NOAA/ATDD Quarterly Activity Report

April 2010 – June 2010

Bruce Baker, Director
Atmospheric Turbulence and Diffusion Division

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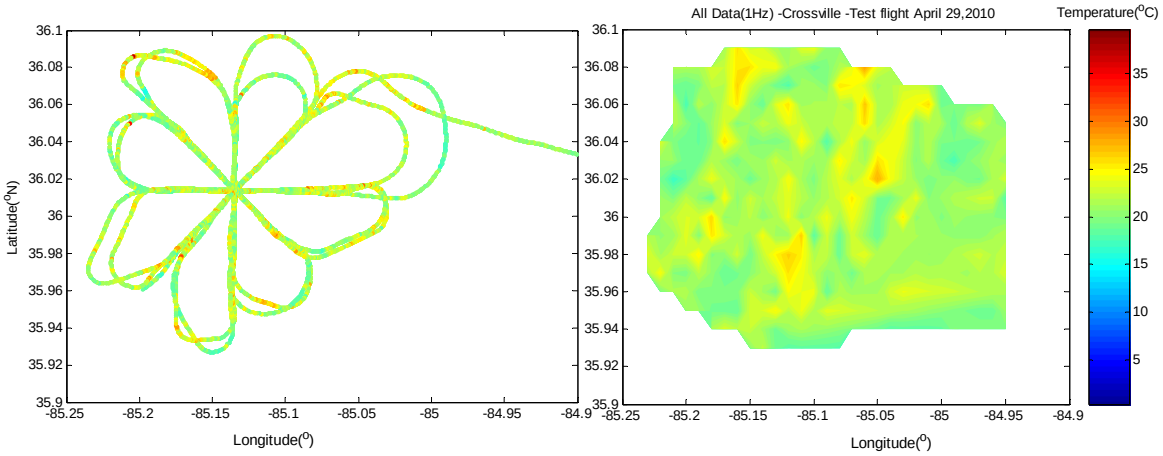
CLIMATE

Local Meteorological Support
Data reduction for April, May, and June was completed without problems The monthly data (a summary file and precipitation table files for each month) have been downloaded to ftp.atdd.noaa.gov/ (anonymous FTP, change directory to pub/data/ormet). The archived data are located in the sub-folder "archive". lynne.satterfield@noaa.gov

U.S. Climate Reference Network
In April, May, and June NCDC retrieved 57 data files from CRN sites through the server ftp.atdd.noaa.gov. Data are passed to NCDC by this path when retrieved episodically by ATDD from individual sites to fill data gaps. A record is maintained of the number of missing hours of retrievable data over the past 12 months. Instruments' characteristics for each site are maintained in the database ISIS (Integrated Station Information System) on NCDC's server, along with a record of events which affect data quality. New events are identified from ATDD's field crews, NCDC's Anomaly Tracking System (ATS), and email messages. lynne.satterfield@noaa.gov

Thirty-one CRN annual maintenance visits were completed this quarter. Twenty of these sites had 249 soil-moisture probes installed. These probes are shown below. There were also six HCN-M installations during this period. Mark.e.hall@noaa.gov

University of Tennessee Space Institute Collaboration
With the objective of characterizing the spatial variability and overall representativeness of single-point surface temperature measurement being recorded by NOAA's Climate Reference Network (CRN), aircraft measurements of temperature and radiation were carried out by NOAA/ATDD, in collaboration with the University of Tennessee Space Institute (UTSI) Aviation Systems and Flight Research Department in Tullahoma, TN. Flight paths have been developed to evenly sample reflected radiation within 5 km radius of the station tower on multiple passes over the tower at 2000 feet, 1500 feet, 1000 feet, and 500 feet above the highest obstacle in the vicinity of the tower. Scientific instruments onboard aircraft (UTSI Piper Navajo (N11UT)) included a Kipp & Zonen SP radiometer, a pair of Apogee PAR sensors, a Heitronics infrared (IR) temperature sensor and a Riegl laser altimeter. Test flights were conducted over the CRN site in Crossville, TN and NOAA/ATDD's Chestnut Ridge research tower (CHESS) near Oak Ridge, TN on April 29 and 18-25 May 18-25 (Figure 7) and comparisons with the surface temperature measured at the tower were carried out. Based on the results, more flights will be planned over various CRN sites this year. The measured spatial variability of surface temperature is critical to improve the accuracy of satellite land surface temperature measurements. praveena.krishnan@noaa.gov, E.Dumas, C.B. Baker, T.P. Meyers



Surface temperature measurements over Crossville on April 29, 2010.

