



NOAA ARL Monthly Activity Report



May 2005

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Highlights

1. Air Quality Forecasting (AQF) – How Well are we Doing? A thorough examination of the AQF system's performance over the summer, using EPA's AIRNOW data, revealed a systematic pattern of varied accuracy that was attributed to synoptic-scale meteorology. The model performed very well during periods when anticyclones, characterized by clear skies, dominated the domain. Conversely, periods characterized by extensive clouds associated with fronts and/or cyclones, resulted in poor model performance. Subsequent analysis revealed that two factors associated with the CMAQ modeling system's cloud-cover scheme (one related to excessive photolysis rates, the other to excessive downward transport of O₃) contributed to this overprediction. Accordingly, changes to CMAQ's cloud-cover schemes were made during the "off season" that were designed to significantly improve the AQF system's performance in anticipation of its second year of operation.

A preliminary evaluation of the new system's performance for May 2005 revealed marked improvement in both the normalized mean bias, which at 8.3% is much lower than that observed for the entire summer of 2004 (22.8%) and the normalized mean error (17.8% for May 2005, compared to 28.1% for 2004). The overall correlation coefficient also improved from 0.59 for the summer of 2004 to 0.63 for the month of May 2005. Additional performance measures, including categorical statistics, are being calculated and summarized on a daily basis and are available. (brian.eder@noaa.gov)

Silver Spring

2. Global Temperature Update Through the Winter of 2004-05. Radiosonde-derived tropospheric and stratospheric temperatures have been updated through last winter. As would be anticipated in a warming regime, global surface temperatures last winter were the fourth warmest of the 38-year record (about 1K above the 1961-90 average), and global 850-300 mb temperatures the third warmest of record (about 0.5K above this average). Temperatures in the low stratosphere of the north polar zone were anomalously cold last winter (4K below average), and at Point Barrow, Alaska (71N) temperatures were a record 10K below the 1961-90 average at 20, 30 and 50 mb. These anomalously cold temperatures permitted development of an unusually strong Arctic Ozone Hole, as reported in the press. In the previous winter of 2003-04, however, the north polar low stratosphere was anomalously warm (about 4K above average), with the consequent near disappearance of the Arctic Ozone Hole. While the news media may revel in these extremes, such large temperature differences in adjacent years point up the frailty of the north polar stratosphere, and if the Arctic Ozone Hole becomes a real problem, they certainly show the importance of estimating such temperatures in advance. (Jim Angell, 301 713 0295, x127)

3. Radiosonde Temperature Trends. The RATPAC study has reached a stage of some finality. RATPAC is the Radiosonde Atmospheric Temperature Products for Assessing Climate program. A dataset of large-area anomaly time series has been developed. This consists of temperature anomaly time series for the globe, the hemispheres, tropics (30N-30S) and extratropics for 1958 through 2004 for 13 atmospheric pressure levels as well as layer means. The new time series show trends of 0.11-0.13 K/decade for the midtroposphere in the global mean and 0.09-0.12 K/decade for 30N to 30S for 1979-2003. Trends in the stratosphere are \sim -0.6 to -0.9 K/decade and are more negative in the tropics than for the globe. Differences between trends at the surface and in the troposphere are generally reduced in the new time series as compared to raw data and are near zero in the global mean for 1979-2003. The dataset has been sent to NCDC where it will be updated operationally and made available online.

In parallel work, effort continues on a program to help define observing system requirements for monitoring upper-air temperature changes. The current radiosonde network is inadequate for climate monitoring, and efforts are underway to design improved upper-air networks for climate monitoring, for which science-based measurement requirements must be specified. These include: measurement precision, accuracy, long-term stability, and vertical, horizontal and temporal resolution. The study addresses requirements for ensuring reliable monthly climate statistics (means and variances) and long-term (\leq 50 yr) trends. dian.seidel@noaa.gov and melissa.free@noaa.gov

