



# NOAA ARL Monthly Activity Report



**March 2005**

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## Highlights

1. *ARL Chairs the AMS ad hoc Statements Committee.* An ad hoc committee of the American Meteorological Society's (AMS) Scientific and Technological Activities Commission (STAC) has been formed to examine the process used by the AMS to issue formal statements. The group has now met twice via conference call and is working on recommendations to improve the process. Dian Seidel chairs the ad hoc committee, which is comprised of about half a dozen STAC committee chairs and the STAC commissioner. [dian.seidel@noaa.gov](mailto:dian.seidel@noaa.gov)

2. *Arctic Mercury Exchange Study.* As an addition to the Canadian Out On The Ice (OOTI) study at Barrow, mercury sensors were deployed at Barrow and Atqasuk (120 km inland). Profiles of gaseous elemental mercury were measured in collaboration with a balloon group from Purdue University. Mercury samplers also flew on the Aerosonde robotic airplanes operated by Ryerson University. Most surprising was the correlation between the time evolution of near-surface gaseous elemental mercury concentrations at Barrow, tens of meters from the ocean, and at Atqasuk, on inland tundra 120km south. To date, all Arctic long-term mercury monitoring had been on coasts (Barrow, Alert, Station Nord). It has been assumed that

direct proximity to sea-ice was a prerequisite for springtime mercury depletions. We now must re-evaluate this assumption. (S. Brooks)

**3. *Inter-agency Nuclear Safety Review Panel (INSRP) Convened.*** INSRP is the activity formally charged with assuring public safety from accidents during space operations using nuclear materials. Deep space projects normally carry radioisotope thermal generators as power sources, and these are normally use plutonium. ARL chairs the meteorology and dispersion panel of INSRP. The panel has been convened to consider materials developed for the coming New Horizons NASA mission to Pluto. (Pendergrass, Schalk)

## **Silver Spring**

**4. *Wildfire Smoke Dispersion.*** The BlueSky emission algorithm (from the U.S. Forest Service) has been incorporated into our smoke forecasting demo project (<http://www.arl.noaa.gov/smoke/forecast.html>). However the emission rate is presently assumed to be constant, and will likely remain that way until some changes are made in the way that NCEP can take land use patterns into account. [roland.draxler@noaa.gov](mailto:roland.draxler@noaa.gov)

**5. *Trajectory Comparisons.*** In a joint study with CMDL, alternative reanalysis data sets have been used to compare isentropic and kinematic 3-d trajectories. The 3-d trajectories attained higher elevations and transport distances than isentropic trajectories. Deviation statistics between meteorological data sets for 3-d trajectories exceeded those for isentropic trajectories. The reasons for this derive from variability in the supplied vertical wind field and the higher wind speeds in 3-d trajectories on the one hand, and the vertical constraints imposed by the isentropic assumption on the other. The paper has been submitted to JGR. [roland.draxler@noaa.gov](mailto:roland.draxler@noaa.gov)

**6. *SPARC Temperature Trends Assessment Panel.*** The Stratospheric Processes and their Role in Climate programme has undertaken a new assessment of stratospheric temperature trends. An international team met March 3-4, 2005, at the University of Reading (UK) to discuss recent findings and scope out a work plan. The team will be preparing a review paper on new observational findings during 2005, and examining model simulations thereafter. The assessment will contribute to the next WMO/UNEP Scientific Assessment of Stratospheric Ozone. [dian.seidel@noaa.gov](mailto:dian.seidel@noaa.gov)

## **Boulder**

**7. *SURFRAD/ISIS.*** One-hour averages of SURFRAD data are now being prepared, for delivery to the National Climatic Data Center (NCDC) archive in Asheville, NC. Test files were created and tested by reformatting software at NCDC. After several iterations, the files passed the scrutiny of NCDC's check program. A parallel algorithm was then developed for ISIS data. After SURFRAD and ISIS data are submitted to NCDC, the staff at Asheville will forward the data to the World Radiation Data Center in St. Petersburg, Russia. [john.a.augustine@noaa.gov](mailto:john.a.augustine@noaa.gov)

