NOAA ARL Monthly Activity Report

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Richard S. Artz, Acting Director
Air Resources Laboratory

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Highlights

1. Fossett's Successful Around the World Solo Flight Used HYSPLIT/READY. Belgian meteorologist David Dehenauw again successfully guided Steve Fossett on his latest record, furthest non-stop flight in aviation history, using resources from both NOAA ARL and NCEP. In a letter, David said, "Thanks to NOAA weather technology I was able to steer him through the jetstreams and both the ARL website and NCEP NOMAD servers were used." David also set a record of his own as being the only meteorologist in the world to successfully guide three non-stop around-the-world flights (Fossett balloon in 2002, Fossett Global Flyer in 2005 and 2006). David hopes to visit NOAA again this spring as he did after the last successful flight in 2002. For more information on the flight see: http://www.globalflyer.com glenn.rolph@noaa.gov

2. Preparing for UrbaNet. The ARL research program designed to test various methods for predicting dispersion in urban areas (DCNet, focused on Washington, DC) has received a lot of attention. FY 2006 Congressional interest in the issue has resulted in two earmarks that are now being "worked" to ensure the development of products suitable for rapid and easy mainstreaming into the NOAA operational suite. The first of these earmarks is to generate a private/public partnership, such that people in cities and urban areas can rely on dispersion (and other) forecasts to make use of all available and relevant data, regardless of the origin of the data. The second earmark is intended to develop an operational dispersion system dedicated to the special conditions of the Gulf coast. The design of the overall program is being negotiated with the parties identified by Congress, and among the various NOAA participants (notably the National Weather

Service, the NOAA Homeland Security Program, and elements of the Earth Science Research Laboratory). (Will Pendergrass, Rick Artz)

3. Perfluorocarbon Tracer Analysis Capability. For decades, sulfur hexafluoride has been the gas used in most atmospheric tracer studies. There are many advantages. First, it is a common industrial chemical that is easy to obtain. Second, it is readily measured in trace quantities. Third, it is completely harmless (unless, of course, the concentrations rise to a level that inhibits the extraction of oxygen from the air). But it also has two disadvantages – it is commonly used as a high voltage electrical insulator, and hence can be found in many areas surrounding electrical substations, and it is most definitely a greenhouse gas. Neither of these disadvantages is a real issue of concern. Certainly, from the greenhouse gas perspective the amounts released in atmospheric tracer studies are miniscule in comparison to the leakage rates from industry. However, there is an appearance of releasing known greenhouse gases into the atmosphere that is mildly disturbing. Accordingly, a search for alternative tracer gases has been ongoing for some considerable time. Perfluorocarbons of various kinds have been used in field trials, with considerable success. While these can be detected with even more sensitivity that for sulfur hexafluoride, the techniques for their detection are more complicated. ARL (Idaho Falls) has therefore been actively researching the relevant measurement technology, with some considerable success, using modifications of the existing automated tracer gas analysis systems (ATGASs) used for sulfur hexafluoride detection. After appropriate modification, it has been found that a range of 10 ppt-10,000 ppt can be easily and precisely measured. Along with sulfur hexafluoride, a number of perfluorocarbon tracers were used in the 2005 New York City tracer study – MID05. Currently, the analysis time for each sample is approximately 16 minutes, so that the system is certainly potentially useable in future studies. It remains to compete testing of the new capabilities, and to refine the analysis systems to permit a faster sample throughput rate. debbie.lacroix@noaa.gov