Presentations
A presentation entitled "Comparison of Satellite, Airborne, and USCRN observations for characterization of potential validation sites of GOES-R land products" by K. Gallo, T.P. Meyers, C.B. Baker, E. Dumas, P. Krishnan, and R. Hale was given during the 2010 NOAA GOES-R Algorithm Working Group (AWG) / GOES-R Risk Reduction (R3) Annual Meeting in Madison, WI on June 7-11, 2010.

AIR QUALITY

Atmospheric Deposition of Ammonia (ADAM) Study
The ADAM field study at the University of Tennessee Knoxville ended in mid-April. Ammonia (NH_3) air-surface exchange was measured with a flux-gradient system and a

Picarro Ammonia Analyzer near plots of wheat that were fertilized with urea (46-0-0) and irrigated. Measured concentrations and fluxes of ammonia varied greatly and were highest in the first 24 hours post-fertilization. Analysis of the data is ongoing. latoya.myles@noaa.gov , M. Heuer

Grand Bay Mississippi Mercury Intensive
A field intensive to study the relationships between atmospheric mercury concentrations and net surface fluxes and to test alternative mercury measurement techniques is scheduled for July 27-Aug 15 at the Grand Bay National Estuarine Research Reserve (NERR). ATDD, in partnership with C. Moore from the University of Maryland, will deploy gaseous elemental mercury and reactive gaseous mercury flux systems, cation exchange surrogate surfaces, event wet deposition collectors, and an experimental morning dew collector. ARL scientists hope to derive relationships among surrogate surface Hg(II) collections, Tekran-derived Hg(II) concentrations, and Hg(II) surface fluxes. For wet deposition, ARL scientists hope to find the relationships between weekly precipitation collection (technique used in the Mercury Deposition Network) and event (< 1 day) sampling, as well as the potential role of morning dew to efficiently collect water soluble Hg(II) from near-surface air. steve.brooks@noaa.gov

Mercury Emissions from Prescribed Forest Fires in WV
On July 7, S. Brooks participated in a meeting with S. Connolly and S. Carpenter of the USDA Forest Service and J. Thompson of the West Virginia University Forestry Department to discuss mercury emissions measurements and modeling from prescribed burns in the Monaghelia National Forest. The Monaghelia National Forest is located in the north central highlands of West Virginia and covers almost one million acres. Elevation in the forest ranges from just below 1000' to 4863' and encompasses the highest ridges in the state. Mercury levels in eastern US forests are often significantly correlated with ecosystem elevation. Management practices for the forest require burning ~30,000 acres each year. With initial funding from the USDA, ARL is preparing to measure mercury downwind of these prescribed burns in 2011.
steve.brooks@noaa.gov

Research at the Nexus of Air Quality and Climate Change (CalNex 2010)
The California Air Resources Board (CARB), California Energy Commission (CEC), and NOAA held a joint field study over California and the eastern Pacific coastal region in May-June 2010. The main focus of CalNex was on the interactions between air quality and climate change issues. ATDD deployed three systems to measure ammonia air-surface exchange: flux-gradient (see Figure 1), relaxed eddy accumulation, and Picarro WS-CRDS Ammonia Analyzer. Instrumentation was installed in early May at a field site near Modesto, CA in the San Joaquin Valley. The site was surrounded by corn fields, alfalfa fields, and a large diary. Both the flux-gradient and relaxed eddy accumulation systems performed well during the study and provided six-hour integrated samples through mid-June. The Picarro malfunctioned in May but was quickly repaired and measured 30-minute concentration gradients. Data analysis is ongoing with an abstract planned for the CalNex special session at the Fall American Geophysical Union (AGU) meeting. latoya.myles@noaa.gov, M. Heuer, S. Klemenz

