NOAA Air Resources Laboratory Quarterly Activity Report

(October – December 2008)

Contents

Highlights

1. HYSPLIT System Upgrade at NCEP. The HYSPLIT system upgrade was implemented at NCEP. There were no changes to the underlying model; however, additions included a back-tracking capability, Google Earth output, RUC (Rapid Update Cycle) forecast meteorology, and GDAS (Global Data Assimilation System) analysis meteorology. The GFS (Global Forecast System) forecast meteorology was extended from +84 hours to +16 days. This operational system at NCEP is run by NCEP Central Operations as needed to respond to accidental releases of hazardous materials into the atmosphere or for large volcanic eruptions. barbara.stunder@noaa.gov

2. Manuscript for Journal of Climate. A paper by Melissa Free and John Lanzante comparing the effects of volcanic eruptions on temperatures in general circulation (GCM) models and radiosonde observations was accepted by the Journal of Climate. The paper shows that the coupled GCMs that include volcanic aerosols in their forcings show post-eruption signals that are generally similar to those in radiosonde observations, with a tendency to understate the tropospheric cooling and overstate the stratospheric warming. Despite the significant temperature changes after eruptions, the effect of the most recent eruptions on temperature trends in the satellite era appears to be small. melissa.free@noaa.gov

3. USCRN Site. The last USCRN site for the CONUS was commissioned on October 2, 2008 at Coos Bay, OR. This was a milestone for the USCRN program. mark.e.hall@noaa.gov

A winter test site was installed near Boulder, CO at the National Center for Atmospheric Research (NCAR) Marshall Field site. This test bed will compare several precipitation gauges in different wind shield configurations. This is a windy site and will hopefully provide good data for windy, snowy conditions. A new gauge designed by Belfort is part of the test bed. mark.e.hall@noaa.gov

4. Roadside Barrier Tracer Study. The EPA Roadside Barrier field study was conducted in October. It consisted of a shakedown test and 5 regular tests. Each regular test spanned a 3-hour period broken into 15-minute tracer sampling intervals. Of the 5 regular tests, one was conducted in unstable conditions, one in neutral conditions, and three in stable conditions. The principal elements of the experiment were a SF_6 tracer line source representing pollution sources from a roadway on the upwind side of the barrier; a mock sound barrier made out of 1-ton straw bales that were 90 m long and 6 m high. On the figure displayed, the winding path to the left of the barrier is the track taken by the vehicle carrying the continuous tracer analyzer); an array of 6 sonic anemometers for making wind and turbulence measurements; a mobile real-time tracer analyzer; and a gridded array of tracer bag samplers downwind of the line source and barrier for measuring mean 15 minute concentrations. To better understand the effects introduced by the roadside barrier, tracer measurements were made on two separate grids so that results could be compared. These two grids were identical to each other with the exception that one grid had the barrier and one did not. They had a large crosswind separation to eliminate any possible interference.

The SF_6 tracer release was started from the line source for each grid before the sampling measurements began in order to establish a quasi-steady state concentration field. The release continued until the end of each test. One anemometer was located upwind of the non-barrier sampling grid at a height of 3 m and served as a reference for the approach flow. Another anemometer was located at a height of 3 m upwind of the barrier for measuring the effects of the barrier on the approach flow. Three anemometers were located on a tower at heights of 3, 6, and 9 m in the wake zone downwind of the barrier and a fourth was located farther downwind near the end of the wake zone effects. The mobile tracer analyzer drove a set route with multiple crosswind and alongwind traverses through the sampling grid. The route took about 15 minutes to complete and one mobile analyzer was assigned to each grid. Each of the sampling grids consisted of 58 locations marked by metal fence posts. The bag samplers were attached to the fence posts at 1.5 m height. In addition to the 58 regular samplers on each grid, an additional 9 samplers were deployed for quality control purposes. These included field duplicates, field controls, and field blanks. dennis.finn@noaa.gov and staff

