs to address the *urban atmospheric environment*. (David Mobley, EPA, 919 541 4676; Ken Schere, 919 541 3795)

**Silver Spring**

***3. METREX Urban Dispersion Model Verification***. MM5 has been installed on our IBM workstation for testing and on the ARL LINUX cluster with the intent of creating one year's (1984) high resolution (4 km) meteorological data fields for use in dispersion calculations. The METREX multiple tracer study took place in 1984, over Washington D.C. Test simulations with 12 processors showed about a 15% ratio of CPU to real time. One year's calculations (36h for each 24h period) should be completed in about three months. MM5 will be initialized from the now public archive of ECMWF ERA-40 data. To permit baseline dispersion simulations, the HYSPLIT ECMWF data decoder needed some modification. Also the MM5 decoder program was modified to include the Turbulent Kinetic Energy outputs. roland.draxler@noaa.gov

***4. Forecast Wind Roses Added to READY Website***. Wind roses can now be computed on READY using gridded model forecast data for a single location within the meteorological model domain. Wind roses typically show the frequency of wind direction at a single location on a 16-point compass over an extended period of time (months to years). Since the use of the wind rose in this case only includes a few points in time (at each forecast hour), caution must be used when trying to interpret the plots in the typical sense of a wind rose. In addition, rings are plotted that represent the wind speed frequency for seven wind speed classes identified by color. In addition, along the bottom of the wind rose plot, a graph of the wind direction versus model forecast hour is plotted to provide information on when (in time) the winds will be from each sector. The color of the line indicates the wind speed at that forecast hour using the same color bands as in the wind rose.

The wind rose can be helpful to predict when conditions might be favorable for poor air quality episodes at a location, given that high concentrations of pollutants tend to be associated with winds from dominant source areas. glenn.rolph@noaa.gov

***5. Using Reanalyses to Homogenize Upper-Air Data***. A Mini-Workshop on Using Reanalyses to Homogenize Upper-Air Data was held Thursday March 18, 2004 at ARL in Silver Spring. About 20 scientists met to discuss ways to improve the temporal homogeneity of radiosonde data for climate purposes using reanalysis data and metadata products, and ways to improve reanalyses for climate purposes. While reanalyses have been made using a consistent assimilation and analysis model, until recently there has been little focus on data continuity and homogeneity in reanalyses. Now each of the major reanalysis centers is beginning to seriously consider these issues. The workshop was an opportunity for exchange of ideas and building connections among reanalysis groups and between the reanalysis and climate monitoring communities. Workshop participants included representatives from NOAA (ARL, NCEP, GFDL), ECMWF, NCAR, LLNL, NASA, and Univ. of Maryland. Several collaborative efforts were planned. dian.seidel@noaa.gov

**Boulder**

***6. SURFRAD/ISIS.*** As of March 19, all historical SURFRAD data have been reprocessed and replaced by new files in the SURFRAD ftp site. The daily clear-sky identification files and monthly average files have also been regenerated and inserted in the ftp site. In the late 1990s, it was discovered that ordinary double domed pyranometers lost signal owing to infrared cooling of the receiving surface. The infrared loss in the regular pyranometers caused an artificial lowering of the signal and resulted in diffuse measurements that were systematically low. During the 2001 instrument exchanges, the pyranometers measuring diffuse solar radiation at SURFRAD stations were replaced with Eppley 8-48 pyranometers, which do not have the infrared loss problem. This winter, an algorithm was developed to correct these data by using data from collocated up-looking infrared pyrgeometers. This algorithm has been applied to all historical SURFRAD diffuse solar data in the current release on the SURFRAD ftp site. Along with the diffuse correction, the accuracy of all historical UVB data has been improved, and the net solar calculation has been tweaked to include twilight. The README

file that describes the SURFRAD data files has been also updated, and a notice was posted on the ARL/SRRB web page notifying users of the data of the changes and improvements. john.a.augustine@noaa.gov.