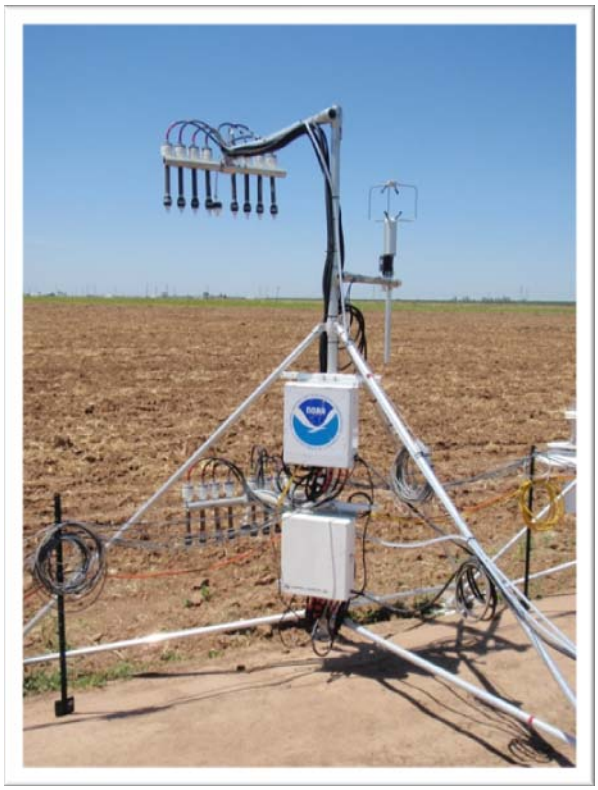


Figure 1. ATDD flux-gradient system at the Modesto dairy site during CalNex. Photo credit: M. Heuer.

Study of Houston Atmospheric Radical Precursors (SHARP)

The SHARP data workshop was held in Austin, TX on July 13-14. One key finding was much greater than expected nitryl chloride ($ClNO_2$) observed in the Houston area. The study had expected merely part per trillion (ppt) levels but mixing ratios of a few parts per billion (ppb) were consistently measured. Modeling efforts show that the presence of $ClNO_2$ in the daytime indicates active cycling between chloride and reactive chlorine radicals. For mercury, this reactive Cl has the potential to oxidize gaseous elemental mercury to Hg(II) species such as $HgCl_2$ and HgCl(OH), potentially explaining the high Hg(II) levels found in the near-surface air along the Gulf Coast. steve.brooks@noaa.gov

Wind Tunnel Tests of Surrogate Surface Mercury Hg(II) Collectors

ATDD surrogate surface samplers for Hg(II) collection have been tested and compared to commercial Aerohead samplers on a weekly basis from December 2009-July 2010. The ATDD sampler is simpler, less expensive, easier to clean, and not prone to the water leaks that plague the commercial unit. Data from the two samplers were exceptionally well-correlated (r^2 = .96) with the ATDD sampler showing a few percent higher collection efficiency. In an attempt to understand this consistent bias we conducted side-by-side wind tunnel tests at the ATDD facility (see Figures 2-3 below).

For both samplers, the transition from laminar to fully turbulent occurred over a ~2 m/s speed range. The turbulent transition of the ATDD sampler was centered at 9 m/s while the Aerohead sampler's transition was centered at 10 m/s. We believe that the more aerodynamic (rounded) edge of the Aerohead sampler produced a smoother flow to the membrane edge and delayed the transition to turbulence by ~ 1 m/s. Consistent with the observed field measurement bias, we would expect ion exchange membrane samplers with a lower turbulent transition speed to collect more Hg(II). While wind speeds in the range of 9-10 m/s are generally considered to be infrequent, our higher elevation measurement locations at Big Piney in far western Maryland and Canaan Valley in West Virginia are windy locations, which may contribute significantly to the observed bias. We could likely expect less bias at less windy locations.

steve.brooks@noaa.gov

Figure 2. Two second exposures of the new ATDD sampler at wind speeds of (a) 10 m/s, (b) 9 m/s, and (c) 8 m/s, respectively. Flow over the membrane is fully turbulent at 10 m/s, transitional (turbulent over the first half of the membrane) at 9 m/s, and laminar at 8 m/s. Photo credit: E. Dumas.

