NOAA Air Resources Laboratory
Monthly Activity Report

April 2007

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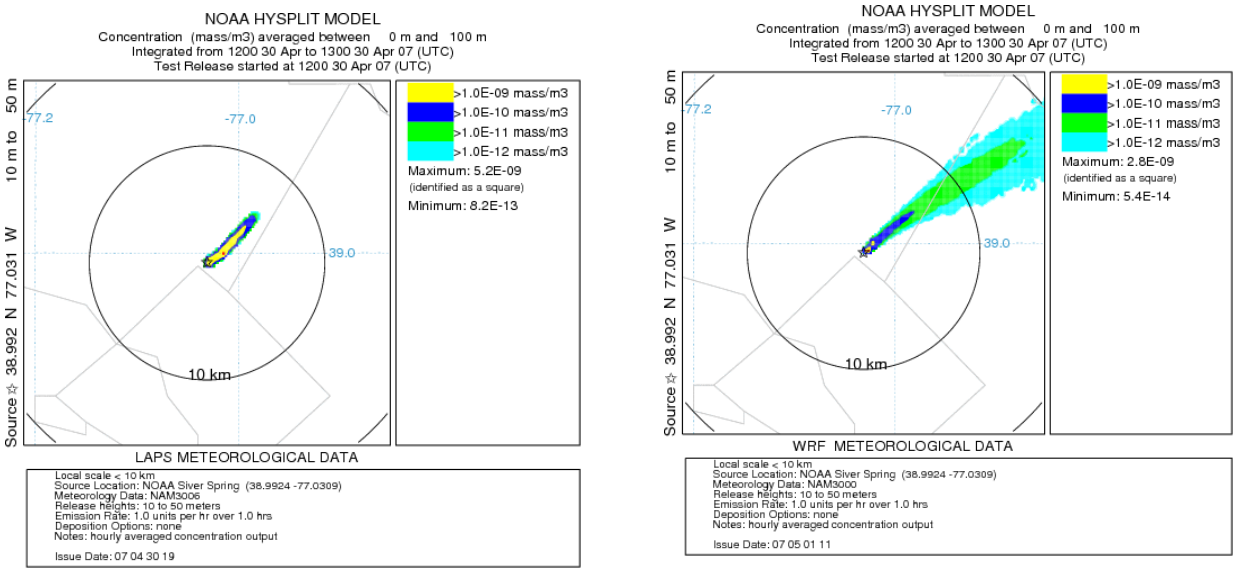
Air Resources Laboratory Headquarters, Silver Spring

1. Collaboration with GSD's Homeland Security Project. The Earth System Research Laboratory's Global Systems Division (GSD) has started running the Local Analysis and Prediction System (LAPS) at 1.5 km resolution over the Washington DC metropolitan area. LAPS is intended to provide the analysis fields for forecast model initialization, currently being configured by ARL. The LAPS data files, which include all the local observations such as ARL towers and AWS surface stations, can be used directly for dispersion calculations. A converter was created to merge the multiple LAPS NetCDF files each hour into a single file that can be used by HYSPLIT. The data

conversion program and an example HYSPLIT plume simulation, is currently running daily on one of GSD's workstations. A sample plot is shown below left using the LAPS analysis data and using NCEP's NAM (WRF-NMM) forecast on the right for a one hour release. roland.draxler@noaa.gov



2. Wildfire Smoke Forecasts. The dependence of the operational smoke forecast upon the sigma-level CMAQ AQM meteorological data files will soon be removed and the forecast will be computed from the new high resolution (40 levels) sigma-level HYSPLIT formatted meteorological data files. Switching the smoke forecast to the new data files will also require switching to the main executable from the single processor version to the multi-processor version. The meteorological files are much larger and hence require more CPUs just to process the data for the dispersion calculation. A 4-CPU version has been tested and gives almost identical results to the single-processor version. The current single processor scripts have been restructured to support a parallel submission. roland.draxler@noaa.gov

3. HYSPLIT Modifications for NOAA's Homeland Security Program Office. Hourly temporal resolution NAM forecast data will be made available for download for emergency response applications. The much larger file sizes may adversely impact downloads at non-NOAA network facilities. Therefore, the CONUS was divided into four quadrants with some overlap, resulting in files of about 70 Mb each. roland.draxler@noaa.gov

4. SPARC Stratospheric Temperature Trends Assessment. ARL hosted a meeting of the SPARC Stratospheric Temperature Trends Assessment panel in Washington April 12-13, 2007. Dian Seidel, Melissa Free and Jim Angell participated. The group is reviewing observations of stratospheric temperature and assessing trends and has uncovered a number of problems associated with various radiosonde, satellite, lidar, and reanalysis datasets. The team is working on a draft manuscript on the observed trends and will next focus on a coordinated assessment of model simulations of stratospheric temperature changes. dian.seidel@noaa.gov

5. Volcanic Ash Workshop. Barbara Stunder participated in the USGS Cascades Volcano Observatory (CVO) Eruption Source Parameters Workshop. Volcanic Ash Advisory Centers (VAAC) have been issuing forecast guidance for years with only a rough understanding of some of the eruption source parameters (ESP), or what dispersion modelers typically call the source term. ESP primarily include: overall dimensions of initial 3-d volume of ash, distribution of ash within the volume, total mass of ash or eruption rate, start time and duration of eruption, and ash particle size distribution. Dispersion modelers from the Canadian Meteorological Center, University of Alaska – Fairbanks, and ARL described their models and ESP needs. Geologists described some information they have. The group agreed to a plan to develop a matrix of ESP by volcanic eruption strength (small – medium – large - don't know/most likely) for many volcanoes. Volcanoes on the list were provided by VAAC worldwide. Also included will be some model sensitivity analyses. The end result matrix, though probably not fully complete, should lead to better operational forecasts of volcanic ash dispersion. barbara.stunder@noaa.gov