**8. *Diffuse Radiation Reference Standard.*** Results of the second intensive observation period (IOP) to define a working diffuse horizontal shortwave irradiance reference standard have been reported (J. Geophys. Res., 110, D06107, doi: 10.1029/2004JD005265). This work supports the Baseline Surface Radiation Network program. Most measurements made with pyranometers have negative offsets associated with infrared cooling of the instrument to the sky. This offset is most evident on clear nights, but, is even larger in clear daytime skies, although it is masked by the daytime signal. Establishing procedures to correct for this effect and to understand and minimize other effects that bias the measurements, such as the angular and spectral responses of pyranometers, were the goals of this research. Ultimately, a set of instruments with minimal biases will be chosen to establish this standard.

A further diffuse IOP is being planned. There has been a persistent problem with diffuse clear-sky models over-predicting the shortwave diffuse measurements. During the May 2003 Aerosol IOP of ARM, varied and

duplicate measurements of aerosol parameters that contribute to most of the uncertainty in this comparison were made. Better determination of the inputs and better diffuse irradiance measurements improved the comparisons relative to previous attempts. One outcome of the comparison was an possible explanation for the relatively large range in direct irradiance model results that needs explanation. [joseph.michalsky@noaa.gov](mailto:joseph.michalsky@noaa.gov)

**9. Polar Aircraft Validation Experiment.** Ozone measurements taken by NASA satellite CAFS (CCD Actinic Flux Spectroradiometer) instruments during the Polar Aircraft Validation Experiment (AVE) mission between January 24, 2005, and February 9, 2005, were re-analyzed. The ozone data on board the aircraft were taken to evaluate the OMI (Ozone Monitoring Instrument) ozone column measurements as part of NASA's AURA mission. The analysis of spectral actinic flux measurements is challenged by CAFS calibration issues. The CAFS ozone retrieval is sensitive to small spectral offsets between look-up tables and measurements. These offsets were corrected by forcing an agreement between tables and measurements during a short-term period of the test flight on January 20, 2005. A unique correction derived on that day was applied to all consequent science flights. The CAFS team (R. Shetter and S. Halls, NCAR, and I. Petropavlovskikh, NOAA/ARL) is planning to test optical collector uncertainties and stray-light effects. They will seek improved characterization of line shapes and wavelength assignment. [irina.petro@noaa.gov](mailto:irina.petro@noaa.gov)

## **Oak Ridge**

**10. ARL Upgrades to Twin Otter N48RF.** Three upgrades are planned for the ARL-funded NOAA Twin Otter. A sampling boom for the ARL BAT probe will be installed. The boom will be attached to the Twin Otter overhead fuselage, on the co-pilot's side and extend forward above the nose. Additionally, two modifications to the electrical system will be funded. The existing scientific power system will be upgraded from 200 amps (28VDC) to 300 amps (28VDC). An additional static inverter will be installed to supply additional A/C power to scientific instrumentation. A long-standing issue with scientific equipment has been the momentary power glitch that occurs with the scientific power is changed from an external power unit to aircraft power during the startup sequence. The power system will be modified to make that switch over seamless. (P. Hall, J. French, and W. Luke)

## **Research Triangle Park**

**11. Community Multiscale Air Quality (CMAQ) Model - Mercury.** The Community Multiscale Air Quality (CMAQ) mercury model was previously applied to the new Clean Air Mercury Rule (CAMR). CAMR was officially announced on March 15th. As part of the CAMR announcement, the Assistant Administrator for EPA's Office of Air and Radiation (OAR) held a press conference during which some of the CMAQ mercury simulation results were described. CMAQ data extractions were developed by OAR showing 144.23 tons of mercury deposited over the United States with 11.05 tons (7.7%) coming from coal-fired electric utility boilers. (Russell Bullock, 919 541 1349)

