NOAA ARL Monthly Activity Report

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1. Highlight – Lightweight Ozone Monitor Successfully Tested. Evidence of the east Tennessee fixation on college football surfaced during September. The new "hitchhiker" ozone monitoring system, developed by ARL, was tested on a plane towing a banner during a recent game of the University of Tennessee Volunteers (go Vols!). The hitchhiker system is a completely self-contained atmospheric ozone monitoring system, consisting of a miniaturized ozone monitor, a data logger, a GPS system, a self-contained power supply, and a data modem that allows the transfer of information directly to a ground station while the package is aloft. It is designed to ride on any general-aviation airplane as ordinary baggage. The system is fully contained in a rugged nylon tool bag. In

operation a small air sampling tube connects the bag with an open window or other access to outside air. ed.dumas@noaa.gov, d.l.senn@noaa.gov, maynard.ludwig@noaa.gov

2. Highlight – Progress with UrbaNet. Upon unexpected release of hazardous material in an urban area, there is immediate need for optimal use of all available information. Numerical forecast models currently reach grid sizes as small as 4 km. Such models forecast the "skimming" flow over the city, above the influence of individual structures. UrbaNet sites and the simpler but much more numerous sites of AWS Convergence Technologies, Inc. provide information about the local scales. These observations are not forecasts, nor can their data be assimilated into the forecast model without losing their fine-scale information. A history of such observations with corresponding archived numerical forecasts, however, allows development of "model output statistics" -- typically multiple linear regressions. These statistical methods have been used since the 1970s to relate models' forecasts to local temperatures, rainfall, and the like. Combined with urban measurements they show promise with channeling along street canyons, strength of turbulent mixing and other parameters important to rapid estimates of contaminant spread. Such model output statistics will be developed first for selected sites in the UrbaNet test-bed areas: National Capital Region, and Las Vegas, Nevada. ron.dobosy@noaa.gov, richard.eckman@noaa.gov

In a parallel activity, AWS data are being scrutinized, to explore the possibility of extracting real-time dispersion information from them. The meteorological community at large has argued strongly that data like those of AWS are of little use because they are affected by local obstacles in the urban surface boundary layer. For the present application, such objections are voided by the realization that it is precisely within this near-surface layer of the atmosphere that accurate dispersion forecasts are required. The data are obtained where we need such data; the challenge is to learn how to optimize their use. The ongoing analysis couples AWS observations from their spatially dense urban network with data from the better sited but sparser DCNet array.

In September, a new UrbaNet site was installed at the new facility of the Emergency Management Agency for Washington, DC. There are now nine such stations in the Washington metropolitan area, each providing data to the ARL research team in real time. Discussions continue with AWS Convergence Technologies and the Joint Forces Headquarters - National Capital Region to collaborate on locating additional UrbaNet sites in the DC region. chris.vogel@noaa.gov, randy.white@noaa.gov, randy.meyer@noaa.gov, will.pendergrass@noaa.gov

A survey of potential fugitive sources of SF_6 and interferants was conducted in Las Vegas, NV, on September 12-14. The survey consisted of driving a van instrumented with an SF_6 real-time analyzer along the Las Vegas Strip and into and around the downtown area. The survey was conducted over several days. No major sources of SF_6 or SF_6 interferants were discovered. The results indicate that the SF_6 atmospheric tracer could be used in a large scaled atmospheric tracer field study without the fear of fugitive SF_6 tracer sources convoluting the concentration data. kirk.clawson@noaa.gov

3. Highlight – Collaboration with NOS -- Gulf of Mexico Mercury Research. To support studies of the origins of mercury affecting the Gulf of Mexico, a new mercury site has been installed at a temporary location at the NOAA Grand Bay National Estuarine Research Reserve (NERR) in Mississippi. Installation included a 16' trailer, a 20' tower, and a Tekran mercury speciation suite. Additional trace gas sensors will be installed in October. We anticipate moving to the permanent location by Summer 2007. A local operator is overseeing the site on a daily basis. steve.brooks@noaa.gov; winston.luke@noaa.gov

4. Highlight – Collaboration with the Canaan Valley Institute -- More Mercury Research. A new mercury site was established on Canaan Valley Institute land in a natural clearing. Site work in September included preparation of a gravel road with storm water culverts, a parking area, utility trenches and conduits, a 20'x8' building with telephone, DSL, electrical, and HVAC, and, a 20'x20' elevated platform for wet and dry deposition sensors. Three-inch conduits for electrical and signal cable were also trenched from the building to the platform and to the future walk-up tower location. The goal is to learn how to quantify the atmospheric contribution to the total pollution input to ecosystems, in a region greatly impacted by upwind power production. steve.brooks@noaa.gov