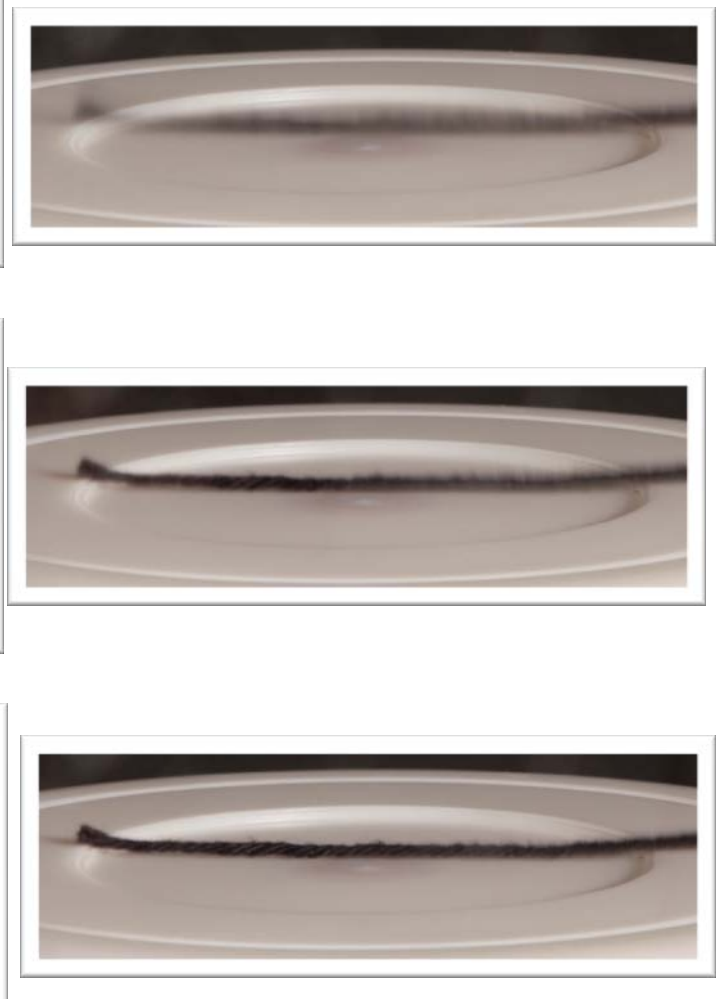


Figure 3. Two second exposures of the commercial Aerohead sampler at (a) 11 m/s, (b) 10 m/s, and (c) 9 m/s, respectively. Flow over the membrane is fully turbulent at 11m/s, transitional (turbulent over the first half of the membrane) at 10 m/s, and laminar at 9 m/s. Photo credit: E. Dumas.

Manuscripts

A manuscript entitled “Ambient ammonia in terrestrial ecosystems: A comparative study in the Tennessee Valley, USA” by R. Allen, L. Myles, and M.W. Heuer was submitted for publication in *Science of the Total Environment*. The paper describes measurements of ammonia concentrations in two Tennessee Valley ecosystems: a forested rural area and a metropolitan site adjacent to an interstate highway. At the metropolitan site, ammonia concentrations were slightly higher in winds emanating from the direction of the highway. latoya.myles@noaa.gov, M. Heuer

A paper entitled “An integrated WRF/HYSPLIT modeling approach for the assessment of $PM_{2.5}$ source regions over the Mississippi Gulf Coast Region” by Y. Anjaneyulu, V.B.R. Dodla, C.V. Srinivas, L. Myles, W.R. Pendergrass, C.A. Vogel, H.P. Dasari, F. Tuluri, J.M. Baham, R. Hughes, C. Patrick, J. Young, and S. Swanier was submitted to *Atmospheric Pollution Research*. It describes an assessment of emission sources in proximity to the Mississippi Gulf Coast using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model driven by the Weather Research & Forecasting (WRF) model. Data collected during the Mississippi Coastal Atmospheric Dispersion Study (MCADS) is also analyzed. latoya.myles@noaa.gov, W. Pendergrass, C.A. Vogel

