NOAA ARL Monthly Activity Report

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Richard S. Artz, Acting Director
Air Resources Laboratory

Contents

1. ***Highlight -- UrbaNet***
2. ***Highlight -- TEXAQSII Smart Balloon Deployment***
3. ***New WRF-NMM Interface for HYSPLIT***
4. ***Stratospheric Temperature Trends Assessment Panel***
5. ***Workshop on Climate Variability and Extremes During the Past 100 Years***
6. ***Hybrid Modeling for Air Quality***
7. ***Global Energy and Water Cycle Experiment (GEWEX)***
8. ***Canaan Valley Institute Collaboration***
9. ***NOAA WP-3D Aircraft Instrumentation***
10. ***Fluxes over Complex Terrain***
11. ***Linking CMAQ and HYSPLIT***
12. ***Integrating Emissions in CMAQ***
13. ***Asymmetrical Convective Model Version 2 (ACM2)***
14. ***Climate Impact of Regional Air Quality (CIRAQ)***
15. ***The National Urban Database and Access Portal Tool Project***
16. ***Resolving Local-Scale in Air Quality Modeling for Exposure Estimates***
17. ***UrbaNet/Urban Dispersion Program***
18. ***Extreme Turbulence Probe***
19. ***Improved Visual Presentation of Test Site Dispersion Predictions***
20. ***Planned Extension of the ARL Research Mesonet in Nevada***

1. Highlight -- UrbaNet. Upon discovery of an unexpected release of hazardous material to the atmosphere, responders need immediate assessments of its spread. UrbaNet, along with the relatively dense network of standard weather stations developed by AWS Convergence Technologies, is developing ways to provide an unprecedented density of relevant data on short notice. It is envisioned that continually-running mesoscale models will forecast flow and mixing above the urban obstructions. The challenge is to develop means of rapidly incorporating all available data with the mesoscale models' forecasts to produce probability-based forecasts of contaminant spread for up to 12 hours after the release. Several Bayesian statistical methods have been examined. A promising method involves the adaptation of the Model Output Statistics (MOS) approach that has been used successfully over the past three decades to relate continental-scale models to local forecasts. The urbanized MOS would be based on a regression containing both model output and more recent field observations, including observations from the private networks that are at the core of UrbaNet. This approach has the advantages that it is relatively simple and it should be possible to objectively determine whether the inclusion of private network data in the regression improves the urban forecasts. ron.dobosy@noaa.gov, richard.eckman@noaa.gov

UrbaNet's array of stations monitoring wind and turbulence is to be expanded in the National Capital Region to include eight new sites on military installations. These sites were negotiated in meetings with military, city, and commercial entities in the area. Memoranda of Understanding for these sites are in process. Installation will begin upon their completion. A ninth station is planned for a site managed by the DC Emergency Management Agency. Additionally, collaboration with AWS Convergence Technologies is developing ways to apply data from their rather dense meteorological network for UrbaNet dispersion forecasting purposes. chris.vogel@noaa.gov, White, and Pendergrass

Las Vegas is the site for the next research phase of UrbaNet. A fugitive SF_6 survey will be conducted in the Las Vegas area next month to locate any existing sources of SF_6 that could be used as sources "of opportunity" or that would complicate a large-scale controlled SF_6 atmospheric transport and dispersion tracer experiment. roger.carter@noaa.gov