Silver Spring

4. 1983 Krypton-85 Study Revisited. Global transport and dispersion continues to be an issue of importance, especially now that long range transport of atmospheric mercury is widely viewed to be a key reason for high mercury deposition rates to some US ecosystems. As the models are refined, there is a recurring need for data for their evaluation. The available data sets are few. Reconsidering historic data sets is sometimes very useful. Recent improvements to HYSPLIT have been tested using Krypton-85 (^{85}Kr) global 3-Dimensional (3D) transport-dispersion model was used to simulate Krypton-85 (^{85}Kr) observations generated by ARL in a field study conducted downwind of the Savannah River Plant (SRP, now the Savannah River Laboratory) in 1982 and 1983. The plant was then a center for reprocessing nuclear fuel, with ^{85}Kr released as a byproduct of the process. In the original analyses of the measurements, a constant value, different for each sampling station, was subtracted from the measurements to obtain the part of the measurement representing the SRP plume. The use of a 3D global model, which includes all major ^{85}Kr sources worldwide, has recently been used to reproduce the day-to-day concentration background variations at the sampling locations, with correlation coefficients of 0.34 to 0.47. These 3D model predictions, without including the nearby SRP source, were then subtracted from the measured concentrations recorded by each sampler to represent the portion of the measurement that can be attributed to emissions from the SRP. The revised plume estimates provide a greatly enhanced basis for testing HYSPLIT. roland.draxler@noaa.gov

5. A National Plan for Volcanic Ash Forecasting for Aviation. ARL is participating in the development of a national plan for volcanic ash dispersion forecasting, in support of the aviation industry. This activity is being led by the Office of the Federal Coordinator for Meteorology, with Barbara Stunder as the ARL participant. barbara.stunder@noaa.gov

6. International Volcanic Ash Dispersion Forecasting – New Standardized Products. A recent Operations Group meeting of the International Civil Aviation Organization adopted new standards for the reporting and graphical depiction of volcanic ash forecasts. The fate of the current ARL/HYSPLIT displays is uncertain,

but it is clear that HYSPLIT will be the dispersion engine to drive the new US products answering to the setting of the international standards. barbara.stunder@noaa.gov

7. Preparations for the 2007 AMS Annual Meeting. Dian Seidel has agreed to serve as co-chair of the 2007 Annual Meeting of the American Meteorological Society. Several preparatory steps were taken at the January 2006 meeting, in Atlanta, including

- Completing a three year term as chair of the AMS Committee on Climate Variability and Change.
- Chairing two sessions of the Conference on Climate Variability and Change;
- Presenting a talk on the use of tropopause height as an indicator of climate change.
- Reporting to the Scientific and Technical Affairs Commission on the deliberations of an *ad hoc* committee she chaired, on Guidelines for Statements by the AMS.
- Participating in planning meetings for the 2007 Annual Meeting..

dian.seidel@noaa.gov

Oak Ridge

8. Spatial Air-Surface Exchange Studies by Conditional Sampling. Airborne flux measurements by eddy correlation rely on a spatial average of at least a few kilometers to assure proper sampling of all relevant turbulence scales in the boundary layer. Much agricultural landscape is a patchwork of fields only several hundreds of meters in width. Major roads and powerlines further limit airborne operation, forcing polygonal paths. Such a pattern dominates in rural Illinois where, fortunately, the patchwork is primarily binary: corn or soybeans. Thus, conditional sampling by surface type is an attractive method to study the spatial exchange situation. The matter is of importance to assessments of atmospheric deposition, to carbon sequestration, and to the depiction of surface drag in weather forecasting models. It is being tested using data gathered in June (2005), when CO_2 flux most strongly differentiates corn from beans. Data scripts have been written to associate "flux fragments", samples over about 40 m of flight track, with their "footprints," the region of surface most likely to have influenced them. We will pair each fragment with corn, beans, both, or neither by overlaying each footprint over a land-use classification for 2005 June. ron.dobosy@noaa.gov, with D. Williamson and S. Kirby, University of Alabama

9. NOAA P-3 BAT Probe Integration for Hurricane Research. Work continues with integrating the new generation probes into the P-3 aircraft for this hurricane season. Once installed and tested, the new system will yield measurements of local turbulence intensities and exchange rates never before quantified in hurricanes. The new system will be substantially different from the old system, in that the data will be fed directly into the P-3 data system, and not into a special data system, as was done in the past. The probe bodies are being modified and refined, the new sphere has been calibrated, and the parts for a new pump system have been ordered. The pump system keeps rain from building up in the probe. (P.Hall and Senn)