A manuscript entitled “A simple and accurate method to measure total gaseous mercury concentrations in unsaturated soils” by C. Moore, M. Castro, and S. Brooks was submitted to internal ARL review. This paper presents a sampling method for measuring gaseous elemental mercury in the pore spaces of surface soils. The manuscript is intended for publication in *Water, Air, and Soil Pollution*. steve.brooks@noaa.gov

Presentations

L. Myles presented a poster during the Impacts of Atmospheric Deposition on Ocean Chemistry and Biology session at the Goldschmidt 2010 Conference in Knoxville, TN on June 14. The abstract entitled “Dry and wet deposition of reduced nitrogen to the Tampa Bay Watershed” was published in *Geochimica et Cosmochimica Acta*. latoya.myles@noaa.gov

DISPERSION AND BOUNDARY LAYER

Harvard University Collaboration

NOAA/ATDD's collaboration with Harvard University (Cambridge, MA) and Aurora Flight Sciences (Manassas, VA) links the ATDD BAT probe to Harvard’s innovative high-sample-rate use of cavity ringdown spectroscopy to measure fluxes of CO_2 and CH_4 over Arctic regions. One major benefit of the collaboration was the opportunity to test the BAT probe at the Massachusetts Institute of Technology's Wright Brothers Wind Tunnel in April, 2010. Data were collected for airspeeds between 35 m s^{-1} and 62 m s^{-1}. Angles of attack varied between ±20º, and angles of sideslip were varied between ±10º. Additionally, the drag and bending forces of the wind were measured and reported to Aurora Flight Sciences to aid in mounting and certifying the BAT probe on the aircraft. The campaign will use a Diamond TwinStar DA-42 airplane, flying at 60 m s^{-1}, nominally. Data from the wind-tunnel test revealed valuable information about the static-pressure measurement system while verifying the ability of the BAT probe to measure angles of attack and sideslip, and the resulting velocity components relative to the probe. Analysis of data from the wind tunnel test is ongoing.

As part of this analysis, a further frequency-response test of the pressure transducers, accelerometers, and temperature sensors in the BAT probe was found necessary. The probe was mounted next to an RM Young sonic anemometer on a Chevy Suburban, as in Figure 4.

Figure 4. BAT Probe and RM Young sonic mounted on Chevy Suburban.