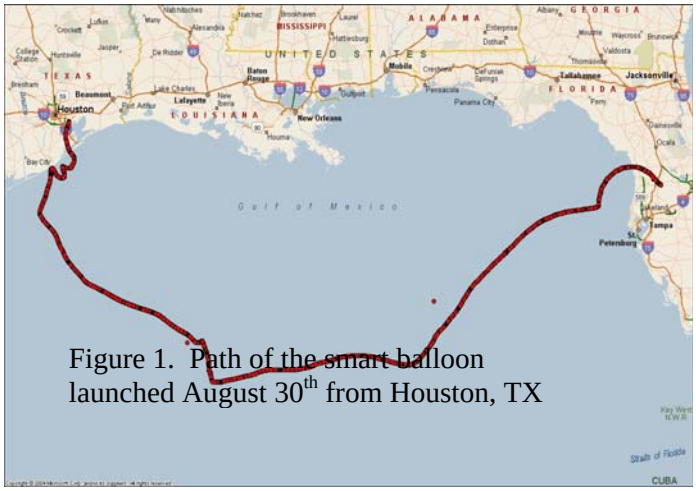

Figure 1. Path of the smart balloon launched August 30th from Houston, TX

2. Highlight -- TEXAQSII Smart Balloon Deployment. The FRD smart balloon team participated in the Texas Air Quality Study II (TEXAQSII). Balloon flights have already begun and are scheduled to continue through mid-September. The balloons carry a bevy of meteorological instrumentation and an ozone sensor. The first smart balloon was launched on 30 August and moved south and east across the entire Gulf of Mexico (Figure 1). The balloon flight was terminated after four days in the air as it moved across Florida, in hopes of retrieving the balloon. Five more balloons are expected to be launched before the end of the experiment. Real-time smart balloon data and tracking maps are available on the internet at http://tws.unh.edu/TWS-DEV/TWS/realtimemapping.htm. randy.johnson@noaa.gov and Shane Beard

Silver Spring

3. New WRF-NMM Interface for HYSPLIT. In anticipation of the eventual elimination of the special sigma-level meteorological file produced by NCEP from WRF-NMM for the Air Quality Forecast model (CMAQ), which is also used by the HYSPLIT Interim Smoke Forecast Tool, a generic decoder has been developed to read the WRF-NMM data files and translate the data onto a grid that is compatible with HYSPLIT (and some other models) that utilize a conformal projection on sigma surfaces. With this capability in place, there is no risk of losing access to outputs from a number of models when the NCEP changes are made. roland.draxler@noaa.gov

4. Stratospheric Temperature Trends Assessment Panel. The SPARC (Stratospheric Processes and their Role in Climate) Stratospheric Temperature Trends Assessment Panel met in Abingdon, UK, July 19-20, 2006. The group is working to understand the observational record of stratospheric temperature, from both ground-based and remote sensors, and to compare the observed changes with model simulations. Current work includes a comprehensive reexamination of the temperature time series from the Stratospheric Sounding Units, flown on NOAA polar orbiters, and comparison of data from different observing systems. A review paper on observations of stratospheric temperature change is in preparation. Dian Seidel (ARL) and Jim Miller (NWS/NCEP) are members of this international panel. dian.seidel@noaa.gov

5. Workshop on Climate Variability and Extremes During the Past 100 Years. Dian Seidel presented an invited talk on "Signals of climate variability and change in radiosonde data" at a workshop on "Climate Variability and Extremes During the Past 100 Years" held in Gwatt-near-Thun Switzerland, July 24-26, 2006. The workshop, sponsored by several Swiss business, governmental, and academic institutions, covered a wide range of climate topics, and included an evening session open to the general public which received wide media attention both locally and internationally. Ideas for several collaborative projects were generated among the international group of participants. dian.seidel@noaa.gov

6. Hybrid Modeling for Air Quality. A hybrid air quality model is being developed, and will be tested over the Houston area. While grid-models (such as CMAQ) are the model platform of choice for simulation of chemically-reactive airborne pollutants on a regional scale, there are various models that can provide detailed resolution of the spatial variations in hourly-average concentrations. In the hybrid application now being completed, CMAQ provides the regional background concentrations and urban-scale photochemistry, AERMOD (from the EPA) simulates the contribution from mobile sources, and the Hybrid Single Particle Lagrangian Integrated Trajectory model (HYSPLIT) provides the spatially resolved concentrations due to point emission sources. Furthermore, multiple HYSPLIT simulations with varying model inputs and physical parameters are used to create a concentration ensemble to estimate the concentration variability. In this first application, the HYSPLIT, AERMOD, and CMAQ models are used in combination to calculate benzene concentrations in the Houston area. The study period is from August 18th to September 4th of 2000. ariel.stein@noaa.gov