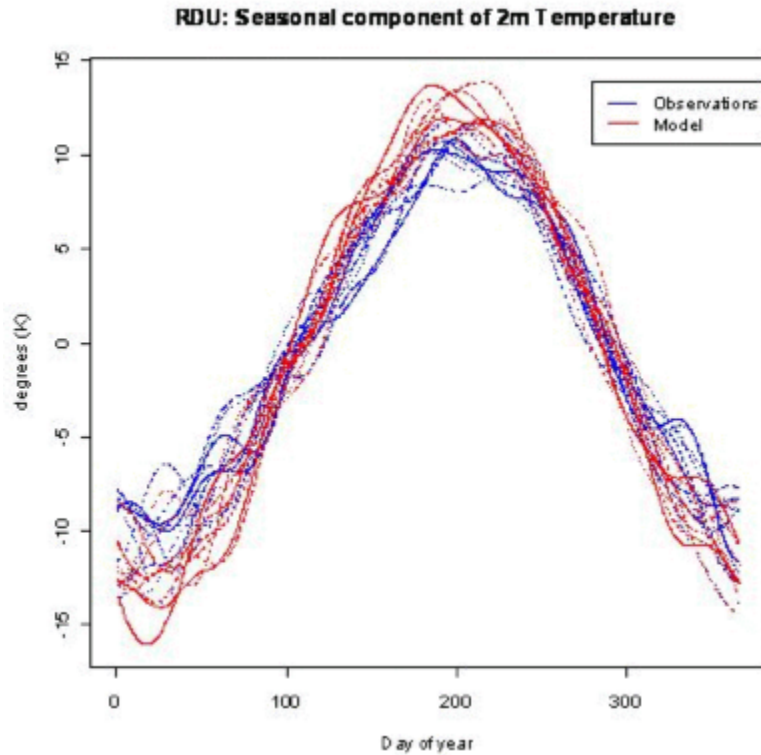
**12. Chlorine and Effects on Tropospheric Ozone.** A preliminary study has been completed to evaluate the effect of chlorine emissions on ozone in the United States. The study included anthropogenic molecular chlorine emissions, natural molecular chlorine released from sea-salt aerosol, and anthropogenic hypochlorous acid emissions from cooling towers and swimming pools. When molecular chlorine emissions were included in the CMAQ model, the only impact occurred near the Great Salt Lake due to the presence of a large anthropogenic chlorine source. Morning and late afternoon ozone mixing ratios at that location increased by a maximum of 14 parts per billion by volume (ppbv) and 4 ppbv, respectively, but the impact on the daily peak ozone mixing ratios was not substantial. When both molecular chlorine and hypochlorous acid emissions were included in the model, the impacts were evident in several areas, including the Great Salt Lake in Utah and the Houston area. Ozone mixing ratios in the Great Salt Lake did not change compared to the case with molecular chlorine emissions. Morning and the daily peak ozone mixing ratios in the Houston area increased by a maximum of 10 and 7 ppbv, respectively. In contrast to hydroxyl radicals, chlorine radical

mixing ratios peaked in the morning and reached up to 15% and 4% of the corresponding hydroxyl radical mixing ratios at the Great Salt Lake and the Houston area, respectively. Chlorine emissions appeared to increase the hydroxyl radical mixing ratios compared to the case without any chlorine emissions. The increases in ozone mixing ratios were accompanied by decreases in volatile organic compounds mixing ratios. (Golam Sarwar, 919 541 2669)

**13. Air Quality Forecast Model Development, Testing, and Evaluation.** In preparation for the 2005 forecast season, enhancements to the Eta-CMAQ air quality forecast system were tested through a variety of sensitivity simulations, which were performed for two periods in July and August 2004. These sensitivities included testing (1) the impact of changes in the radiation and land-surface modules in the Eta model on predicted O<sub>3</sub> levels, (2) the impact of a modified photolysis attenuation scheme in which below-cloud photolysis attenuation is based on the ratio of the downward shortwave radiation and its corresponding clear sky value, (3) the impact of turning off the above-cloud entrainment in Community Multiscale Air Quality (CMAQ) on air quality forecast results, and (4) testing the combined effects of the cloud mixing and photolysis attenuation effects. Sensitivity simulations for the two periods indicate that turning off the above-cloud entrainment in CMAQ results in reducing the predicted O<sub>3</sub> regionally, thereby, significantly reducing the high model bias in forecast O<sub>3</sub>. The changes in the photolysis attenuation algorithm, although providing closer coupling with the Eta radiation fields, did not result in a significant improvement in model performance. An updated version of the CMAQ code, including the changes to the cloud mixing scheme and an optimized (~50% faster relative to last year's version) and updated version of the PREMAQ processor have been delivered to the National Centers for Environmental Prediction (NCEP) for parallel testing. It is expected that these codes would become operational in the Air Quality Forecast (AQF) system in early May 2005. Comparisons of distributions of gaseous and particulate species, which are derived from both the operational O<sub>3</sub> and developmental PM model forecast runs from the summer of 2004, are being compared against measurements collected onboard the NOAA P3 aircraft during the 2004 International Consortium for Atmospheric Research on Transport and Transformation (ICARTT) field study. (Rohit Mathur, 919 541 1483; Jonathan Pleim, 919 541 1336)

