



NOAA Air Resources Laboratory Quarterly Activity Report

(April - June 2009)

Contents

Highlights

1. *Summer Interns*
2. *Study of Houston Atmospheric Radical Precursors (SHARP)*
3. *GRUAN Analysis Team for Network Design and Operations Research*
4. *Mississippi Coastal Atmospheric Dispersion Study (MCADS)*
5. *USCRN Installation of Soil Moisture and Soil Temperature (SM/ST) Probes*

Air Resources Laboratory - Headquarters

6. *Progress on Planetary Boundary Layer Climatology Study*
7. *ENSO Effects in the Stratosphere*
8. *Manuscripts*

Atmospheric Turbulence and Diffusion Division

9. *WRF Model Output Statistics (MOS)*

Field Research Division

10. *ET Probe*
11. *WISDOM*
12. *Transport and Dispersion Modeling*

Special Operations and Research Division

13. *Air Quality – IMPROVE*
14. *Air Quality – Particulate Matter National Ambient Air Quality Standards*
15. *Air Quality – Urban Visibility Assessment*
16. *CalNex*
17. *WRF/HYSPLIT*
18. *Southern Methodist University Memorandum of Understanding*
19. *Outreach*

Highlights

1. Student Interns. Angelica Betancourt-Negron was a summer intern at the Air Resources Laboratory in Silver Spring under the NOAA Educational Partnership Program. Angelica is a rising senior, double majoring in Physics and Geography, at the University of Puerto Rico. Working with Dr. Dian Seidel, she analyzed a global radiosonde dataset to develop a climatology of the stable planetary boundary layer. Her work contributes to a comprehensive boundary layer climatology project at ARL. Angelica is looking forward to returning to NOAA next summer and to pursuing graduate studies in Atmospheric Science after completing her undergraduate degree. dian.seidel@noaa.gov

Sherry (Yiwen) Li was a summer intern working with the ARL HQ IT team. Sherry provided assistance with a variety of tasks including the creation of an Alfresco collaboration website for ARL's intranet; IT purchases, and equipment configuration and troubleshooting; property management, and IT inventory maintenance; vulnerability scanning and fixing; and other end user help and support. Sherry was an asset to the ARL IT team. She will return, as a senior, to the U. of California, San Diego in September. rick.jiang@noaa.gov

Five undergraduate scholars visited ATDD this summer: Aziza Marchant and Samuel Ubanyionwu in NOAA's Educational Partnership Program, David John Gagne and Kenneth Pratt on NOAA's Hollings Scholarships, and Ridwaana Allen on a Howard Hughes Summer Research Fellowship. Their mentors were Tilden Meyers, LaToya Myles, Will Pendergrass, and Ron Dobosy. These scholars were highly motivated and productive people who gave as much value as we hope they got. It was a joy to have them. latoya.myles@noaa.gov

2. Study of Houston Atmospheric Radical Precursors (SHARP). ARL Staff completed the field deployment of trace gas and aerosol pollutant sensors as part of the SHARP project, April 15-May 31, in Houston, TX. The multi-investigator, multi-institution project included an extensive array of trace gas and aerosol instrumentation deployed on fixed and mobile platforms to enhance our understanding of the complex chemical and physical atmospheric processes occurring in the Houston area. Paul Kelley and Winston Luke measured ambient air concentrations of reactive nitrogen species (NO , NO_x , NO_y), precursors to the formation of ground-level ozone, from a rooftop laboratory installed atop the North Moody Tower, an 18-story dormitory on the campus of the University of Houston. Steve Brooks from the Canaan Valley Institute measured atmospheric mercury species at a site in the Houston Ship Channel (HSC). Concentrations of gaseous elemental mercury, reactive gaseous mercury, and fine particulate mercury stayed near their background levels except when the wind was from the HSC's petrochemical facilities 1 km to 8 km distant. Such episodes produced sharp increases in all three species, significantly correlated with concentrations of NO_x . Plans are being developed for permanent year-round measurement of mercury species in Houston. steve.brooks@noaa.gov; winston.luke@noaa.gov

3. GRUAN Analysis Team for Network Design and Operations Research. The Global Climate Observing System (GCOS) Reference Upper Air Network (GRUAN) established an informal, international analysis team for network design and operations research at its March 2009 meeting. Dian Seidel chairs that team, which has now had two quarterly conference call meetings. This quarter, the group developed a work plan and identified five focused research projects directly relevant to GRUAN implementation. Seidel leads one of the projects, a collaborative effort with scientists at NOAA/NESDIS Satellite Applications and Research in Suitland. The study focuses on understanding the spatial representativeness of GRUAN radiosonde observations via analysis of the climatology of horizontal drift of radiosonde balloons from their surface launch locations. This work will help GRUAN address questions such as:

- How far apart can measurement systems (e.g., radiosondes and ground-based radiometers) be and yet be considered effectively to sample the same atmospheric column?