Data analysis for the fast response tracer analyzers has been completed and all quality control (QC) steps completed. Final data files for release will be generated within the next couple weeks. The bag sampler data are in the final steps of QC. The last review steps should be completed within about a week and final data files for release will be generated for them. Preparation of the final report is underway. roger.carter@noaa.gov

Analysis of the 54 meter long release line data is complete. Mass flow meter data indicates that regulation of the flow of tracer to the two release lines was maintained to less than $\pm$1% of the average release rate using instantaneous one second readings. Using 10 second smoothing through the full range of the releases typically brought the variation, from the beginning to the end of the test, to less than $\pm$0.25% with no long term drift throughout the 3-hour period. This is very good considering the fact that the mass flow controllers were operating at 10 to 25% of the full scale operating range. randy.johnson@noaa.gov

Preliminary data analysis for the roadside barrier study indicates the following:

a) The areal extent of the concentration footprint downwind of the barrier was a function of atmospheric stability with the footprint expanding as stability increased.

b) The magnitudes of the normalized concentrations were a function of atmospheric stability. The normalized (and actual) concentrations increased on both the barrier and non-barrier grids as atmospheric stability increased.

c) Lateral dispersion was significantly greater on the barrier grid than the non-barrier grid. Plumes on the non-barrier grid tended to have much sharper and better defined boundaries as opposed to the more diffuse and lower concentration gradient patterns observed on the barrier grid. It is likely that at least part of the greater horizontal plume spread on the barrier grid can be attributed to edge effects. However, there are many cases where edge effects appeared to be minimal or negligible.

d) There was invariably a concentration deficit in the wake zone of the barrier with respect to concentrations at the same grid locations for the non-barrier release. This was due to (1) vertical movement and dispersion forced by the barrier, (2) turbulence above the wake zone generated by shear flow across the barrier enhancing turbulent dispersion, (3) horizontal plume spread (with or without edge effects), and (4) edge effects.

e) The barrier tended to trap high concentrations in the roadway in low wind speed conditions, mainly during the stable tests.

f) Edge effects were evident in many of the individual 15-minute sampling periods. They ranged from negligible or minor to severe. The importance of the edge effects was related to mean wind direction, the extent of wind meander, wind speed, and atmospheric stability. Lower wind speeds and/or the damped vertical motions and turbulence associated with increased atmospheric stability contributed to the development of edge effects.

g) The barrier decelerated and deflected the approach flow.

h) The anemometers on the tower array in the wake zone provided strong evidence for the presence of a rotor in the wake of the barrier and a higher turbulence region above the wake zone induced by shear across the top of the barrier. kirk.clawson@noaa.gov and staff

5. NTS Field Experiment Support. SORD provided the complete weather data collection, interpretation, and forecasting an international consortium of nuclear scientists required to conduct an experiment at the Nevada Test Site. Specific weather criteria had been identified for safe and successful experiment execution. GPS Radiosonde balloons were released in the early morning and pre- and post-experiment execution. PIBAL balloons were released and tracked hourly until experiment execution. The day's weather forecast was presented in the Plan of the Day morning briefing. Participating SORD staff included 2 Meteorologists, 3 Meteorological Technicians, 1 Information Technology Specialist, and 1 Electronics Technician. walter.w.schalk@noaa.gov

Atmospheric Turbulence and Diffusion Division

6. Arctic Mercury. Steve Brooks participated in a meeting of the Arctic Monitoring and Assessment Program (AMAP) in Quebec City, Quebec on December 7-11, 2008. The purpose of the meeting was to draft a detailed, stand-alone mercury report, which is scheduled for completion in late 2009. Selected chapters will also be published in Environmental Science & Technology. steve.brooks@noaa.gov

