NOAA Air Resources Laboratory
Quarterly Activity Report
FY2012 Quarter 4
(July - September, 2012)

Contents

DISPERSION AND BOUNDARY LAYER

1. New HYSPLIT web-based interface

Final preparations have been made to a new HYSPLIT web-based interface soon to be tested by a few experienced NOAA HYSPLIT users and NWS Weather Forecast Offices. This interface will allow weather forecasters to set up a release of a hazardous chemical to the atmosphere using the extensive scenario-based source term configuration of CAMEO/ALOHA. Based on the selections, the model creates a time-varying release rate to feed into HYSPLIT for transport and dispersion. Development was briefly halted due to the ARL move to College Park and the introduction of a new, more powerful, web server at ARL Headquarters to be used by the HYSPLIT/ALOHA system before being moved to an operational server at the NOAA Web Operations Center (WOC). After testing is complete and corrections or modifications are made based on the tester's input, work will begin to implement the system at the WOC. glenn.rolph@noaa.gov

2. Harvard Collaboration: Arctic Methane Emissions

The NSF-funded collaboration with Harvard University to measure spatially distributed fluxes of methane and carbon dioxide from the arctic landscape is progressing toward a December installation of the instruments into the Centaur (DA-42) aircraft in Manassas, Virginia. The instrument suite combines the proven Mobile Flux Platform (MFP) developed by ARL and Airborne Research Australia with Harvard's innovative high-rate airborne sensor of methane, carbon dioxide, and water. The MFP's primary components are ARL's Best Aircraft Turbulence (BAT) probe to measure the wind relative to the airplane and NovAtel's current-generation Synchronous Position, Attitude, and Navigation (SPAN) system to measure the airplane's motion relative to the ground. The SPAN system was delivered to ATDD, and software has been written to test its performance and to integrate it into the MFP's data-acquisition system. The integration required only a few weeks of work, after which the SPAN system was returned to Harvard. Ron.dobosy@noaa.gov

3. Transport and Dispersion Modeling

The Field Research Division (FRD) drafted a Software Quality Assurance (SQA) plan for ARL HYSPLIT in collaboration with Roland Draxler from ARL headquarters. This plan will provide the basis for a gap analysis that is part of the process for being granted formal acceptance of ARL's HYSPLIT model within the DOE's Subcommittee on Consequence Assessments and Protective Actions consequence assessment model toolbox. The SQA plan and the User's Guide for the implementation of NOAA/INL Emergency Operations Center (EOC) HYSPLIT were also updated to version 1.1, consistent with the current operational version. FRD tested all facets of the NOAA/INL EOC HYSPLIT implementation using the formal protocol described in version 1.1 of the SQA (dennis.finn@noaa.gov)

4. Mesoscale Forecast Modeling

Work continued on developing probabilistic point forecasts based on output from the WRF system running at FRD. The WRF forecasts have both biases and random errors that can be estimated by comparisons with data from the NOAA/INL Mesonet. The probabilistic algorithm uses the past performance of the WRF model to adjust the current forecast to account for model bias. It also computes ranges for the forecast variables based on the random errors observed in the past. The algorithm is continually updated based on the most recent model performance. (richard.eckman@noaa.gov)

5. Support for Experiments on the Nevada National Security Site
James Wood and Kip Smith provided enhanced weather support for a non-proliferation experiment conducted on the Nevada National Security Site (NNSS). This support included weather forecasts and a lightning watch focused on the experiment location. In addition, a radiosonde balloon was released to collect upper air data. The balloon collected data to over 90,000 feet. These activities are necessary to provide information for use and analysis in the experiment set-up and execution, and for the safety of the personnel. This support was critical to the preparation of the experiment, as the NNSS weather was influenced by monsoonal moisture and generated numerous thunderstorms with hundreds of cloud to ground lighting strikes and rain, which caused a lightning alert to be issued and resulted in a stop work declaration. Data were assembled and distributed to the principal investigator post-experiment. (walter.w.schalk@noaa.gov)

The first equipment procurement for the upgrade/replacement to the mesonet on the Nevada National Security Site (NNSS) was awarded. This procurement includes data loggers, temperature/relative humidity sensors and shields, pyranometers, enclosures, power supplies, solar panels and charging, and station GPS. The second equipment procurement will be submitted early in FY13. (walter.w.schalk@noaa.gov)