5. Highlight -- Preparations for the 2007 AMS Annual Meeting. The program for the AMS Annual Meeting, to be held the week of January 14 in San Antonio, Texas, was prepared during August and reviewed by the meeting co-chairs, Dian Seidel and Mary Cairns. The meeting will include about 22 specialty conferences, forums and symposia, special sessions highlighting the meeting theme of "Bridging the Studies of Weather and Climate", talks in observance of the Martin Luther King holiday, 5 town hall meetings, 5 short courses, social events, media events, a video theatre, career fair, exhibits, and more. dian.seidel@noaa.gov

ARL Headquarters, Silver Spring

6. HYSPLIT Developments. The need to use the Hybrid Single Particle Lagrangian Integrated Trajectory model (HYSPLIT, and similar capabilities) over urban areas has generated a requirement for better and more extensive input data. To these ends, the NCEP WRF-NMM decoder has now been generalized to provide sigma-level data extracts over limited spatial domains. This modification will provide more compact long-term archives in areas where spatially dense data are needed. In addition, a program was developed to convert NAM-12 km NetCDF output files (the AWIPS standard format) to the HYSPLIT compatible format. This is in support of a collaborative program with GSD (Boulder) to provide a HYSPLIT plume forecast capability that can run on WSFO's AWIPS workstations. roland.draxler@noaa.gov

7. HYSPLIT Global Modeling. The global model originally developed to compute ^{85}Krypton background concentrations based on the 2.5 degree global reanalysis data was tested using our new 1degree resolution data archives. Several additional tests were required to remove inconsistencies in the input meteorological data height fields that were not present in the 2.5 degree archives. Further testing revealed that due to the higher vertical resolution of the 1 degree data, a lower vertical mixing scaling coefficient (10 versus 50 m^2/s) was required to achieve the same concentration dilutions as with the calculation using the 2.5 degree data. roland.draxler@noaa.gov

8. HYSPLIT-WEB Update. The ARL "READY" web site is an exceedingly popular access point for researchers (and others) seeking trajectory and dispersion computations. Access to the web site is available at all times, to registered users. HYSPLIT is a very popular part of the READY site, enabling users to make their own dispersion and trajectory forecasts whenever such products are needed. During September, many additional features were added to the registered users web version of HYSPLIT trajectories (http://www.arl.noaa.gov/ready/hysplit4.html)

- GFS Forecast Data -- An option has been added to the forecast trajectories to enable trajectories that run off the chosen meteorology grid (in time or space) to continue running with the current Global Forecast System (GFS) meteorological data if the data range is available. The current GFS forecast dataset contains 48 hours of analysis and 84 hours of forecast information.

- Multiple Source Locations -- Users now can enter up to three different trajectory source locations instead of just one. All trajectories will be calculated for all specified levels (1, 2 or 3) for a total of up to nine trajectories per run.

- Trajectory Matrix Option -- A trajectory matrix option will produce a grid of trajectories bounded by the first 2 entered source locations and evenly spaced with a grid increment given by the distance between the lower left grid point (trajectory 2) and trajectory 3. Only one height is currently allowed.

- Trajectory Ensemble Option -- A trajectory ensemble option will produce multiple trajectories from the first user-selected starting location. Each member of the trajectory ensemble is calculated by offsetting the meteorological data by a fixed grid factor (one grid meteorological grid point in the horizontal and 0.01 sigma units in the vertical). This results in 27 members for all-possible offsets in X, Y, and Z.

- Source Location Symbol -- An option has been added to allow users to turn on or off the source location symbol on the trajectory map. This is useful for the trajectory matrix display.

- Rerun the model using user-defined defaults – An option has been implemented to allow users to rerun a trajectory calculation by modifying the user entered defaults of that particular run to produce a new calculation with its own Job ID number.