7. ***Implementation of Weather Research and Forecast Model (WRF).*** Tools are being developed at ATDD to aid in the response to an unanticipated release of toxic materials to the atmosphere in the complex ridge-valley terrain of East Tennessee. Expanding on ATDD's Regional Air Monitoring and Analysis Network (RAMAN), staff are implementing the Weather Research and Forecast (WRF) Model in two modes. The WRF has run regularly since 2008 March, drawing initial and boundary conditions from the Rapid Update Cycle (RUC) model. Current forecasts are posted on the web and all forecasts are archived. Current work is to incorporate RAMAN data, along with any vertical soundings that may be available, by variational assimilation. ron.dobosy@noaa.gov

Field Research Division

8. Low Cost Tracer Detector. A prototype of the low cost tracer analyzer was operated during the final test of the EPA Roadside Barrier Tracer Study. A preliminary look at the data collected indicated it did collect some tracer concentrations, but further analysis is, of necessity, being delayed until the data analysis required for the project and the final report have been completed. roger.carter@noaa.gov

9. ET Probe. There is a good chance that ARL will receive NOAA funding for the ET probes this fiscal year as part of the Hurricane Forecast Improvement Project (HFIP). A primary research thrust for HFIP is to improve hurricane intensity forecasts, and limited knowledge of air-sea turbulent exchange in hurricane conditions is a major source of uncertainty. The focus of the ET probe effort will be to obtain measurements of air-sea fluxes in hurricane conditions. To this end, the first task will be to upgrade the current probes so they are better suited for extended deployments. Upgraded probes will then be deployed at near-shore sites to test their performance after extended exposure in a marine environment. For the longer term, the plan is to deploy probes on deepwater platforms and eventually on buoys. richard.eckman@noaa.gov

10. Nuclear Radiation Safety. Earlier this year, the US Nuclear Regulatory Commission (NRC) began an audit of the NRC Materials License that was issued to the NOAA laboratories in Boulder, CO and Idaho Falls, ID. As part of this audit, two NRC inspectors visited FRD on Dec 3, 2008. They reviewed our complete nuclear materials program including storage, handling, inventories, wipe tests, records, procedures, etc. No violations of NRC regulations were found. We continue to work with the other NOAA laboratories to ensure that all NRC regulations are followed and all nuclear materials are handled responsibly and safely. roger.carter@noaa.gov, Kirk Clawson, and Dennis Finn)

Special Operations and Research Division

11. National Ambient Air Quality Standards (NAAQS)/EPA. EPA staff is considering a proposed welfare-based secondary Particulate Matter (PM) NAAQS designed to address visibility impacts in urban areas at PM concentrations below the health related Primary PM NAAQS 24-hour mean control level of $35 \mu g/m^3$. To do so, EPA must determine the urban haze level that would be considered adverse to public welfare, which requires input from surveys of public response to various haze conditions depicted in urban scenic photographs. The technical issues and approaches used to conduct these surveys was the topic of an EPA sponsored workshop held in Denver, CO (10/6/08 to 10/8/08). Dr. Pitchford and others are using the information disseminated at the workshop to draft plans to conduct the surveys, which if approved would be started after OMB approval, probably next year. The workshop summary is available at the following link: http://vista.cira.colostate.edu/improve/Publications/GrayLit/033_UrbanVisibilityWorkshop/WorkshopSummaryMemo-1.pdf. marc.pitchford@noaa.gov

12. IMPROVE Project. Marc Pitchford chaired the IMPROVE (Interagency Monitoring of Protected Visual Environments) Steering Committee annual meeting at Okefenokee National Wildlife Refuge in southern Georgia (10/28-29/08). In addition to the annual updates on the status and performance of the ~160 site PM/visibility monitoring network, the meeting topics included data quality and user advisories, interim report on a nitrogen deposition special study, the ecological role and air quality consequence of wild-land fire at Okefenokee and elsewhere. IMPROVE is working with Environment Canada and NOAA to arrange for funds to cover the cost of operating a second IMPROVE particle speciation site in Canada. The current site is at Egbert, Ontario and the proposed second site would be in the Canadian Rocky Mountains. The meeting summary and presentations are available at
http://vista.cira.colostate.edu/improve/Activities/activities.htm. marc.pitchford@noaa.gov