Research Triangle Park

10. Atmospheric Environment Special Issue on Model Evaluation. A special issue of *Atmospheric Environment* containing papers from the *Third Community Modeling and Analysis System (CMAS) Conference* is now in press. Publication is expected during summer 2006. The CMAS Conference was held in Chapel Hill, North Carolina, during October 18–20, 2004. The *Model Evaluation Special Session* of the conference highlighted the latest developments in model evaluation results and techniques, with particular application to the Community Multiscale Air Quality (CMAQ) model used for air quality forecasting and assessment by NOAA and EPA. The conference was attended by 184 researchers from 8 countries, 58 presentations were made, and 27 posters were displayed. Presenters of papers and posters addressing aspects of model evaluation were encouraged to submit journal articles for the special issue. ARL/ASMD personnel

either authored or co-authored 11 of the 25 papers accepted for publication after formal journal peer review. william.benjey@noaa.gov

11. Community Multiscale Air Quality (CMAQ) Model-Mercury Modeling. Testing was conducted on the recently completed Community Multiscale Air Quality (CMAQ) mercury model. This configuration of the model is expected to be released in February/March 2006. Testing used a new version of the MCIP pre-processor with elemental mercury (Hg0) dry-deposition velocity calculations added and new emissions inputs, which include natural and recycled mercury emissions from water surfaces, soils, and vegetation. New natural and recycled mercury emission data were developed from coarse-resolution modeling estimates of Hg0 emissions from volcanoes, oceans, and geology obtained from Atmospheric and Environmental Research, Inc., Palo Alto, California, combined with high-resolution estimates of Hg0 emissions from vegetation developed at Lamar University, Beaumont, Texas, using a specially adapted version of the Biogenic Emission Inventory System v3, also known as BEIS3. Testing showed that the modifications resulted in more reasonable air concentrations in CMAQ mercury simulations. o.russell.bullock@noaa.gov

12. Coupled CMAQ - WRF Modeling System via the Earth System Modeling Framework. Progress has been made on a fully coupled (two-way) Weather Research and Forecasting (WRF) meteorological model and Community Multiscale Air Quality (CMAQ) model using the Earth System Modeling Framework (ESMF). ESMF is a set of tools that allows different models to be coupled in an online mode. In doing this, variables from a meteorological model can be passed to an air quality model on a time-step by time-step basis, and variables of the air quality model (*i.e.*, aerosols) that impact meteorology (*i.e.*, shortwave radiation) can be passed to the meteorological model. This framework leads to a more consistent and accurate modeling system. The framework will also allow other models (*e.g.*, ecosystem models) to be connected to the modeling system rather easily. Currently, efforts are focused on a proof-of-concept model demonstration. This first test will incorporate the WRF model and a "shell" code to represent the CMAQ model within ESMF. The purpose of this first step is to develop the necessary code superstructure to connect the two models, perform re-gridding between the models, develop the date-time synchronization and any other transformations. In January, most of this first step was completed. The WRF model is now running within ESMF and the code superstructure is mostly in place to add the CMAQ model. In February, the remainder of this first step will be completed, and efforts will focus on replacing the shell code with the full CMAQ model. robert.gilliam@noaa.gov

13. Ambient Air Measurements at the Research Triangle Park Location. Through a collaborative effort with the Environmental Protection Agency's (EPA) Office of Air Quality Planning and Standards (OAQPS), the Atmospheric Sciences Modeling Division has created an Ambient Air Monitoring Training and Outreach Center located at EPA's Research Triangle Park, North Carolina, campus. The center monitors, stores, and disseminates various air quality and meteorological measurements. OAQPS is responsible for the air quality data, which include CO, SO_2, NO, NO_y, $NO_2 + NO_z$, and O_3 ($PM_{2.5}$ to be added later), while the Division is responsible for the meteorological data, which include 10 m wind speed and direction, 2 m temperature, relative humidity, solar radiation, and precipitation. All data are collected and stored on an hourly basis. There are many purposes of the monitoring center, as it will:

- Provide a dedicated set of precursor, O_3, $PM_{2.5}$, and meteorological instruments to post campus-based measurements on AIRNow and local intranets.

- Provide a comparison of particular interest to Research Triangle Park staff during local episodes of elevated ozone or $PM_{2.5}$.