Some of these options will be made available to the concentration section of HSYPLIT-WEB in the future. glenn.rolph@noaa.gov

9. Climate-Scale PBL Behavior. A new project on the climatology and variability of the global planetary boundary layer (PBL) is starting, as a collaborative effort involving scientists at ARL Headquarters, ARL Atmospheric Sciences Modeling Division, NESDIS/National Climatic Data Center, U. Mass (Amherst), and Russia. Although there is a large literature describing the characteristics and variability of the PBL on diurnal and seasonal time scales, and in various specific locations, there is apparently very little published work on the PBL addressing global features and long-term changes, which will be the focus of this study. dian.seidel@noaa.gov

10. Forest Fire System with Expanded HYSPLIT-Chemistry Modeling. A collaboration with the CMAQ team at Research Triangle Park is proving very productive – combining the use of the HYSPLIT and the Community Multiscale Air Quality model (CMAQ) to improve forecasting of the distribution of particulate matter (PM) in the Eastern US. A case study covering the period from July 14th to 23rd of 2004 has been used to assess the contribution from wild fire emissions located in Alaska to the PM levels in the Eastern US. HYSPLIT was used to track and quantify the transport, dispersion and deposition of primary PM from Alaskan fire sources to the CMAQ domain boundary, and CMAQ was then used to account for the additional PM sources within its Eastern US domain. Comparison between model results and field measurements show that the HYSPLIT-CMAQ system gives better estimates of the PM concentrations than CMAQ alone with clean background concentrations as boundary conditions. However, large uncertainties are associated with the Alaskan fire emissions estimates. Further investigation is needed to assess the best emissions algorithm. Therefore, an additional set of PM emissions estimates based on MODIS observations are being developed to determine the long-range

contribution of emissions from Alaskan forest fires. (See the related item from Research Triangle Park below -- ***Improving Estimates of Wildland Fire Emissions.***) ariel.stein@noaa.gov

11. Trajectories for a "Surprise" Alaskan Volcano. The Fourpeaked volcano, which is not known to have erupted historically, came to life in September. Fourpeaked is located about 200 miles southwest of Anchorage. An automated forecast trajectory program was setup following inquiries from the National Weather Service office in Alaska. Computed trajectories can be reviewed at http://www.arl.noaa.gov/ready/traj_alaska.html. Discussions have started about transferring this capability to NCEP for operational use. barbara.stunder@noaa.gov

Atmospheric Turbulence & Diffusion Division (ATDD), Oak Ridge

12. Collaboration with USDA and EPA – Emission and Deposition of Ammonia. Accurate measurement of the rate of exchange of ammonia between the surface and the air has proved elusive. Several methods appear feasible, but none is well developed. ARL has led the development of some of the new methods. In recent work, a dual-height annular denuder sampling system (developed by M. Heuer and T. Meyers of ARL/ATDD), was tested in an intercomparison experiment to measure atmospheric ammonia fluxes over mature soybeans, in Lillington, NC. The system measured ammonia, sulfur dioxide, nitric acid, and PM2.5 nitrate and sulfate concentrations at heights of 1m and 4m above the canopy. Three-hour integrated samples were collected and shipped back to ATDD for analysis by ion chromatography. Other ammonia analyzers were operated by Winston Luke of ARL and by EPA scientists. mark.heuer@noaa.gov, latoya.myles@noaa.gov, simone.klemenz@noaa.gov, tilden.Meyers@noaa.gov

13. CO_2 Exchange Studies. ARL initiated the now-global program to measure the rates of exchange of CO_2 between the atmosphere and the surface. The early work was done at the Walker Branch Watershed in Oak Ridge. Today, there are similar centers of excellence in many countries, operating under the "FluxNet" umbrella. The US "AmeriFlux" network is a part of this activity. To enhance the overall capability at the ARL site in Oak Ridge, Scott Richardson of the Department of Meteorology at Pennsylvania State University has recently installed a high precision carbon dioxide (CO_2) system at the Chestnut Ridge site. It records CO_2 concentrations with an accuracy of 0.2 ppm. In support of the Chestnut Ridge program, a video camera has been installed. Some of the research results are to be published shortly in "Agricultural and Forest Meteorology." mark.heuer@noaa.gov, tilden.meyers@noaa.gov

Atmospheric Sciences Modeling Division (ASMD), Research Triangle Park

14. Community Multiscale Air Quality (CMAQ) Model-2006 Public Release. The next release version of the Community Multiscale Air Quality model (CMAQv4.6) was delivered to the Community Modeling and Analysis System (CMAS) center for public distribution. This version of CMAQ included: a new version of the Asymmetric Convective Model (ACM2) for boundary layer turbulence and diffusion; a new Carbon Bond chemical mechanism (CB05); updates to the gas-phase and heterogeneous N_2O_5 reactions; additional capability of CB05 and AE4 aerosol mechanisms for plume-in-grid, mercury, sulfate tracking, carbon apportionment, and air toxics (which also includes toxic metals); a simulation restart file; and a utility program to convert MCIP meteorological data into HYSPLIT format. The distribution also included updates to the build and run scripts, a benchmark test case with reference data, and associated documentation (release notes and instructions). shawn.roselle@noaa.gov