4. Tropopause Research. Recent studies by Santer et al. have suggested that the tropopause may be a sensitive indicator of climate change, since it tends to rise in elevation as the troposphere warms and as the stratosphere cools, both expected responses to increases in atmospheric greenhouse gases. However, the tropopause, particularly outside the tropical region, has complex structure and its variability on various time scales has not been studied in depth. In collaboration with NCAR, ARL is undertaking an analysis of the global tropopause, with particular emphasis on the co-variability of the tropopause with the atmospheric temperature profile. dian.seidel@noaa.gov

Oak Ridge

5. Arctic Mercury Exchange Study. Mercury sensing equipment was installed on the US Coast Guard Icebreaker Healy. Fluxes of Gaseous Elemental Mercury (GEM) from snow/ice/water surfaces due to (solar) photoreduction will be measured on an Arctic Ocean transit, Alaska to Norway. Ancillary measurements include incident solar radiation, surface temperature, and atmospheric concentrations of carbon monoxide and ozone. These measurements of summertime mercury fluxes in an environment of year-round sea ice are critical to completing the mass balance of Arctic mercury. As a bonus, photostationary conditions (constant

solar zenith angle) exist near the North Pole. This will help assess the influence of temperatures and surface features on the air-surface exchange of mercury due to photoreduction. steve.brooks@noaa.gov

6. *East Tennessee Ozone Study (ETOS)*. Updates were developed to permit users to view ambient concentrations of SO₂, HNO₃, NO₃⁻, and SO₄²⁻ in close to real time. The ETOS intensive study is due to start in July. latoya.myles@noaa.gov, White, Lew and Senn

7. *Intensive Field Studies in Illinois*. Preparations for the GEWEX Intensive Study at Bonneville, IL in June began. Soil heat flux sensors were fabricated; a soil respiration chamber prototype was constructed; and a spectrometer was designed and fabricated. The soil respiration chamber allows a data logger to open and close a collar embedded in the soil. Soil CO₂ fluxes can then be measured. New soil heat flux sensors are being designed and constructed, at considerable savings. ATDD has been looking into ways to calibrate, or check the calibration, of heat flux sensors. (Senn and Heuer)

8. *NCEP-ARL Collaboration on the Nocturnal Boundary Layer*. The linear wave model describing turbulence in the nocturnal boundary layer has been modified to read Fourier-transformed terrain elevations, use these values in the solutions of the Taylor-Goldstein equation, and calculate the vertical profile of wave stress. This is a necessary first step in the parameterization process. The next step is to expand the wave model to calculate wave stress over three-dimensional terrain. The development relies heavily on data from four nights from the CASES-99 field campaign. carmen.nappo@noaa.gov

9. *The Rapid Response Tool for Emergency Response*. A new website provides graphical real-time display of data from ATDD/DCNet, ATDD/RAMAN, ASOS/AWOS, and FSL/MADIS for preselected cities. Pre-calculated output from the HYSPLIT model can also be viewed. Additional plumes have been added for all nuclear power plant sites. Wind barbs and temperature symbols have been upgraded. All layers now have consistent units (wind speed ms⁻¹, temperature C, etc.). Visit the website at <http://dataviewer.atdd.noaa.gov> ed.dumas@noaa.gov

10. *Progress in the Climate Reference Network*. New USCRN sites were installed at Merritt Island, FL and Selma, AL. In May NCDC retrieved data from nine USCRN 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. The database, CRNSites, on NCDC's server was updated and checked for consistency and accuracy. It contains instruments' characteristics for each site along with a record of events which affect data quality. New events are identified from ATDD's field crews, from NCDC's data-quality checks recorded in the Anomaly Tracking System, and by email. The maintenance of ATDD's equipment database is continuing. This database includes all equipment, past and current locations, repair history, and current status. lynn.satterfield@noaa.gov

Research continues to improve the instrumentation. (Brewer, Randolph, Bryant, Rutherford, Dunn, and Boice)