Oak Ridge

7. Global Energy and Water Cycle Experiment (GEWEX). A detailed analysis will soon be completed of hyperspectral measurements made over the vegetation stands at selected ARL/GEWEX flux tower sites. The aim is to understand the phenological patterns and quantify the vegetation canopy coverage in the growing cycle at each of the various GEWEX sites using ground-based observations. This information is useful as a realistic vegetation input for model simulations to evaluate the measurements of energy, water, and carbon fluxes from the towers. Such data are routinely used by NCEP to benchmark their surface boundary layer predictions. tilden.meyers@noaa.gov, T. Wilson, and M. Heuer

8. Canaan Valley Institute Collaboration. Monitoring of mercury species and trace gases continues at the Canaan Valley Institute's (CVI) site. A new site is being prepared for monitoring mercury and trace gases outside the watershed; once the new road, shelter building, sensor platform, and utilities connections are completed, the CVI site will be relocated there. A meteorological tower is a planned future installation. steve.brooks@noaa.gov

9. NOAA WP-3D Aircraft Instrumentation. The second turbulence probe destined for a NOAA WP-3D aircraft has been completed. This month the wiring harness was built, and the probe was assembled, calibrated, and tested. Future developments will further reduce weight, volume, and power requirements while tapping recent advances in computer miniaturization to integrate the data system's computer into the probe. A turbulence microprobe, suitable for small unmanned aircraft, is also planned. It will simply spill raw data onto "flash" storage media to be processed upon return. philip.hall@noaa.gov, Dumas, and Senn

10. Fluxes over Complex Terrain. Although aircraft can most easily sample fluxes over flat terrain, many important landscapes are hardly flat. Seeking to address more general landscapes, the Sky Arrow airplane recently sampled turbulence over two landscapes in central Missouri. Upland areas studied were rolling with about 60 m relief. The area was thickly forested except for irregular breaks. Bottom land along the Missouri River was cultivated and flat, similar to central Illinois. About 15 hr of data were collected from straight paths over both kinds of terrain. Flights maintained constant altitude above sea level, about 30 m above the

highest obstacle along each flight track. The continually changing altitude above ground over the rolling landscape is the primary challenge for flux calculation. The paths over farmland, known to yield good fluxes, provide a control. ron.dobosy@noaa.gov, with D. Williamson, S. Kirby, and K. Elebash, University of Alabama

Research Triangle Park

11. Linking CMAQ and HYSPLIT. A new software interface has been developed to link the Community Multiscale Air Quality (CMAQ) modeling system with the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model. The models require many of the same hourly, gridded meteorological parameter fields for their applications; however, their meteorological input data files exhibit differences in their format and data structure. Consequently, a new MCIP2ARL interface program has been constructed, specifically designed to retrieve the key meteorological parameter fields required by HYSPLIT from CMAQ's Meteorology Chemistry Interface Processor (MCIP) data files. With this capability now in place, the HYSPLIT trajectory model can be driven with the same wind fields used in CMAQ simulations. The coupled model system permits innovative analyses of various CMAQ output files to be performed within HYSPLIT's Lagrangian trajectory framework. A utility program converts trajectory coordinates into grid cell locations and retrieves selected species from a CMAQ 3-D concentration file. This integrated Eulerian-Lagrangian modeling system will enable researchers to assess the transport processes affecting pollutant concentrations. james.godowitch@noaa.gov