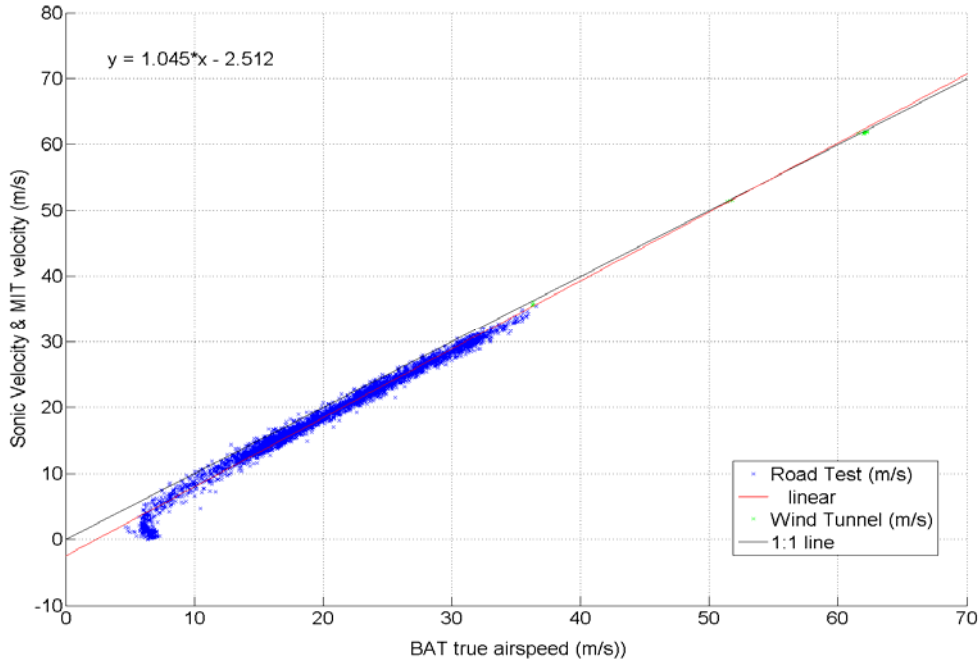
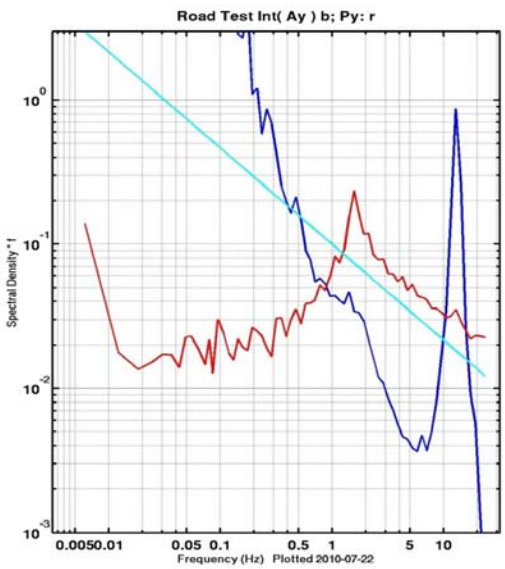
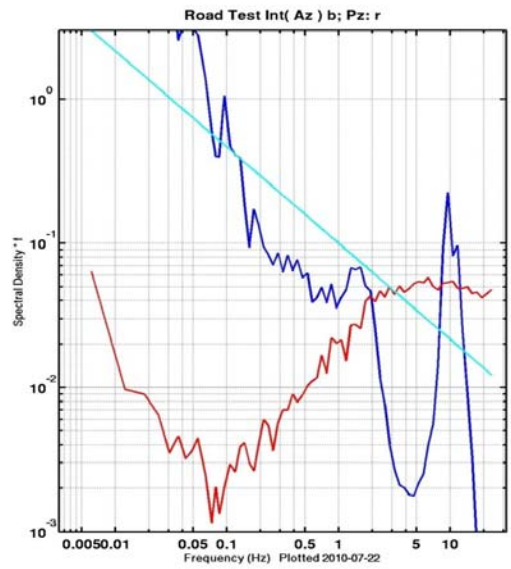


Figure 5. Airspeed data from the wind tunnel, RM Young sonic, and ATDD BAT Probe with best-fit line.

Figure 5 compares the total airspeed measured during the road test (blue) and the wind-tunnel test (green). The red line is the least-squares fit. The vertical axis gives the reference measurements from the sonic anemometer and the wind tunnel. The horizontal axis shows data collected from the BAT probe. A pressure-sphere sensor like the BAT probe becomes more sensitive as the speed increases. The drop-off of airspeed data around 6-7 m s^{-1} shows the lower limit of the probe's range.

Figure 6 presents spectra from the road test, demonstrating good frequency response in the accelerometers and pressure sensors. An additional wind tunnel test is planned for late September at MIT to quantify the performance of the static-pressure measurement system and of a FUST (fast ultra-sensitive temperature) sensor that will be installed on the BAT probe. ed.dumas@noaa.gov, C.B. Baker, R.J. Dobosy, D. Senn





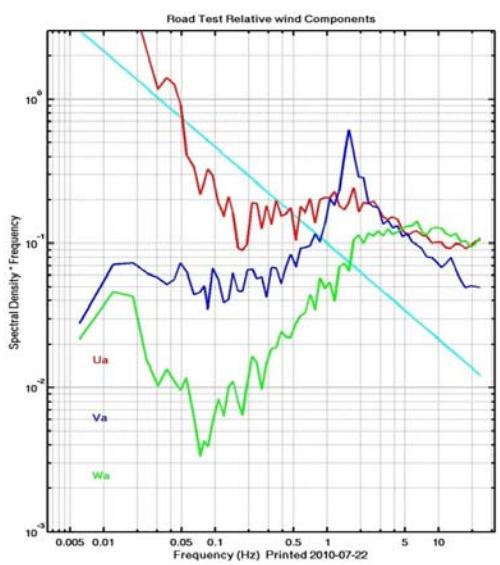


Figure 6:

Power spectra from the road test. Cyan line has -2/3 slope. Va is the component across the vehicle's path. Ua and Wa are influenced by the roof and windshield. See photograph. Int(Ay), Int(Az) are integrated acceleration, giving the high-frequency motion (vibration mostly) of the probe's head. Py and Pz are the pressure differences across the probe's head from which Va and Wa are determined.