- How far apart can GRUAN sub-sites be and still be considered a single GRUAN site?
- How close must a satellite overpass be to a GRUAN site for the GRUAN observation to be useful for calibrating a satellite observation?
- How far from the GRUAN station is a reference radiosonde likely to drift before falling back to ground level for possible retrieval?

An abstract on this work has been submitted to the IIPS conference at the 2010 AMS Annual Meeting. dian.seidel@noaa.gov

4. *Mississippi Coastal Atmospheric Dispersion Study (MCADS).* Scientists and summer interns from ATDD joined scientists and students from Jackson State University, Mississippi, in a field study measuring atmospheric dispersion in the Gulf Coast's characteristic flow regimes. Measurements were made at multiple sites along a line perpendicular to the coast. Parameters were atmospheric ozone, nitric acid, and sulfate, along with vertical profiles and surface measurements of wind, temperature, and humidity. These will provide data from which to improve atmospheric dispersion forecasts in a region of pronounced sea breezes and related mesoscale phenomena. will.pendergrass@noaa.gov

5. *USCRN Installation of Soil Moisture and Soil Temperature (SM/ST) Probes.* For more detailed monitoring of drought and saturation conditions, a total of 24 Climate Reference Network sites have been upgraded since mid-April with SM/ST probes and relative humidity measurement. A further 16 sites are planned to receive the upgrade by the end of 2009. mark.e.hall@noaa.gov

Air Resources Laboratory – Headquarters

6. *Progress on Planetary Boundary Layer Climatology Study.* A radiosonde-based dataset describing the climatology of the planetary boundary layer (PBL) has been developed by Dian Seidel and colleagues. This global dataset is the first of its kind and is meant to provide a basis for evaluating the representation of the PBL in climate and air quality models, as well as for comparison with PBL height estimates from Global Positioning System (GPS) radio occultation observations and from satellite and ground-based lidar aerosol observations. Seidel presented a seminar on this work in a July visit to GFDL and discussed potential collaboration on a study comparing the observed climatology with that of GFDL's new climate model. Similar discussions with NCEP and with NCAR have also been initiated. An abstract on this work has been submitted to the air pollution conference at the 2010 AMS Annual Meeting and to an upcoming GPS data users workshop. dian.seidel@noaa.gov

7. *ENSO Effects in the Stratosphere.* A paper by Melissa Free and Dian Seidel describing significant El Nino cooling in the tropical stratosphere and warming in the Arctic stratosphere was submitted to Journal of Geophysical Research-Atmospheres. melissa.free@noaa.gov

8. *Manuscripts.* The following paper "Effect of Volcanic Eruptions on the Vertical Temperature Profile in Radiosonde Data and Climate Models" by Melissa Free and John Lanzante appeared in the June issue of the Journal of Climate. melissa.free@noaa.gov

Winston Luke completed revisions to a manuscript describing results from ARL's involvement in the 2006 Houston field study, the TexAQS-II Radical and Aerosol Measurement Project (TRAMP) at the University of Houston. A special issue of Atmospheric Environment will be devoted to the results of the TRAMP study. winston.luke@noaa.gov

Atmospheric Turbulence and Diffusion Division

9. WRF Model Output Statistics (MOS). A set of MOS equations and the infrastructure to improve and extend them was developed for ATDD's implementation of WRF (Weather Research and Forecasting) in east Tennessee by David John Gagne, one of the summer interns. This provides a tool for testing the effectiveness of MOS in accounting for several known and suspected biases in mesoscale models' forecasts. In particular for east Tennessee, WRF is known to overpredict the wind speed among the long low ridges on the valley floor that are too small to be resolved. ron.dobosy@noaa.gov

Field Research Division

10. ET Probe. The upgraded data system for the Extreme Turbulence (ET) Probe is completely assembled and undergoing testing. The data system consists of two separate subsystems. Data collection is accomplished by electronic filters and a data acquisition board installed directly inside the probe's sphere. Anti-aliasing filters are used on all the analog data channels to limit the amount of oversampling required. Digitized 50 Hz data are sent via a serial link to the data processing subsystem, which is an external single-board computer running Linux. This computer executes software to calculate winds from the raw pressure measurements and can save both the raw data and the derived wind observations. For maritime applications, it was decided to keep the computer in a housing external to the sphere in order to improve the chances of data recovery even if the ET Sphere itself is damaged or lost in a hurricane. Currently, data are stored on a 32 Gb SDHC card which has the advantage of no moving parts, small size, and very low power requirements. The entire system including probe and all data processing components requires only 12 watts of power.

The temperature sensors originally used in the probes are no longer manufactured and have been replaced by thermocouple-based sensors that use an AD594 thermocouple amplifier. This design was first suggested by ATDD and has proven to be an inexpensive and reliable substitute for the old temperature sensors.