12. Integrating Emissions in CMAQ. Work has recently been focused on incorporating biogenic emission estimates and point-source plume-rise computations in the Community Multiscale Air Quality (CMAQ) model. This is a first step toward coupling an in-line version of CMAQ into the meteorology driver model, *e.g.*, the Weather Research Forecasting (WRF) model. This new CMAQ modeling system will be able to handle the interactions between meteorology and chemistry and provide a more realistic simulation of air quality. A new CMAQ emissions module has been developed to encapsulate all the internal emissions processing and to facilitate bringing the biogenics and plume-rise calculations in line. In addition, dry deposition velocity calculations will be incorporated to provide a possible two-way surface exchange capability within CMAQ. jeffrey.young@noaa.gov

13. Asymmetrical Convective Model Version 2 (ACM2). A new model combines a simple non-local closure scheme, called the Asymmetrical Convective Model (ACM), with an eddy diffusion scheme. The new model, ACM2, has been tested against large-eddy simulations and field data from the Cooperative Atmosphere-Surface Exchange Study experiment of the late 1990s. The ACM2 has been implemented in the Mesoscale Model Version 5 (MM5) and the Community Multiscale Air Quality (CMAQ) models and further evaluated for the International Consortium for Atmospheric Research on Transport and Transformation 2004 field experiment. MM5 simulation results show accurate simulations of PBL height and vertical profiles in the convective boundary layer. The ACM2 has also been incorporated into the Weather Research and Forecasting (WRF) model. jonathon.pleim@noaa.gov

14. Climate Impact of Regional Air Quality (CIRAQ). A tropospheric chemistry model coupled to a global climate model (GCM) utilizing the Intergovernmental Panel on Climate Change (IPCC) A1B scenario for greenhouse gas concentrations has been used to derive downscaled regional climate and air quality scenarios for the continental United States for two five-year periods representing current (1999-2003) and future (2048-2052) conditions. For the initial simulations, anthropogenic emissions are held constant at 2001 levels to isolate the effect of climate change from the effect of changing emissions. An additional five-year simulation using anthropogenic emissions scaled according to the IPCC A1B scenario for the United States in 2050 has now been completed. chris.nolte@noaa.gov

Research has been finalized on the use of regional climate simulations to drive current and future air quality simulations. The research compared sea level pressure patterns of a Regional Climate Model (RCM) with observations over a 10-year period. To parse the data further, principal component analysis (PCA) has been applied to 10 years of daily sea level pressure to identify the major modes (components) of variability in the data. The regional climate model's weather patterns were compared with the observed weather patterns and differences were used to explain the differences in temperature and precipitation.

The Regional Climate Model performed well in terms of replicating the weather patterns off the west coast of the United States during all seasons. During the winter season, the Regional Climate Model underestimated temperatures over the southeast quadrant of the United States, and overestimated across the Great Lakes and southern Canada. The model did not simulate a synoptic weather pattern with arctic high pressure over the northeastern United States, which led to overestimates of temperatures in this area. The model performed relatively poorly for the summer for the eastern United States. A major component of the summer weather over the eastern United States is a persistent subtropical high pressure cell located off the East Coast. This cell was not replicated in the Regional Climate Model. The Regional Climate Model predicted a cooler, drier continental high pressure system located over the Midwest and Great Lakes region. This resulted in much drier and cooler conditions across the entire eastern part of the United States than were observed. robert.gilliam@noaa.gov, brian.eder@noaa.gov

15. The National Urban Database and Access Portal Tool Project. The National Urban Database and Access Portal Tool (NUDAPT) project, which is sponsored by the Environmental Protection Agency's Advanced Monitoring Initiative Program, is seeking to build a specialized database of urban variables and parameters capable of running advanced meteorological and air quality models for the nation's major urban areas. When completed, NUDAPT will contain high resolution building data and derived products such as urban canopy parameters, gridded anthropogenic heat, and population (on a diurnal basis). A database for Houston, Texas, is being created to serve as the project's prototype. An important requirement for NUDAPT is that the database be publicly accessible to the modeling community. To achieve this goal, the NUDAPT project includes a task to develop a Portal Tool to make the contents of the urban database publicly accessible. Significant progress has been made toward the development of an initial prototype portal. jason.ching@noaa.gov