Research Triangle Park

11. *Community Multiscale Air Quality Modeling System (CMAQ)*. A new version of the Biogenic Emissions Inventory System (BEIS3.13) has been developed for the 2005 release of CMAQ. This new version will produce a substantial decrease in estimated isoprene across the continental domain and in estimated monoterpene emissions in portions of the western United States compared with the existing version, BEIS3.12 donna.schwede@noaa.gov; george.pouliot@noaa.gov

12. *The Effect of Chlorine Emissions on Ozone in the Eastern United States*. A study is under way to evaluate the effect of chlorine emissions on atmospheric ozone in the eastern United States. The study includes consideration of anthropogenic molecular chlorine and hypochlorous acid emissions. The

atmospheric chlorine chemistry was combined with the Carbon Bond-IV gas-phase chemical mechanism and incorporated into the Community Multiscale Air Quality (CMAQ) model. The horizontal domain is based on the CMAQ forecast applications over the eastern United States and consists of 268 x 259 grid cells with a 12-km resolution; the vertical dimension consists of 22 layers. Photochemical modeling simulations were performed during the period of September 14–21, 2004. Initial results of the model simulations indicate that chlorine emissions can increase ozone mixing ratios in the Houston area by as much as 22 ppbv. Additional model simulations are being conducted. Golam Sarwar, 919 541 2669; rohit.mathur@noaa.gov

Idaho Falls

13. Urban Dispersion Program (New York City Study). Planning and preparing for the UDP atmospheric tracer study in New York City, scheduled for August) continues. Arrangements have been made to conduct a background SF₆ study in Midtown during the month of June. This will determine what affect, if any, the local fugitive SF₆ sources have on the detection of intentionally released SF₆. kirk.clawson@noaa.gov and staff

14. Tracer Developments. An extensive series of 14 tests on the FRD Programmable Integrating Gas Samplers (PIGS) was completed this month. One purpose of the tests was to check the operation of the firmware upgrades in the PIGS and software changes on the Automated Tracer Gas Analysis System (ATGAS). The other purpose was to check the operation of samplers in the presence of exceedingly high concentrations of SF₆. A modification of the operating procedures has resulted, so that problems will be minimized while SF₆ concentrations are not greater than 20,000 ppt. roger.carter@noaa.gov and Debbie Lacroix

Perfluorocarbon standards were ordered to continue the perfluorocarbon tracer detection development work. Ten cylinders of a combination of perfluorodimethylcyclobutane (PDCB), m-perfluorodimethylcyclohexane (m-PDCH) and perfluoromethylcyclohexane (PMCH) were ordered in concentration ranges from 100 ppt to 100,000 ppt. It will take at least 8 weeks for the vendor to prepare and certify these standards. debbie.lacroix@noaa.gov

15. Extreme Turbulence Probe. Much of the recent activity for the ET probe has been related to future planning. NOAA is now planning budgets for FY 08-12, and an attempt is being made to integrate the ET probe research into the Science, Technology, and Infusion program. This effort is being closely coordinated with the BAT probe effort led by Dr. Jeff French at ATDD. Part of the proposed effort would be the development of improved BAT and ET probes that are based on compact PC/104 embedded computer modules. To avoid redundant efforts, the improved BAT and ET probes would share as much hardware and software as possible. The ultimate goal of the ET probe effort would be the deployment of the probes on NOAA operational platforms, such as the C-MAN stations along the coast and the network of moored buoys operated by NOAA. Probes on moored buoys would require additional sensors to detect platform motion, but such sensors are already available from the BAT-probe development. richard.eckman@noaa.gov

Las Vegas

16. NOAA CIIASTA – Urban Atmosphere Research Program. Installation of an ozone sensor at the Desert Rock Meteorological Observatory was completed. The sensor is fully operational and is archiving data for the Southern Nevada Ozone study being funded by the Clark County Department of Air Quality and managed by CIIASTA. A second ozone sensor has been placed in the desert near Jean, NV, in the Mojave National Preserve. The intent is to obtain ozone data upwind of the Las Vegas urban area, so as to test the hypothesis that all ozone detected in Las Vegas is due to local sources. james.s.wood@noaa.gov