An initial test of an upgraded probe was conducted on June 25 by mounting the system on a vehicle and driving at highway speeds. Initial analysis of the road-test data indicates the new probe functions as expected based on our experience with the old design. One issue that did crop up was some noise in the static pressure signal, and this is being investigated. rick.eckman@noaa.gov, Roger Carter, Randy Johnson, Shane Beard, Tom Strong

11. WISDOM. FRD will be responsible for WISDOM (Weather In-Situ Deployment Optimization Method) balloon launches during the month of September in Bermuda, Azores, and Senegal. Contacts in each of these countries have been established to assist us in locating a suitable facility for

balloon inflation and launches. A trip is being planned to visit each of these countries to present WISDOM goals, finalize launch locations, establish in-country contact points, and possibly identify trainees to assist in this work. randy.johnson@noaa.gov

12. Transport and Dispersion Modeling. The modified Con2dose radiological modeling program, originally developed by the ARL HQ HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) group, was able to generate maps for up to 8 dose types and 2 additional concentration/deposition parameters for one radionuclide at a time. This program has been modified to also accommodate the combined doses (rem) from multiple nuclides, up to 16 nuclides per simulation and generate individual concentration and deposition maps for each nuclide included in the simulation in $\Phi\text{Ci}/\text{m}^3$ and $\Phi\text{Ci}/\text{m}^2$, respectively.

An effort has been made to retain the functionality of the existing programs as much as possible. Therefore, edits of the code have emphasized adding features without taking away from existing functionality. Some modifications have also been made to the Doseplot plotting program with this in mind. Doseplot generates the radiological maps using the output from Con2dose. The Doseplot modifications include adding options for the choice of EAL contours as requested by our Idaho National Laboratory (INL) partners while retaining the EPA Protection Action Guide options. The table of dose conversion factors will also be altered to reflect the needs of INL, but it will be a simple matter of having more than one table available.

However, we have made significant changes to the subroutine in Doseplot that generates the output files for plotting the contour intervals. Originally this subroutine generated KML (Keyhole Markup Language) files for use in Google Earth. It has been rewritten and simplified and the output is now in the form of a text file customized for use in the Google Maps application also under development. We believe that it would be possible to accommodate both the original Google Earth and Google Maps options within the same program if it was determined that this was desirable.

The choice of Google Maps instead of Google Earth stems from decisions relating to the need to customize and optimize the application for our INL partners. The user interface is still web-based and is being developed within the Flash API programming environment. The interface will offer a significantly different appearance and utility than the existing Google Earth format. A basic working prototype of the interface exists but there is still work to be done to get it into final form.

We have successfully tested code and a script for building any desired multiple nuclide HYSPLIT control file and initiating a radiological dispersion run from the web interface. The initial focus is on the use of preconfigured release scenarios identified by INL (i.e. known nuclides, maximum release rates, deposition parameters). Work is in progress for implementing the means to identify and archive the results of multiple runs by multiple users. This includes an effort to have the option to share output with other users if desired. Preliminary benchmark testing was completed for optimizing the grid spacing and number of particles with respect to number of nuclides used, model simulation time, plume plot quality and resolution, and computer runtime. Plumes for shorter simulation times tend to have blocky edges and it is necessary to reduce the grid spacing and/or increase the number of particles. A contour smoothing algorithm has also been developed to help with this issue.

There is still a considerable amount of work to be done with regard to linking the various components of the modeling system in the background (e.g. spawning model runs, constructing command lines, feedback to the user, etc.). We also still need to complete development of the scheme for using meteorological observations from the INL mesonet as input to HYSPLIT. dennis.finn@noaa.gov, Brad Reese, Jason Rich, Roger Carter, and Rick Eckman

As part of a relicensing effort for the Advanced Test Reactor at INL, FRD was asked to perform an analysis of five years of data from the INL Mesonet and provide the results in two file formats used by Nuclear Regulatory Commission dispersion models. The data analysis was largely completed by June and will wrap up in July. neil.hukari@noaa.gov, Rick Eckman, Donna Harris, and Kirk Clawson

Special Operations and Research Division

13. Air Quality – IMPROVE. Marc Pitchford briefed the U.S. and Canadian members of the International Joint Commission Air Quality Advisory Board at its meeting in Washington D.C. on the progress made in expanding the IMPROVE (Interagency Monitoring of Protected Visual Environments) monitoring network to include sites in Canada, and other related topics. IMPROVE operates ~160 PM monitoring sites in remote areas of the U.S. and one site collocated with Environment Canada (EC) monitoring at Egbert, Ontario, which is funded by EPA. EC has requested a second IMPROVE monitoring site be set up at Banff National Park, Alberta. Resources for that site would be provided by EC through a MOU with NOAA (currently in legal review). marc.pitchford@noaa.gov