Weather Research and Forecast Model
ATDD's research to enhance the utility of boundary-layer measurements in operational mesoscale forecasting includes a modeling component. This component's role is to support development of more effective instrument deployments and improved assimilation schemes. To this end the ongoing run of WRF Version 2.2 in East Tennessee has been joined by a run of WRF Version 3.1 for West-Central Texas, where ATDD is collecting surface-layer and boundary-layer measurements in collaboration with the operators of a wind farm. Both sets of forecasts are being archived. Both use the out-of-the-box selection of physical models and numerical methods for their respective versions, and are initialized from the Rapid Update Cycle Model three times per day: 03 Z, 09 Z, and 18 Z. Assimilation of ATDD's measurements surrounding each site is in development. ron.dobosy@noaa.gov

Presentations
C. Vogel presented a paper at the Fifth International Symposium on Computational Wind Engineering held May 23-27 in Chapel Hill, NC. The paper, entitled "Observations and Analyses of Turbulent Flow within an Urban Roughness Sublayer" highlighted sodar observations of vertical wind profiles from a rooftop in downtown Washington, DC. Analyses showed stark differences between the observed profiles and observed wind shear, and those predicted through the use of well known parameterizations. The results make a strong case for further studies investigating wind profiles near the top of urban canopies and for assessment of impacts on atmospheric dispersion prediction. chris.vogel@noaa.gov, W. Pendergrass

MISCELLANEOUS

L. Myles participated in the second Leadership Effectiveness and Advancement Program (LEAP) training session in Silver Spring, MD, on May 5-7. LEAP is a pilot OAR developmental opportunity for current and potential NOAA management and leadership personnel.

TRAVEL

Edgemon, T., Gainesville, AL, March 30 – April 2, 2010, for an unscheduled maintenance visit.

Meyers, T., Boulder, CO, April 5-8, 2010, to attend NEON meeting.

Hamby, A., Fairhope, AL and Orange Beach, AL, April 9-11, 2010, for a HCN/CRN unscheduled maintenance visit.

Dobosy, R. and Dumas, E., Cambridge, MA, April 12-14, 2010, to make preparations for wind tunnel test at Harvard University and MIT for the NOAA/ATDD BAT probe.

Land, G., Washington, DC, April 12-15, 2010, to attend Management Concepts "FAR Overview" course.

Burris, J. and Edgemon, T., Forrest City, AR; Amarillo, TX; Fort Sumner, NM; Socorro, NM; Los Alamos, NM; Holbrook, AZ; Tusayan, AZ; Page, AZ; Torrey, UT; Cortez, CO; Comtrose, CO and Denver, CO, April 13-27, 2010, to perform annual maintenance on USCRN weather stations.

Meyers, T., Austin,TX, April 18-21, 2010, to attend NCEP/NOAA Workshop.

Pendergrass, W., Big Spring, TX, April 19-21, 2010, to visit the Duke Wind Farm.

Baker, B., Asheville, NC, April 29-23, 2010, to attend Drought Assessment Workshop at NCDC.

Pendergrass, W., Albuquerque, NM, April 25-27, 2010, to attend INSRP meeting.

Dobosy, R., Dumar, E. and Senn, D., Cambridge, MA, April 25-29, 2010, to conduct a wind tunnel test at MIT for the Harvard/ATDD/BAT probe.

Galloway, K. and Randolph B., Denver, CO; La Junta, CO; Goodwell, OK; Oakley, KS; Lincoln, NE; Manhattan, KS and Stillwater, OK, April 26 – May 6, 2010, to conduct CRN annual maintenance visits.

Meyer, R. and White. R., Abilene, TX; Big Spring, TX, Pecos, TX; Indio, CA and Pasadena, CA, April 27 – May 28, 2010, to install site in Texas and CalNex experiment in California.