16. Resolving Local-Scale in Air Quality Modeling for Exposure Estimates. For assessing the impact of airborne pollutants on human health, air quality models can be useful (1) for providing local details on the concentration gradients that would be prohibitive to acquire through monitoring, and (2) for providing quantitative estimates of the effectiveness of alternative emissions control strategies for mitigating undesirable health consequences. While grid-models are the model platform of choice for the simulation of chemically-reactive pollutants, various transport and diffusion models (often called dispersion models) have been developed to simulate the fate of airborne pollutants that are relatively chemically inert. Not having to treat atmospheric chemistry of mixtures, dispersion models can readily provide detailed resolution of the spatial variations in hourly-average concentrations of airborne pollutants.

The Division is developing a hybrid approach to integrate results from a regional model with near-field concentration gradients from dispersion models. An urban plume dispersion model is used to estimate the sub-grid variability of annual average concentration values within CMAQ grid cells. Then, various sub-grid "adjustments" to the CMAQ results are used as input to the Hazardous Air Pollutants Exposure Model (HAPEM). In tests focusing on Philadelphia, for benzene and formaldehyde, significant (greater than a factor of two) increases in maximum exposure impacts have been seen in exposure estimates in comparison to exposure estimates generated using CMAQ grid-average concentration values. vlad.isakov@noaa.gov

Idaho Falls

17. UrbaNet/Urban Dispersion Program. *A*nalysis of the 2005 Midtown Manhattan atmospheric tracer data set was begun. Peak-to-mean concentration ratios were similar to those found in the 2003 Oklahoma City data set, and commonly ranged from 5-10, and upwards to as high as 25. Plume width calculations indicate that near the source the plumes spread rapidly and then at a much slower rate downwind, probably due to the effects of blocking and channeling of the flow. The average ratio of plume arrival speed to wind speed aloft, a proxy for the extent of flow decoupling, was similar to the average daytime ratio for Oklahoma City dennis.finn@noaa.gov

18. Extreme Turbulence Probe. There continues to be interest in the ET probes for NOAA programs related to hazard resilient communities and wind hazard reduction. Material related to the probes has been presented at the planning meetings for these programs, and the response has been positive. These programs were created fairly recently in response to the active hurricane seasons, so they are still in the planning stages. richard.eckman@noaa.gov

Las Vegas

19. Improved Visual Presentation of Test Site Dispersion Predictions. Modifications to the ARL dispersion capabilities have been focused on integrating with the newly defined plume pathway emergency planning zone (EPZ). Of vital importance was visualization of the SORD dispersion model outputs showing the location of the predicted 1.0 rem and 5.0 rem Protective Action Guides (PAGS) for the unlikely occurrence of a release of hazardous material into the atmosphere during proposed tests. SORD research meteorologists have worked closely with NNSA/NSO health physicists and key test-operations personnel to develop new test procedures and emergency preparedness plans to take advantage of NOAA technology and dispersion models. darryl.randerson@noaa.gov

20. Planned Extension of the ARL Research Mesonet in Nevada. The mesoscale network run by ARL in Nevada has historically been devoted to questions related to dispersion in complex terrain. With the selection of Las Vegas as the next focal area for the ARL urban research program, under the UrbaNet banner, the ARL mesonet will be extended into the urban region of the Las Vegas basin. ARL already models the Las Vegas vicinity in some considerable detail, on a regular basis and in collaboration with the University of Nevada at Las Vegas. ARL staff in Las Vegas are starting to design the mesonet extension, so that an urban dispersion test bed can be constructed, making full use of the existing array of instrumentation. darryl.randerson@noaa.gov