**14. Emissions for Air Quality Forecasting.** For the 2005 ozone season, a revised and updated pre-processor to CMAQ, called PREMAQ, has been delivered to the National Centers for Environmental Prediction (NCEP). PREMAQ has been optimized to reduce run time by 50%. Updates have been made to reduce file sizes and to streamline the program. Additionally, the main emission calculations contained within PREMAQ, the plume rise for point sources, the biogenic emission estimations, and the mobile source emission calculation have been revised. For mobile sources, the vehicles miles traveled data have been updated to reflect 2005 projections. Finally all required data sets for the northeastern and eastern United States domains have been delivered to NCEP. (George Pouliot, 919 541 5475)

**15. Analysis of Regional Climate Scenarios for the CIRAQ Project.** Using 10 years of regional climate model (RCM) simulations under current climate conditions, an initial analysis of the seasonal variability of 2 m temperatures using the Kolmogorov-Zurbenko filter has been performed. Temperatures from the RCM simulations have been compared to observations from 25 National Weather Service sites. Qualitatively, the model and observations show similar inter-annual variability. However, a high summer bias and a low winter bias in the modeled temperatures are evident at a substantial number of the 25 sites. This bias is illustrated below in an example for the Raleigh-Durham (KRDU) airport weather station. Of the 25 sites considered, biases are most evident at sites in the southeastern United States. (Ellen Cooter, 919 541 1334; Alice Gilliland, 919 541 0347; Jenise Swall, 919 541 7655; and, Rob Gilliam 919 541 5493)



Analysis also continued of a decade of baseline 700 mb  $u$ - and  $v$ -wind component GISS/MM5 regional climate model (RCM) scenarios. For the spring season, the dominant patterns of 700 mb transport are similar to those from the two reanalysis databases. However, significant differences between the GISS/MM5 and reanalysis data sets are noted for the winter season. The reanalysis data sets show a prevalent southwesterly transport of warmer air northward over the South Central and southeastern United States. In the GISS/MM5 patterns, the frequency of southwesterly transport is greatly reduced, resulting in a cold surface temperature bias throughout this region. (Ellen Cooter, 919 541 1334; Rob Gilliam, 919 541 4593)

**16. Meteorologically-Related Variability in Emissions.** The Climate Impact on Regional Air Quality (CIRAQ) project is evaluating the variability of biogenic- and mobile-source emissions based on five years of down-scaled meteorology (based on MM5 simulations from a global circulation model) for a base period centered around 2000. The purpose of this work is to characterize the variability in emissions due to meteorology so that changes in emissions projected into the future (*e.g.*, 2050) due to economic growth, technology, and land-cover changes can be distinguished from seasonal and inter-annual variability. Preliminary analysis shows definite east to west variations in isoprene and NO emissions in the United States, and inter-regional and seasonal isoprene emission variations within the eastern United States related to dominant circulation patterns. Variability attributable to meteorology (primarily temperature) of modeled mobile-source emissions is dependent on the temperature averaging period used in mobile source modeling. In general, mobile-source emissions are less sensitive to temperature than biogenic emissions since there are several other important variables used in the modeling (vehicle miles traveled, vehicle fleet composition, road type, fuels, local control programs, etc.). Initial results were presented at the 14<sup>th</sup> International Emission Inventory Conference in Las Vegas, April 12-14, 2005. (Bill Benjey, 919 541 0821)