Heuer, M., Modesto, CA, April 28 – May 7, 2010, for CalNex experiment.

Brooks, S., Oak Ridge, TN, May 2 – 14, 2010, to attend required training in Oak Ridge and conduct wind tunnel tests of sensor.

Bryant, K. and Jordan, J., Little Rock, AR; Amarillo, TX; Santa Fe, NM; Mills, NM; Clayton, NM; Mountainair, NM; Kim, CO and Springfield, CO, May 3-15, 2010, to conduct HCNM installations.

Klemenz, S., Modesto, CA, May 3 – 26, 2010, to participate in CalNex experiment.

Myles, L., Silver Spring, MD, May 4-8, 2010, to attend the OAR LEAP program meeting.

Johnson, K. and Rutherford M., Little Rock, AR, Santa Fe, NM; Moriarty, NM; Mills, NM; Clayton, NM; La Junta, CO, Lamar, CO and Kansas City, MO, May 6-15, 2010, to install HCN-M weather stations.

Meyers, T., Champaign, IL, May 9-13, 2010, for SEBN site visits.

Pendergrass, W., Pasadena, CA, May 10-15, for CalNex 2010 experiment.

Kochendorfer, J. and Miller J., Champign, IL, May 11-12, 2010, to conduct maintenance on the Bondville site in Champaign, IL.

Shifflett, B., Boston, MA, May 16-21, 2010, to attend COTR Training.

Edgemon, T. and Hamby, A., St. Louis, MO; Aberdeen, SD; Minot, ND, Wolf Point, MT; Medora, ND, Deadwood, SD and Kansas City, MO, May 20-30, 2010, to conduct CRN annual maintenance.

Vogel, C. Chapel Hill, NC, May 23-27, 2010, to attend the Fifth International Symposium on Computational Wind Engineering.

Baker, B., Chapel Hill, NC, May 25-28, 2010, to attend wind energy meeting.

Johnson, K., Cullman, AL, May 26, 2010, to make a HCN-M unscheduled maintenance visit.

Heuer, M., Modesto, CA, June 1-26, 2010, to participate in CalNex experiment.

French, B.,Galloway, K., and Randolph, B., Harrisburg, PA; Kingston, RI; Durham, NH; Limestone, ME and Old Town, ME, June 1-14, 2010, to conduct CRN maintenance visits.

Jordan, J., Newton, GA, June 3-4, 2010, to conduct an unscheduled maintenance visit for CRN.

Meyer, R. and White, R., Pasadena, CA; Las Cruces, NM; Big Spring, TX and Dallas, TX, June 11-27, 2010, to remove CalNex tower/system in Pasadena and reinstall the Duke Energy site in Big Spring, TX.

Hamby, T., Tuscaloosa, AL, June 12-14, 2010, to make an unscheduled maintenance visit for HCN.

Burris, J., Dinkins, Z. and Johnson, K., Sioux Falls, SD, Pierre, SD; Whitman, NE; Spearfish, SD; Jamestown, ND; Goodridge, NM; and Madison, WI, June 14-25, 2010, to conduct CRN annual maintenance visits.

Black, M., Fort Morgan, CO, Limon, CO and Denver, CO,June 20-23, 2010, to meet with technicians from FRD to perform maintenance on HCN-M sites in Colorado.

Dobosy, R., Boulder, CO, June 21-25, 2010, to attend Workshop for Weather Research and Forecast Model.

Meyers, T., Champaign, IL, June 26-27, 2010, for SEBN site visit.

Wilson, T., Winnipeg, Canada, June 28-30, 2010, to attend a soil moisture workshop.

cc:

Abelquist, E.
Artz, R.
Bach, W. D.
Baldocchi, D.D.
Berlinrut, D.
Cunningham, D.C.
Dahlman, R. C.
Fine, S.
Hanna, S.R.
Hicks, B.B.
Hildebrand, S.G.
Holland, M.
Hosker, R.P.
Jacobs, G.
Mann, R.
Michalsky, J.
Mills, D.
Mills, G.A.
Page, A.
Petty, R.
Radcliffe, L.
Randerson, D.
Riches, M.R.
Roberts, S.
Roddye, L.C.M.
Wilson, K.B.
Womack, J.