***7. Science Team Meeting for Earth Observing Satellites, Boulder.*** During the week of March 29, Joe Michalsky and John Augustine attended the NASA sponsored Science Team Meeting for Earth Observing Satellites (EOS) principal investigators at the National Center for Atmospheric Research in Boulder. ARL/SRRB was recently funded through a joint proposal with CMDL to continue to provide surface observations of the surface radiation budget and other novel products in support of NASA's CERES instrument aboard three EOS satellites. NASA scientists at the meeting who regularly use SURFRAD data and products were highly complimentary of the SURFRAD program. john.a.augustine@noaa.gov.

***8. DOE Atmospheric Radiation Measurement Program.*** Gary Hodges and Joe Michalsky participated in the DOE Atmospheric Radiation Measurement (ARM) annual meeting in Albuquerque, NM. Global dimming of shortwave radiation has been suggested in a number of recent papers. Gary analyzed total horizontal, diffuse horizontal, and direct normal irradiance data from northern Oklahoma for the past ten years of the ARM program that suggest no statistically significant trend in these data, and if anything a slight upward trend in the summer months, although this is not statistically significant at the 95% confidence level. Joe gave a presentation on the second diffuse horizontal irradiance intensive observation period. The purpose is to establish a working standard in ARM and the BSRN for this measurement, which has persistently been found lower than model predictions for even the simple clear-sky case. Joe also gave a presentation on the aerosol climatology at the southern Great Plains site suggesting that tropospheric aerosols may be indicating a long-term change in their character, perhaps associated with changes in the chemical composition of the atmosphere in northern Oklahoma. joseph.michalsky@noaa.gov.

***9. Central UV Calibration Facility (CUCF).*** To take on a more proactive role towards the Central UV Calibration Facility (CUCF) establishing itself as the world's UV calibration laboratory, it has organized an intercomparison of standards of irradiance between the European Joint Research Center (JRC) at Ispra, Italy and the CUCF. The UV laboratory at the JRC is the European counterpart to the CUCF. Previous impromptu intercomparisons of international standards by the CUCF has shown differences between NIST-traceable and PTB-traceable (Germany's standards lab) irradiance scale. Recently, but as of yet unpublished results from intercomparison campaigns held by the national labs have shown that the NIST and PTB's scales are comparing more closely. The comparison of the CUCF's secondary standards to those of the JRC is an extremely useful comparison showing how well each of the secondary laboratories is transferring their respective primary irradiance scales to the field UV monitoring instruments. patrick.disterhoft@noaa.gov

**Oak Ridge**

***10. Bay Regional Atmospheric Chemistry Experiment (BRACE).*** La Toya Myles, a new NOAA staff member, transferred from Tallahassee, Florida to work with Dr. Meyers on analysis of BRACE samples and computer datasets. Ms. Myles plans to complete her Ph.D. during May 2004.

***11. Mercury in the Arctic.*** The 2004 Barrow Arctic Mercury Study in March involved scientists from four nations and a coordinated set of measurement systems (three Hg speciation systems, three gradient flux systems, one eddy flux system, one interstitial gas profile sampler, one particulate mass sampler, three manual mercury sampling systems, and one robotic aircraft sampler). Spatial mercury transects (conducted with the U. of Alaska Fairbanks) revealed the highest snowpack mercury immediately adjacent to the offshore lead with a significant drop-off in total mercury content with distance from the lead to 100 km inland. The 2004 study continues until May 3, and we are considering a follow-up data workshop meeting at ATDD in September. (Brooks)

***12. U.S. Climate Reference Network***. Three new USCRN sites were installed at Cape Charles, North Carolina; Desert Rock, Nevada; and Kesterson Reservoir, California. (Hall, French, Black, Brewer, Randolph, Bryant, Rutherford, and Boice)

**Research Triangle Park**

***13. Community Multiscale Air Quality (CMAQ) Modeling System.*** This month there are two model "releases" to report. The first is an internal release for EPA's Office of Air Quality Planning and Standards based on initial Community Multiscale Air Quality (CMAQ) model code optimizations implemented by Department of Energy's Sandia National Laboratory (SNL) located in Albuquerque, New Mexico. Bench marking on the Division's "rain" Linux cluster indicates a 10-12% speedup over the original EPA optimized code delivered to SNL in February. Tests using 8 processors on the cluster show that the optimized code is well within the goal of running an annual simulation in less than 10 days.