15. CMAQ Modeling System Peer Review. The next peer review of CMAQ planned for December 2006. The previous peer review was conducted during May 2005. The peer review will be conducted under contract by the University of North Carolina at Chapel Hill, Carolina Environmental Program (CEP). There will be a summarization of the results of the last peer review followed by a new peer review that will have an emphasis on the meteorological modeling aspects of the system. CEP is in the process of selecting a panel of approximately seven peer reviewers from the academic, regulatory, and industrial and consulting air quality modeling communities. The peer review report should be available by April 2007. william.benjey@noaa.gov

16. Improving Estimates of Wildland Fire Emissions. Estimates of wildland fire emissions are highly uncertain, and PM predictions suffer as a result. The Division is examining several methods for improving these estimates. Estimates for June-July 2005 are being compared from several alternative approaches: a NESDIS method using data from the GOES satellite, an inventory derived from the NOAA's Hazards Mapping System (HMS) daily fire pixel counts, and a "ground truth" inventory derived from the U.S. Forest Service's Form-209 wildland fire reports. For large fires reported across the continental United States, the fire locations from all sources of data were very consistent. Additional analysis is planned to compare the temporal consistency among the approaches. Emissions estimates for this test period for the various approaches will be created for input into CMAQ. The period June 18–July 9, 2005, has been selected, because of the large number of wildfires reported in the southwestern United States during that period. For retrospective modeling, the goal is to develop a method for combining satellite information with the Environmental Protection Agency's wildland emission inventory to improve its spatial and temporal resolution. For input to NOAA's air quality forecast system, the goal is to use satellite information to develop near-real-time wildfire emission estimates. george.pouliot@noaa.gov

17. Special Issue on the Relationships between Air Quality and Human Health. The Air & Waste Management Association published a special issue of *Environmental Management* dedicated to the relationships between air quality and human health. Dr. S.T. Rao, Director, NOAA Air Resources Laboratory's Atmospheric Sciences Modeling Division, provided an introduction for the special issue. In addition, Dr. Richard Spinrad, Assistant Administrator, NOAA OAR, Dr. George Gray, EPA Science Advisor and Assistant Administrator, EPA ORD, and Dr. Howard Frumkin, Director, CDC's National Center for Environmental Health/Agency for Toxic Substances and Disease Registry, wrote letters emphasizing the collaborative research efforts of NOAA, EPA, and CDC in understanding better the relationship between health and air pollution. ARL scientists featured prominently in the authorship of articles. st.rao@noaa.gov

Field Research Division (FRD), Idaho Falls

18. TEXAQS-II: Smart Balloon. During August and September, FRD launched six NOAA "smart" balloons as part of the Texas Air Quality Study II. The NOAA smart balloon design allows the operator to remotely control balloon flight levels to permit sampling of different layers of the atmosphere. The balloons were used to measure ozone concentrations with a state-of-the-art miniature sensor that was designed and built by scientists at the University of New Hampshire. The balloons also included instruments to measure a number of other meteorological variables while immersed in plumes of urban air. Houston has one of the highest levels of ozone in the U.S., and scientists are trying to better understand how the pollutant is exported from "mega-polluted" areas such as Houston and Mexico City and what its impact is on the air quality of the Northern Hemisphere.

"The balloons provide a very unique platform," stated collaborator Robert Talbot, director of the UNH Climate Change Research Center, which is a part of the Institute for the Study of Earth, Oceans, and Space where the miniature ozone sensor was developed. "The real power of the balloons is the continuous observation on spatial scales that other platforms can't do," said Talbot. For example, a smart balloon, drifting at 10 meters per second in a polluted plume of air, can make much higher resolution measurements than an aircraft traveling ten times faster but flying in and out of the plume. Thus, the balloons provide a new perspective on the flow and dispersion of pollution from the Houston area, and will help scientists learn how these plumes disperse over the Gulf of Mexico in particular. ARL scientists will work in collaboration with faculty and students from UNH and the University of Hawaii in analyzing the data obtained during the smart balloon flights. randy.johnson@noaa.gov