6. GPS-Met observing system at the Desert Rock Observatory
Rick Lantrip and James Wood with the Special Operations and Research Division installed a Global Positioning System (GPS) meteorological observing system at the Desert Rock Observatory. The system measures atmospheric water vapor using ground-based GPS receivers. The raw data are used to estimate the integrated precipitable water (IPW) content of the atmosphere. The system was installed in conjunction with an Earth System Research Laboratory-based program. The GPS IPW data for Desert Rock (DRA1) became available on ESRL's website at gpsmet.noaa.gov in mid-September. The IPW data will be used by SORD forecasters and will be assimilated, along with other GPS-Met data from sites in the Southwest, into the WRF model. (kip.smith@noaa.gov)

7. DOE Meteorological Coordinating Council Activities
Walt Schalk participated in DOE Meteorological Coordinating Council (DMCC) Assist visits at the DOE Oak Ridge National Laboratory (ORNL) and the DOE Y-12 plant in Oak Ridge, TN. An Assist visit is a program of the DMCC where a team of three meteorologists from the DOE complex visit a DOE site and look at the site's meteorology program. This includes reviewing equipment, procedures, documentation, and products and services provided to other groups at the site, as well as reviewing meteorological data and evaluating expertise input to consequence assessments, including dispersion modeling. The team puts together a report that provides suggestions of improvements and noteworthy practices of their program which can be provided to their management. This program has been very successful in helping sites to improve their programs. (walter.w.schalk@noaa.gov)

AIR QUALITY

8. Aircraft Mercury Study
Steve Brooks, Xinrong Ren, and Winston Luke participated in an aircraft mercury study in collaboration with University of Tennessee Space Institute (UTSI). Measurements of gaseous elemental mercury (GEM) and reactive gaseous mercury (RGM), and fine particulate mercury (FPM), as well as supporting measurements of ozone, sulfur dioxide, condensation nuclei and meteorological

parameters were made on the UTSI Piper Navajo aircraft at altitudes ranging from the surface to 20,000 feet in the region near Tullahoma, TN. Mercury speciation was also measured at a ground surface site near the Tullahoma Airport for comparison with aircraft measurements. Two weeks of flights were completed in August and September. The results revealed that oxidized mercury species in the air were greater than concentrations measured at ground level. These preliminary results support the recent findings of Dr. William Landing's group at Florida State University and other researchers that RGM and FPM cycle back and forth in the atmosphere, dependent on particle availability, temperature, and humidity. In addition to consistent RGM and FPM trends with altitude, back trajectory analysis showed higher oxidized mercury levels when the air masses arrived from the north and west, and lower levels when the air masses arrived from the south. The study aims to characterize the seasonal variations from summer to fall. Measuring and modeling the vertical distribution of GEM and RGM has provided important information regarding sources (natural vs. anthropogenic) of mercury in the lower and middle troposphere. Two more weeks of flights are scheduled in October and November, 2012. steve.brooks@noaa.gov; xinrong.ren@noaa.gov; winston.luke@noaa.gov

9. Proposal Selected for NASA's DISCOVER-AQ Project

Xinrong Ren (lead PI), Winston Luke, and Paul Kelley received funding approval for a proposal to the University of Texas Air Quality Research Program for providing measurement support to NASA's DISCOVER-AQ (which stands for: Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality) project in Houston in 2013. DISCOVER-AQ is designed to assess the ability of satellites to accurately measure column abundances of important air quality indicators (e.g., particulate matter, ground-level ozone, formaldehyde, nitrogen dioxide) by comparing satellite- and aircraft-derived column measurements with surface chemical observations. ARL has proposed to measure O_3, SO_2, NO/NOx/NOy, and NO_2 at two sites in the Houston Metropolitan Area. Xinrong.Ren@noaa.gov

10. Great Lakes Restoration Initiative

Work continued on the 2nd phase of the Great Lakes Restoration Initiative project. In this phase, sensitivity analyses and extended model evaluation were carried out for the overall model-based analysis of atmospheric mercury deposition to the Great Lakes. Numerous simulations were conducted that will contribute to the sensitivity analysis. In a closely related effort, an analysis of atmospheric mercury deposition to the Lake Superior Basin (LSB) was carried out at the request of Region 5 EPA and the Lake Superior Workgroup (made up of state, provincial, federal, and other stakeholders). A memorandum was prepared and transmitted to the interested parties. Key findings included:

- for some LSB mercury emissions sources, there appears to be significant differences in mercury emissions estimates between values estimated by the Lake Superior Workgroup and large-scale inventories prepared by USEPA and Environment Canada;
- despite these emissions uncertainties, among LSB mercury emissions sources, metallurgical facilities appear to be the largest mercury emissions source;
- however, due to speciation of emissions and location, LSB coal-fired power plants contribute as much or more mercury via atmospheric deposition to the basin;
- while LSB emissions sources contribute significant mercury to the basin, on a pound for pound basis due to their proximity, they contribute only about 1% of the total atmospheric mercury deposition to the LSB from all global anthropogenic and natural sources.