14. Air Quality – Particulate Matter National Ambient Air Quality Standards. Marc Pitchford participated in conference calls and attended the EPA Clean Air Science Advisory Committee (CASAC) meeting at Research Triangle Park, NC, to hear review comments on the Draft Particulate Matter Integrated Science Assessment (ISA) which is a review of the recent particulate matter science and is the first major set in the 5-year review process for the Particulate Matter National Ambient Air Quality Standards (PM NAAQS). Marc is the primary author of Chapter 9, "Welfare Effects" of PM. Marc also completed revisions in response to EPA's CASAC and public comments on the December 2008 review draft version of the document. This is the science foundation for the review and possible revision to the PM NAAQS. Marc prepared information on monitoring options being considered by EPA if they promulgate a Secondary PM NAAQS designed to reduce visibility impact in urban areas. This will be presented via conference call to the Monitoring Subcommittee of the National Association of Clean Air Agencies. marc.pitchford@noaa.gov

15. Air Quality – Urban Visibility Assessment. Marc Pitchford participated in conference calls to plan and began drafting the urban visibility assessment document, a part of the EPA review of the particulate matter (PM) National Ambient Air Quality Standard (NAAQS). This will describe the use of available air quality data, relative humidity data, and CONUS air quality simulation model predictions to estimate current hourly visibility conditions in 15 major urban areas. The current plan is to use the hourly model output of PM composition to determine the diurnal variations in composition and normalize the concentrations using the modeling data. The ultimate goal is to

generate typical hourly PM light extinction values using a linear algorithm that requires the composition and humidity data for each month and every 36km grid cell for CONUS. The assessment will compare current levels to results of survey studies on the haze levels that the public find to be unacceptable. These assessment results will be used in the risk analysis portion of the review and possible revisions to the PM National Ambient Air Quality Standards (NAAQS). Preliminary results have been reviewed, including air quality modeling output that estimates the diurnal concentrations of the major PM components and the contributions by policy-relevant background sources (i.e. natural and outside of US control). marc.pitchford@noaa.gov

16. CalNex. Representatives of NOAA, NASA, NPS and Western Regional Air Partnership (WRAP; i.e., a multi-state and tribal organization) met at the NOAA facility in Boulder, CO to discuss the possibility of extending the geographic scope of the NOAA CalNex 2010 air quality study in California to include impacts in adjoining downwind states. The field study will include airborne and ship-based air quality and meteorological measurements during May and the first half of June, 2010 designed to improve our understanding of the sources and processes that effect air pollution in Southern California. The rationale for extending the scope to downwind states is to better characterize the impact which are thought to be substantial of transported pollutants on the remote and urban areas in the region. NPS and other routinely measure high ozone and particulate in national parks in Nevada, Arizona, Utah and Colorado that is associated with transport over southern California. A substantial portion of the pollutants measured in the downwind urban areas is suspected to result from transported materials. NASA expressed interest in collaborating with NOAA on CalNex 2010 if the study were to have an expanded geographic scope. This could include use of airborne and satellite air quality measurements and data analysis support. David Parrish, Tom Ryerson, and Edward Dunlea, the NOAA CalNex 2010 managers that were at the meeting, expressed general support for expansion of the scope of the study within the constraints of the measurement platforms and welcomed the collaboration by WRAP, NASA, and NPS. Additional coordination and planning to reflect these adjustments to the plan are needed. marc.pitchford@noaa.gov

17. WRF/HYSPLIT. Scripts were modified to create and display Hysplit 1-hour plumes from 5 locations on the NTS using the WRF forecasts from 00 and 12 UTC. They are created at release times at 15, 17, 19, 21, 23, and 01 UTC. The plumes are available as plots which can be displayed in a web browser or in kml files which can be downloaded and opened in Google Earth. Work is being done using the uncoupled version of the NOAA LSM to try and determine whether or not the soil moisture content coming from the NAM model, which provides the initial and boundary conditions for the SORD WRF model forecast, is reasonable. Desert Rock SURFRAD data was downloaded and will be used to run the NOAAH model. kip.smith@noaa.gov

18. Southern Methodist University Memorandum of Understanding. An MOU was drafted to do work with the Southern Methodist University (SMU). The program would entail multiple radiosonde releases for several days at two different locations in Nevada. Document was submitted to SMU for initial review. walter.w.schalk@noaa.gov

19. Outreach. SORD staff participated in the 2009 “Take Our Daughters and Sons to Work Day.” In addition, two demonstrations to local schools were conducted relaying basic meteorology facts and principles. In addition, demonstrations of hot/cold air circulation, instrumentation (old and new,

surface and upper air), dew and frost creation, cloud formation, lightning, and dust devils were presented. walter.w.schalk@noaa.gov