The second "release" constitutes a delivery to the Air Quality Forecasting team at NOAA's National Center for Environmental Prediction (NCEP) for implementation by their operations center for the upcoming 2004 ozone forecast season. We have conducted some preliminary tests for two large domains other than the northeastern United States domain that was used for last year's forecasts. These tests were conducted on EPA's IBM 1600 E-server that is similar to NCEP's IBM systems used for forecasting. The timing results indicate that the code should still perform adequately to meet the required forecast time window. (Jeffrey O. Young, 919 541 3929)

In collaboration with EPA's Office of Air Quality Planning and Standards, the Division performed an annual simulation of the Models-3 Community Multiscale Air Quality (CMAQ) for the year 2001. The continental-scale simulation, which used the CB-IV chemical mechanism, and the 2001 National Emissions Inventory, was performed using a 36-km horizontal grid cell size. The model results were compared with the observational data from four different networks: CASTNet, AIRS, IMPROVE, and STN. Preliminary results indicate that the model simulates sulfate well with correlations ®) ranging from 0.78 to 0.92; Normalized Mean Biases (NMB) ranging from -6.0 to 4.0% and Normalized Mean Error (NME) ranging from 24 and 43%; depending on the network. Simulations of ammonium and $PM_{2.5}$ were also fairly good (ammonium r: 0.58- 0.82; NMB: 7- 25%; NME: 34-66%; PM 2.5: r: 0.52-0.68; NMB: 7.0-9.0%; NME: 47.0-50.0%). The quality of the nitrate, elemental and organic carbon simulations, while considerably better than those in the past, is still lagging the performance of the other species (nitrate r: 0.42-0.73; NMB: -5.0-27.0% ; NME: 76.0-102.%; EC r: 0.46, NMB: -2.4% ; NME:61.6%; OC r:0.34; NMB: 34.5%; NME: 82.6%). The evaluations were also examined over seasons and over different parts of the modeling domain space. (Brian Eder, 919 541 3994)

***14. Air-Quality Forecasting.*** The preprocessor to the Community Multiscale Air Quality (CMAQ) model (PREMAQ) was modified to accept meteorological information from the Eta model on a grid of "cross" points rather than a grid of "dot" points. The post-processed Eta output is available in GRIdded Binary (GRIB) format, which only recognizes an unstaggered horizontal grid; for this version of PREMAQ, an unstaggered grid of "cross" points (i.e., scalar points) was chosen. This change inverted the dimensions and indexing of the variables on the staggered grid inside PREMAQ. This update to the PREMAQ code eliminates an interpolation step for most meteorological fields, and ensures a more precise alignment of the meteorological data. This improvement to PREMAQ will provide subtle but important changes to the linkage of Eta and CMAQ for the air-quality forecasting system. (Tanya Otte, 919 541 7533)

In preparation for the 2004 ozone season, the emission algorithm and processing for the forecast system has been finalized. The two most significant improvements to the emission estimates were the incorporation of MOBILE6 into the pre-processor for the air quality forecast system and a revision to the electric utility nitrogen oxides ($NO_x$) emissions that accounts for year-to-year changes in capacity and controls as forecast by the Department of Energy. Using only the electric utility $NO_x$ revision to the 2001 annual point source inventory, the annual total of $NO_x$ emissions from all point sources is reduced by 7% from 7.1 million tons to 6.6 million

tons between 2003 and 2004. This reduction in emissions in 2004 will be used in this summer's 2004 ozone season air quality forecast.

Evaluation of the forecast system for one week during August 2003 shows improvement between the modeled ozone concentrations and observed ozone concentrations. The emission inventories were updated as follows:

- The mobile source inventory was revised from the Mobile5b model to the Mobile6.2 model using 1999 vehicle activity estimates in both cases.
- The point source inventory was revised from the 1999 National Emission Inventory (NEI) Version 1 estimate to the 2001 NEI Version 3 estimate with $NO_x$ adjustments to the electric utility sector based on the Department of Energy's forecast for 2003 and 2004 (projected from 2001).
- The area source inventory was updated from the 1999 NEI Version1 to the NEI 2001 Version 3.