Discussions with the Lake Superior Workgroup are continuing. Mark.cohen@noaa.gov

11. HYSPLIT Source-Receptor Tutorial

As a follow-up from ARL's HYSPLIT training held in June, a tutorial was developed regarding the use of HYSPLIT back-trajectories to analyze measurement data, through gridded trajectory frequency and GIS analysis. Three research groups interested in applying this technique to their own monitoring data participated in several remote sessions, including scientists at: (1) the Clark County, Nevada, Department of Air Quality, looking at the impact of regional transport (e.g., from Los Angeles) of ozone and its precursors on air quality in Las Vegas, NV; (2) the Red Cliff Band and Bad River Band of Lake Superior Chippewa Indians, who are investigating the local, regional, and long-range impacts of mercury deposition affecting fish in their ecosystems; and (3) the Texas Commission on Environmental Quality, Air Quality Division, investigating a range of air quality issues. In all cases, the research groups have monitoring data and are trying to develop ways to interpret and understand what the data means in terms of source attribution, e.g., where does the air come from when they see high concentrations? Mark.cohen@noaa.gov

12. Marine Isoprene Emissions Product

Daniel Tong, Pius Lee and Rick Artz kicked off a 3-year project, funded by the National Environmental Satellite Data and Information Service (NESDIS), to develop a near real-time satellite-based marine isoprene emission product. Other partners in the project are Environment Canada, New York Department of Environmental Conservation, Washington State University, and University of Houston, as well as NESDIS. Currently, air quality and climate models consider land-based isoprene emissions, but not marine sources. This project, with funding support from the Joint Polar Satellite System Proving Ground and Risk Assessment Program, would combine Visible Infrared Imaging Radiometer Suite Ocean Color data from NOAA's latest satellite (Suomi National Polar-orbiting Partnership) and meteorological data from National Weather Service to develop such a product.
Daniel.tong@noaa.tong

13. National Air Quality Forecasting Capability

Pius Lee participated in the annual, invitation-only National Air Quality Forecasting Capability (NAQFC) evaluation meeting. He reported on the FY12 NAQFC changes and the respective scientific basis for the changes. Feedback from the participants (about 45 people from over a dozen states and Canada) highlighted the improvement of the accuracy of FY12 air quality forecasts as compared to those in FY11. The frequent high bias of daily maximum concentration of surface ozone occurred in FY11 predictions had been significantly reduced; especially in many of the maritime locations.
Pius.lee@noaa.gov

CLIMATE

14. Climatology of the Planetary Boundary Layer

Dian Seidel completed a study of the climatology of the planetary boundary layer over the continental U.S. and Europe. This study is part of a larger project exploring climatological variations of boundary layers in different regions of the globe and their representation in global climate models. The project is a collaborative effort involving former National Research Council Postdoctoral Associate Yehui Zhang and colleagues at NOAA's Geophysical Fluid Dynamics Laboratory, NOAA's Earth System Research Laboratory, National Center for Atmospheric Research, and the European Centre for Medium-Range Weather Forecasts. Aspects of this project completed this quarter include:

- Publication of the paper: "Climatology of the planetary boundary layer over the continental United States and Europe" in the Journal of Geophysical Research.
- Provision of the resulting datasets to the scientific community via the Journal of Geophysical Research, as supplementary material to the article.
- Presentation of this work at the AMS Symposium on Boundary Layers and Turbulence, in Boston, July 2012.
- Presentation (by Chris Golaz, GFDL) of this work at the 1st Pan-Global Atmosphere Systems Studies Conference, in Boulder, September 2012.
- Agreement to participate in the Transcom Boundary Layer Height intercomparison project involving the major carbon cycle modeling groups around the world. The project, led by Andy Jacobson of NOAA/ESRL, will compare the models' simulated boundary layer heights to observed, using the new climatological data as a basis for comparison.
- Initiation of dialogue with colleagues at NASA Goddard Space Flight Center regarding potential future collaboration. A group of eight scientists met in September 2012 to discuss a variety of interests in modeling and observations of boundary layer climatology. Further meetings are anticipated to refine potential research plans. Dian.Seidel@noaa.gov