## Idaho Falls

**17. New York City Urban Dispersion Program.** The first field test of the Urban Dispersion Program in New York City using perfluorocarbon tracers has been completed. The opportunity was taken for the ARL team leader to meet with other principal investigators of the UDP program. The proposed August three-week field deployment is beginning to appear doubtful, as no funds have been forthcoming from DHS. However, seed money was obtained to conduct a limited background SF<sub>6</sub> study in NYC in the upcoming month. (Kirk Clawson, 208 526 2742)

During April, a preliminary test involving a limited number of samplers will be conducted in the proposed UDP study area to quantify the background SF<sub>6</sub> concentration. In preparation for this, samplers, cartridges and necessary equipment have been assembled. The cartridges have been cleaned and tested, and the samplers tested for proper operation. (Roger Carter, 208 526 2745, Vance Hawley, Debbie Lacroix)

The Automated Tracer Gas Analysis System (ATGAS) developed at FRD to analyze for single tracers is undergoing a major software upgrade to enable it to simultaneously analyze for multiple tracers. The ATGAS was initially designed primarily for high throughput and automated sample handling which are absolutely essential in large tracer field studies. A significant upgrade is required to support multiple tracers. Several key components have been upgraded and are operational, but a number of processing programs need to be modified to recognize and appropriately handle the multiple tracers. Completion of the upgrade is anticipated in May. (Roger Carter, 208 526 2745)

**18. Extreme Turbulence (ET) Probe.** Further investigations were made during March in comparing the ET probe with a sonic anemometer during the road tests performed in 2004. There is considerable scatter from one road test to another, but there does seem to be a slight positive bias (on the order of 1-2%) of the ET probe's wind speed compared with the sonic. This suggests that a small empirical adjustment may be required to the dynamic pressure obtained from the ET probe. (Kirk Clawson)

**19. Smart Balloon.** Side-by-side tests were conducted to compare the performance of the smart balloon transponder and sensors against a reference station data set – from the Idaho Falls meteorological station. Overall the results show good tracking on all of the sensors except for the solar pyranometer. Further testing will be done on the solar pyranometer to resolve this difference. (Randy Johnson, 208 526 2129, Shane Beard)

**20. Pentagon Shield.** News was received this month that there is a possibility of a second Pentagon Shield study to be conducted in November of this year. Details are still sketchy, but this is much more planning time than was provided for the first field deployment in May of last year. (Kirk Clawson, 208 526 2742)

## Las Vegas

**21. Cloud-to-Ground Lightning.** Cumulative frequency distributions of cloud-to-ground (CG) lightning activity vs. flash intensity (kA) for a circular area of 50 mi radius centered on the Nevada Test Site have been prepared. A total of 140,356 flashes were detected. The analysis revealed the following:

1. For negative CG flashes: 50% contained flashes with peak currents <10 kA and 99% contained flashes with peak currents <50 kA.
2. For positive CG flashes: 50% contained flashes with peak currents <8 kA and 99% contained flashes with peak currents <70 kA.

The peak current detected was 226 kA. (Randerson and Sanders)

**22. Las Vegas Urban Test Bed.** Two ARL ozone monitors are being tested prior to deployment by CIASTA and DRI in studies of air quality affecting the Las Vegas valley. Meetings were held with technical personnel from SORD, NNSA/NSO/STD, DRI, and Chugach, Inc. to identify a site at the Nevada Test Site for a vertical profiler that will be used to support the Las Vegas study, now planned to begin in May. (Pitchford)

**23. IJC -- Air Quality.** Marc Pitchford and Rick Artz participated in the International Joint Commission (IJC) Air Quality Advisory Board workshop titled “Beyond Keeping Clean Areas Clean and the Prevention of Significant Deterioration” held in at the David Skaggs Research Center in Boulder, CO (March 22 – 23). This second IJC workshop on this topic explored opportunities for collaboration between air quality programs in the U.S. and Canada. Presentations were made from representative of both countries on current and planned activities in air quality forecasting, monitoring programs, uses of satellite remote sensing, and use of air quality indices for communicating air quality levels to the public. Plans for data sharing and collocated monitoring to facilitate assessment of data comparability across the border are already underway as a result of the first workshop in Vancouver, BC last year. ([marc.pitchford@noaa.gov](mailto:marc.pitchford@noaa.gov) or 702-862-5432)