The updates to the point, area, and mobile source inventories reduced the mean bias in the maximum 1-hour ozone concentrations from 6.1 ppb to 4.7 ppb. (George Pouliot, 919 541 5475)

***15. Climate Change Impact on Regional Air Quality.*** A 10-year MM5 simulation using boundary conditions from the Goddard Institute for Space Science (GISS) climate model is currently being processed and analyzed. The initial simulation represents a current scenario climate; the next simulation planned will represent a future scenario climate (2050-2060).

The processing tool converts the raw model output into a data stream acceptable to the Community Multiscale Air Quality (CMAQ). Then, hourly grid statistics are computed and stored in the project database, as well as locations of max and min values. Analysis of the regional climate simulation began this past month. Hourly surface observations from the last 10 years have been processed and placed in the project database. Roughly four stations per state were chosen to represent the intra-state climate variability. Various aspects of these observations will be compared to the climate model to assess how well the current scenario climate is simulated, so that we have confidence in our future climate simulation. The first analysis of the data will be to compare the annual and seasonal variability in both the model and observations. This will be done for each of the observation locations as well as cumulatively, then ranked between stations to see if the model more realistically simulates the climate of certain regions over others. More examinations of the data are planned over the next few months, including using filtering techniques and principal component analysis. (Robert Gilliam, 919 541 4593)

***16. Community-Scale Air Toxics Modeling for Philadelphia.*** A Memorandum of Collaboration has been prepared and is in effect between ASMD, the Air Program Division of Environmental Protection Agency's Region 3; and the Air Quality Management Section of Delaware's Department of Natural Resources and Environmental Control (DNREC). The purpose and results of this collaborative effort will be to provide gridded modeled toxic concentration fields to drive human exposure models. Specifically, the collaborators will use the Community Multiscale Air Quality (CMAQ) modeling system at neighborhood scales linked to human exposure models in a prototype demonstration for performing risk assessment due to toxic air pollutants. In this collaboration, ASMD will be performing annual simulations of an air toxics version of CMAQ grid cell sizes of 36 km, 12 km, and 4 km utilizing 2001 meteorology and 1999 emissions, and will use the results to drive the Hazardous Air Pollution and Exposure Model, HAPEM-5. To further examine the feasibility of this CMAQ prototype, the 12-km and 4-km model nests are being centered over Philadelphia and Delaware to address the modeling concerns and needs of both EPA/.Region 3 and DRREC. The DNREC Air Quality Management Section will be performing episodic runs of CMAQ at 1-km resolution to examine its potential for air toxic modeling assessments at fine scales. Region3 will be performing dispersion modeling with the Industrial Source Complex (ISC) model, employing a high resolution receptor network for determining inherent constituent within-grid concentration variability estimates in accordance with the design of the neighborhood scale modeling paradigm. (Jason Ching, 919 541 4801; Tom Pierce , 919 541 1375; S T Rao, 919 541 4542)

**Idaho Falls**

***17. CBLAST-High***. Processing of winds and temperature data collected during last year's hurricane season have been completed and made available to the CBLAST community. Fluxes were calculated from four of the six hurricane flights. Measurements from the remaining two flights (FLT 2 and 3) were unuseable because of problems with water in the BAT probe ports.

At present, we are focusing on estimating surface flux of sensible heat and momentum from the BAT data. We are also working with Will Drennan from RSMAS (Univ. Miami) to estimate latent heat fluxes by combining BAT measurements with measurements from a modified LICOR 7500 mounted inside the nose of the NOAA P3. These data will be presented for the first time at the upcoming AMS Hurricane and Tropical Storm Conference in Miami in May.