15. Climate Reference Networks

Three Climate Reference Network (CRN) sites were installed in Alaska. Seventy-four annual maintenance visits (AMVs) were made. Twelve of these visits were made to CRN sites, including five sites in Alaska, and 62 AMVs were made to Regional Climate Reference Network (RCRN) sites. The RCRN site in St. George, UT, was dismantled. Mark.E.Hall@noaa.gov

16. Temperature Sensor Comparison Study

Preparations began for an in-situ comparison of several temperature sensors, including the Nimbus temperature sensors used by the National Weather Service, the Belfort Instrument Smart Motorized Aspirated Radiation Shield and its platinum resistance thermometers (PRTs), and the Met One aspirated temperature shield and the PRTs used by the CRN program. Bench calibrations and characterization of each temperature sensor were performed. Deployment to the field will occur next quarter. The instruments will be mounted on four towers in selected areas near the Oak Ridge Affiliated Universities south campus area for approximately one year to make comparison measurements under a variety of conditions. Each tower will be placed in an area representing a unique CRN site class. Ancillary measurements, such as wind speed & direction and incoming/outgoing solar radiation, will be measured from each site as well. Each site will be powered

by combination of solar panels and batteries. john.kochendorfer@noaa.gov, E. Dumas, D. Senn, T. Meyers, C.B. Baker

ARL 4th Quarter Publications

Dobosy, R., E. Dumas, D. Senn, B. Baker, D. Sayres, M. Witinski, C. Healy, J. Munster, and J. Anderson. Calibration and quality assurance of an airborne turbulence probe in an aeronautical wind tunnel," appears in an Early On-line Release in the *Journal of Atmospheric and Oceanic Technology*.

Hicks, B., E. Novakovskaia, **R. Dobosy, W. Pendergrass,** and W. Callahan. Temporal and spatial aspects of velocity variance in the urban surface roughness layer, appears in an Early On-line Release in the *Journal of Applied Meteorology and Climatology*.

Mao, J., **X. Ren**, L. Zhang, D. M. Van Duin, R. C. Cohen, J.-H. Park, A. H. Goldstein, F. Paulot, M. R. Beaver, J. D. Crounse, P. O. Wennberg, J. P. DiGangi, S. B. Henry, F. N. Keutsch, C. Park, G. W. Schade, G. M. Wolfe, J. A. Thornton, and W. H. Brune. (2012) Insights into hydroxyl measurements and the atmospheric oxidation in a California forest. *Atmospheric Chemistry and Physics*, 12, 8009–8020, 2012.

Ngan, Fong, Daewon Byun, **Hyuncheol Kim**, Daegyun Lee, Bernhard Rappenglueck, and Arastoo Pour-Biazar. (2012) Performance Assessment of Retrospective Meteorological Inputs for Use in Air Quality Modeling during TexAQS 2006. Atmospheric Environment. 54, 86–96. doi.org/10.1016/j.atmosenv.2012.01.035.

Olson, J. R., J. H. Crawford, W. Brune, J. Mao, **X. Ren**, A. Fried, B. Anderson, E. Apel, M. Beaver, D. Blake, G. Chen, J. Crounse, J. Dibb, G. Diskin, S.R. Hall, L.G. Huey, D. Knapp, D. Richter, D. Riemer, J. St. Clair, K. Ullmann, J. Walega, P. Weibring, A. Weinheimer, P. Wennberg, and A. Wisthaler. (2012) An analysis of fast photochemistry over high northern latitudes during spring and summer using in-situ observations from ARCTAS and TOPSE. *Atmospheric Chemistry & Physics*, 12, 6799-6825, doi:10.5194/acp-12-6799-2012, 2012. http://www.atmos-chem-phys.net/12/6799/2012/acp-12-6799-2012.pdf

Santiago, Manuel, Marta G. Vivanco, and **Ariel Stein**. (2012) Evaluation of CMAQ parameterizations for SOA formation from the photooxidation of α-pinene and limonene against smog chamber data. *Atmospheric Environment*. Volume 56, Pages 236–245. doi:10.1016/j.atmosenv.2012.04.011.