- Provide an operational site and demonstration facility with state-of-the-art air monitoring equipment and procedures.

- Provide a realistic and useful training site for visiting State, Local, and Tribal monitoring personnel to complement classroom-based instructional programs. brian.eder@noaa.gov

14. Climate Change Effects on Atmospheric Emissions. ARL/ASMD scientists are examining the potential effect of climate change on meteorologically-influenced emissions, particularly biogenic and mobile sources. Five years of emissions each for a base period (centered on 2000) and a future period (centered on 2050) have been estimated using meteorology from MM5 with boundary conditions set by the Global Institute for Space Studies (GISS) version II' model. The Environmental Protection Agency's 2001 national emission inventory for modeling (version "ad") was used for the base and future years, except that biogenic and mobile source emissions were allowed to respond to changes in climate. Preliminary results indicate that annual and seasonal biogenic emissions for the future period are noticeably greater over the United States, and are more variable than for the base period. Changes in mobile emissions are not nearly as noticeable. Annual biogenic isoprene emissions are approximately 20 percent greater for the future period than the base period, and the variance is approximately 32 percent greater. After additional analysis, we will compare meteorologically-influenced emissions derived from MM5 driven with regional climate data versus emissions derived from MM5 subject to nudging from actual weather observations. This will help elucidate effects of climate change caused by meteorological changes as opposed to meteorological modeling approaches. william.benjey@noaa.gov

Idaho Falls

15. New York City Dispersion Study – MID05. Analysis of data from the New York City dispersion program of 2005 is now reaching a point where a NOAA technical memorandum is being prepared. This will constitute a complete report on the study, including descriptions of FRD's involvement in MID05 as well as an analysis of how the atmospheric tracer plume dispersed in the deep street canyon urban environment. roger.carter@noaa.gov, Debbie Lacroix, and Jason Rich

16. Extreme Turbulence Probe. The "ET Probe" is a pressure-sphere turbulence and anemometry system designed for operation in winds high enough to destroy conventional sensors. It has been deployed in the path of several hurricanes, and has yielded new information on the nature of air-surface exchange in exceedingly high winds. At this time, the development is sufficiently advanced that formal reports are in preparation.. richard.eckman@noaa.gov and Ron Dobosy, ATDD

17. Smart Balloons in TexAQSII. In collaboration with colleagues at the University of New Hampshire and the University of Hawaii, plans are being made for six smart balloons to be used during the TexAQSII study to be held later this year. These balloons allow measurement of the changes in air chemistry as a parcel of air moves away from the source of pollution. In previous studies, the balloons yielded evidence of strong stratification over the Atlantic. The results to come from the Texas deployment are eagerly awaited.

A meeting for planning and platform coordination with other study participants will be held in Austin, Texas during the month of April (no definite date is set yet). Some of the other platforms that plan to participate are the NOAA WP-3D, the NOAA Twin Otter lidar aircraft, the NOAA research vessel Ronald H. Brown, the CIRPAS Twin Otter, and possibly the NASA J-31. randy.johnson@noaa.gov

Las Vegas

18. Preparing for UrbaNet – Las Vegas. For several years, research by the ARL group in Las Vegas has been increasingly directed towards studying the atmospheric environment of the Las Vegas urban area, essentially a built-up region surrounded by desert. The basic tools to conduct such a study have been in place for a long time, some as a result of the ARL partnership with the Department of Energy at the Nevada Test Site and some due to dedicated efforts by the ARL team working with NOAA support. In

the past, the Cooperative Institute for Atmospheric Studies and Terrestrial Applications (CIASTA) has been a major partner with ARL on is growing endeavor, but with the coming end of CIASTA this particular mechanism for extracting support for joint studies from other agencies is no longer available. The Las Vegas urban area study has therefore slowed down.

The new UrbaNet program has injected new life into the overall program. Because of its location in arid surroundings, the availability of a fully-functioning research mesonet upwind, and the long-term running of a fully data assimilative mesoscale model, Las Vegas is seen as a "lowest hanging fruit" selection for early attention under the UrbaNet program. darryl.randerson@noaa.gov