19. Real-time Tracer Analysis Technology. Experiments conducted at FRD have demonstrated a new technology that could possibly replace the current system used in the continuous tracer analyzers. A semi-permeable gas membrane successfully removed the oxygen from an air stream allowing an electron capture detector (ECD) to measure tracer concentrations ranging from 49 to over 5,000 pptv. The current continuous tracer analyzers, which are a vital part of FRD's dispersion measurement capabilities, rely on a hydrogen-oxygen reaction to remove the oxygen from the sampled air. This requires tanks of compressed hydrogen and nitrogen for the analyzer to be operated. These are always safety concerns. A semi-permeable membrane requires no compressed gases and would be simpler and safer to operate. roger.carter@noaa.gov

20. Perfluorocarbon Tracer Analysis Development. The development of a perfluorocarbon tracer (PFT) analysis capability at FRD is nearly complete. Two different PFTs (PDCB and PMCH) have been included in the development of this capability. The analysis time is about 5 minutes per sample with an instrument limit of detection (ILOD) of 1 pptv. Some recently-collected field tracer samples were analyzed to determine if there were any interferences from the urban air environment. Debbie Lacroix

21. Flow Decoupling in Urban Areas. Analysis of data from the 2005 New York tracer study (MID05) indicates that flow decoupling in Midtown Manhattan during daytime conditions occurs at wind speeds of less than about 2-3 m s^{-1}. For wind speeds less than this threshold, a good possibility exists that the track of the tracer plume at street level will vary from the wind direction at rooftop levels by as much as 90 degrees. For wind speeds greater than this threshold, the track of the plume at street level will be consistent with the building-top wind direction. The exact wind speed threshold for flow decoupling is a function of the thermal regime (atmospheric stability), characteristics of the urban canopy, and wind direction. Coupled flows tend to occur in daytime conditions in association with well organized wind fields characterized by higher wind speeds and consistent wind directions at all meteorological stations across the metropolitan area. At very low wind speeds, transport by advection is significantly diminished, plume arrival is delayed, plume decay is very slow, and it is possible to realize high concentrations upwind of the release site. In warmer parts of the day, the urban atmosphere becomes increasingly unstable, vertical dispersion is enhanced, and the surficial area of the plume concentration footprint contracts. High rooftop concentrations are a possibility. Significant tracer concentrations can persist for several hours after the release has ended. These results, together with other MID05 analyses, are included in the draft manuscript entitled: "Analysis of Plume Dispersion Characteristics for Continuous Tracer Gas Releases in Midtown Manhattan, MID05" presently undergoing internal FRD review. dennis.finn@noaa.gov

Special Operations and Research Division (SORD), Las Vegas

22. Interagency Monitoring of Protected Visual Environments (IMPROVE). Dr. M. Pitchford chaired the IMPROVE Steering Committee meeting at Mammoth Cave National Park, KY. Among the topics covered at the meeting were the review and approval of a plan to cope with projected reduced funding by EPA that could result in decommissioning of up to 35 sites out of about 160 nationwide; reductions in the data availability lag times; and the implementation of web site data advisories as a means to communicate data issues to the user community. The approval of the plan for network downsizing to reduce costs is the culmination of extensive assessments and numerous subcommittee meetings over a six-month period to identify the monitoring sites that contribute the least to our understanding of rural particulate pollution and regional haze in visibility-protected federal class I areas (i.e. national parks and wilderness). Based on these analyses, only three of the 35 sites that were listed could be removed without sacrificing representative monitoring for some of the 156 visibility-protected areas. The number of sites decommissioned depends on EPA funding that won't be known until the Fiscal Year 2007 budget is passed by Congress.

Aerosol speciation data will be delivered on a monthly basis with a six-month lag-time (e.g. January data available in July) starting later this year. If any of the aerosol species are not complete in time partial data will be delivered and made available in a preliminary data archive on the IMPROVE web site. A new feature of the IMPROVE web site will be the data advisory section, where unusual characteristics of the data discovered by IMPROVE staff scientists or data users are briefly described so that other users are aware of potential quality or applicability issues. Often these will describe suspect data where there are no legitimate reasons for invalidating the data, though they will likely be flagged as suspect. In some cases they may point to some unexpected insight into how to use the data that is not commonly known. Another change mandated at the meeting was the creation of a web page on the IMPROVE site explicitly for quality assurance data such as measured field and laboratory blanks, calibration values, etc. This section may be of greatest use for future investigators who will want to better understand the factors that might have influenced this long-term data base (i.e. nearly 20 years of aerosol speciation data). A more complete summary of the meeting is posted on the IMPROVE website at http://vista.cira.colostate.edu/improve/. marc.pitchford@noaa.gov