Seidel, D. J., Y. Zhang, A. Beljaars, J.-C. Golaz, A. R. Jacobson, and B. Medeiros. (2012) Climatology of the planetary boundary layer over the continental United States and Europe, *J. Geophys. Res.*, 117, D17106, doi:10.1029/2012JD018143.

Stein, A.F. and **R. D. Saylor.** (2012) Sensitivities of sulfate aerosol formation and oxidation pathways on the chemical mechanism employed in simulations. *Atmospheric Chemistry and Physics,* 12, 8169-8182. doi:10.5194/acpd-12-8169-2012

Wilson, T.B., **T.P. Meyers, J. Kochendorfer**, M. C. Anderson, and **M. Heuer**. (2012) The effect of soil surface litter residue on energy and carbon fluxes in a deciduous forest. *Journal of Agriculture and Forest Meteorology* Volume 161, 15, Pages 134–147.

Yan, H., S.Q. Wang, D. Billesbach, W. Oechel, J.H. Zhang, **T. Meyers**, T.A. Martin, R. Matamala, D. Baldocchi, G. Bohrer, D. Dragoni, and R. Scott. (2012) Global estimation of evapotranspiration using a leaf area index-based surface energy and water balance model. *Remote Sensing of Environment* 124; 581–595. http://dx.doi.org/10.1016/j.rse.2012.06.004

Yi, Chuixiang, Gerald Rustic, Xiyan Xu, Jingxin Wang, Anand Dookie, Suhua Wei, George Hendrey, Daniel Ricciuto, **Tilden Meyers,** Zoltán Nagy, and Krisztina Pinter. (2012) Climate extremes and grassland potential productivity. *Environmental Research Letters*, Volume 7, Issue 3, pp. 035703.

Zhang, Y., L. Jaeglé, A. van Donkelaar, R. V. Martin, C. D. Holmes, H. M. Amos, Q. Wang, R. Talbot, **R. Artz**, **S. Brooks**, **W. Luke**, T. M. Holsen, D. Felton, E. K. Miller, K. D. Perry, D. Schmeltz, A. Steffen, R. Tordon, P. Weiss-Penzias, and R. Zsolway. (2012) Nested-grid simulation of mercury over North America. *Atmospheric Chemistry & Physics*, 12, 6095-6111, doi:10.5194/acp-12-6095-2012. http://www.atmos-chem-phys.net/12/6095/2012/acp-12-6095-2012.pdf

Outreach

About 16 middle-school students visited ATDD's wind tunnel in July as part of the Oak Ridge Institute of Science and Education's Oak Ridge Summer Science Camp. Students built model wind turbines, assembling blades of their own design onto model-turbine hubs. Randy White, Ed Dumas, and Ron Dobosy measured the voltage drop across a standard load resistor as a function of the wind-tunnel speed following recommendations of Dave Senn. The students noted the readings and received instruction on how to convert these to power output. ron.dobosy@noaa.gov, R. White, E. Dumas, D. Senn

Walt Schalk visited a local elementary school and gave a weather presentation and demonstration to a 5th grade class. The demonstrations included the showing of ABC's "Schoolhouse Rock's, The Weather Show", a visual history of wind and temperature instruments; physical demonstrations of dew and frost, atmospheric circulations, cloud formation, a dust devil ("tornado box"), and finished with a release and visual tracking of a dozen helium filled latex balloons. The children asked questions like: "Is the center of a hurricane like a black hole?" and "Why don't we get tornadoes in Nevada?" (walter.w.schalk@noaa.gov)

Walt Schalk visited the ARL Atmospheric Turbulence and Diffusion Division (ATDD) in Oak Ridge, TN and met with Tilden Meyers, Will Pendergrass, John Kochendorfer, and Latoya Myles. Walt was accompanied by Erik Kabela, a new meteorologist from Oak Ridge National Laboratory (ORNL) formerly from DOE's Savannah River Site. The group discussed ATDD's WRF modeling work, since this is an interest to Erik and ORNL. Walt also discussed ATDD's Eastern Tennessee Ozone Study (ETOS)

tower network with the DOE/NNSA Y-12 Site Meteorologist. They have an interest in the ETOS regional data to complement their own local data. A meeting of the two organizations was recommended. (walter.w.schalk@noaa.gov)