Preparations continue for this year's upcoming hurricane season. A new sensor board for the BAT was fabricated to replace the board that was damaged by water last year. Some erosion of the cone was noted after last year's flights. An aluminum ring is being manufactured that will be mounted on the front edge of the BAT cone to protect it from the impact of water in hurricane flights. The BAT is scheduled to be re-installed on N43RF in late May. Test flights will occur in early June and again in August. jeff.french@noaa.gov

***18. ET Probe.*** One of the ET probes at FRD was modified in March in an attempt to reduce problems with water entering the pressure ports and affecting the pressure data. All the ports were enlarged to 6.4 mm in diameter, and larger-diameter plastic tubing was used inside the sphere. This tubing is routed upward to the top of the sphere in the hope that gravity will assist in keeping the tubes from getting fouled by water. The new design was tested by mounting it on a pickup truck next to a 3D sonic anemometer. Preliminary road tests in dry conditions indicate that the ET probe closely matches the sonic data; the enlarged holes do not appear to have affected the probe's performance. Idaho does not get many rainy days, so the probe was tested for wet conditions by spraying it with a garden hose and then driving the truck. When the water spray was hitting the probe, a large number of spikes showed up in the pressure data. These spikes are very sharp and may be relatively easy to eliminate in the data processing. Once the truck was in motion, the wet ET probe appeared to be still providing reasonable mean horizontal winds, but there was a lot of noise in the data affecting the turbulence quantities. Some of this noise was periodic in nature, with a frequency of about 4 Hz. One theory is that water drops are sloshing back and forth inside some of the tubes and creating a pressure signal. Further modifications are already planned to help in reducing this noise. richard.eckman@noaa.gov, Tom Strong

***19. Smart Balloon.*** Full funding for this project has been restored after being completely cut early in March. We continued testing of the balloon transponder hardware and software and making changes to the communications software to convert from the Globalstar to the Iridium satellite system. UNH is now testing the ozone sensor. This sensor will be incorporated into the transponder package. randy.johnson@noaa.gov

***20. Proteus Aircraft***. Work began on the fabrication of a BAT probe for the Proteus aircraft (http://www.scaled.com/projects/proteus/proteus.htm). The BAT will provide turbulence data at the PROTEUS operating altitude – near the top of the troposphere. These measurements will provide a means to investigate relationships between vertical velocity, ice super-saturations, and ice crystal growth in cirrus clouds. Such measurements are critical for the advancement of our understanding of the role of cirrus clouds in the radiation balance. Installation and flight testing of the BAT on Proteus is tentatively scheduled for mid-summer with the first deployment in fall 2004. jeff.french@noaa.gov

***21. INEEL Support***. Last year an INEEL dispersion study was completed based on nine years of data from the Mesonet operated by FRD. The work was published as a NOAA Technical Memorandum (OAR ARL-246). Although this study had a relatively narrow focus for INEEL emergency planning, there are some aspects of the

work related to probability theory and dispersion that may have broader application. Hence, the outcome of the study is being reviewed to determine whether parts of it can be adapted for journal publication, possibly in *Atmospheric Environment* or the *Journal of Applied Meteorology*. This may require some extensions of the original study. richard.eckman@noaa.gov

**Las Vegas**

***22. DOE Meteorological Coordinating Council (DMCC).*** SORD serves as the lead of the DOE Meteorological Coordinating Council. Authorization was received to proceed with the DOE input to the "Federal Plan for Meteorological Services and Supporting Research, FY05". A DMCC Memorandum requesting updates to DOE meteorological programs was prepared and mailed to program managers at the various field offices. The deadline for inputs is April 15. Inputs will be melded into the new report and sent to DOE Headquarters in late April. (Darryl Randerson, 702 295 1232)

***23. Climatology/Maximum Temperature Predictions.*** March was the warmest on record for the NTS with averages as much as 10°F above normal. The maximum predictions for selected MEDA stations showed negative bias' with an average of -3.1°F and an absolute error of 4.4°F. The consistent departures were in the middle of the month when most of the record, or near-record, temperatures were occurring. This technique doesn't seem to handle extreme events very well, but is not too surprising when using statistics for prediction. (Doug Soule', 702 295 1266)

***24. Climatology/Wind Roses Updates***. The hourly, monthly, and annual wind roses for all active MEDA stations were updated through 2003. The graphics were transferred to SORD's Web Server, and are available for general use. The NOAA logo and ARL/SORD were added to each plot. (Doug Soule', 702 295 1266)