Atmospheric Turbulence & Diffusion Division (ATDD), Oak Ridge

6. Climate. The two Oak Ridge sites of NOAA's Surface Energy Balance Network (SEBN) recorded the impact of the late-spring freeze that damaged fruit crops over the entire southeast US. The oak-hickory forest surrounding the sites would normally be fully leafed by the end of April. This year's coverage was only 25%, drastically altering the partition of the sun's energy received at the ground. Far more energy than normal went to heating the lower atmosphere, far less to hydrating it. The impact of this event on the forest and on the climate in the southeast US this spring will be tracked by these SEBN sites along with the southeastern sites of the US Climate Reference Network, many of which received their annual maintenance visits in April. tilden.meyers@noaa.gov

7. Air Quality. Field studies of the air-surface exchange of two contaminants, mercury and ammonia, were prepared in April for measurements in May. Mercury, emitted from coal burning, will be part of the Greenland Summit Halogen HOx experiment. Halogens, especially bromine, have a major role in oxidizing atmospheric mercury. Ammonia, released in agriculture, will be studied in North Carolina, along with its chemical companions, nitric acid, sulfur dioxide and associated particulates. In both studies the physics and chemistry of these contaminants' air-surface exchange will be sampled to aid characterization and modeling. steve.brooks@noaa.gov

Atmospheric Sciences Modeling Division (ASMD), Research Triangle Park

8. Multipollutant Version of the Community Multiscale Air Quality (CMAQ) Model. The Division has expanded the Air Toxics version of CMAQ to include mercury. The new 2002 Multipollutant platform model can now predict ozone, PM, mercury, and 38 other hazardous air pollutant concentrations and interactions among them within the same simulation. In the coming year, EPA's Office of Air Quality Planning and Standards (OAQPS) plans to begin to use this version of CMAQ for accountability studies, and regional and local scale studies to help EPA project and assess the potential co-benefits and effectiveness of various control programs such as Clean Air Interstate Rule, Clean Air Mercury Rule, Clean Air Visibility Rule, and various onroad and nonroad mobile source rules. In addition, OAQPS expects to use this platform in its future development of a National Air Pollutant Assessment Study that would be based on a fully integrated toxics and criteria

pollutant national emission inventory for the year 2008. shawn.roselle@noaa.gov, Deborah Luecken, EPA, Bill Hutzell, EPA, O. Russell Bullock, NOAA and Sarwar Golam, EPA.

9. Climate Change Science Program (CCSP) Synthesis and Assessment Product (SAP) 3.2. A first draft of the CCSP SAP 3.2 was completed this month, focusing on the climate impacts of long and short-lived chemical species on air quality. A Division scientist has participated in SAP 3.2 as a co-author, working with Dr. Chip Levy from the NOAA Geophysical Fluid Dynamics Laboratory and Dr. Drew Shindell from the NASA Goddard Institute of Space Studies on this effort. While the primary focus of SAP 3.2 was on global-scale climate simulations (led by Drs. Levy and Shindell), several sections were included on the value of downscaling to address with regional climate issues. Reviews will now be underway at the National Research Council, and the final product will be completed by December 2007. alice.gilliland@noaa.gov

10. Air Quality Forecast Model Development and Testing. Several updated model codes along with updated emissions data sets for 2007 have been delivered to the National Weather Service for deployment in early May 2007 in the experimental ozone forecast system over the Continental United States. Updates relating to the representation of vertical mixing of pollutants have been made to the CMAQ and PREMAQ codes for use in experimental O_3 forecasting over the continental United States in 2007. Updated emission inputs for use in the forecast modeling system were developed by incorporating available projections (from base year inventory to current year) for various emission source sectors. jeffrey.young@noaa.gov, Rohit Mathur, Jonathan Pleim, and George Pouliot

11. Two-Way Coupling of the Weather Research and Forecasting (WRF) Model and the Community Multiscale Air Quality (CMAQ) Modeling System. The Division has made considerable progress toward the development of the meteorology-chemistry interface module (air quality preparation, or "AQPREP") for the forthcoming two-way coupled WRF model and CMAQ modeling system. The current output set from CMAQ's offline Meteorology-Chemistry Interface Processor (MCIP) was examined in detail to identify fields that are required for performing online WRF-CMAQ processing. An analysis of the WRF internal variables was conducted to determine which of the required meteorological and geospatial fields could be filled directly from WRF fields that are available in memory and which fields needed to be computed. Algorithms were then adapted from MCIP, as needed, to compute meteorological and geospatial fields that are needed for biogenic emissions, plume rise calculations, chemistry transport modeling, and grid identification header fields in the "Models 3 Input/Output" (M3IO) data format used by CMAQ. Finally, a draft version of AQPREP was coded in Fortran 90. tanya.otte@noaa.gov

12. The Effects of Emissions, Heterogeneous Reaction, and Surface Photolysis Reaction on Model Performance for Nitrous Acid. Comparison of model predictions with observed data suggest that the CMAQ modeling system underestimates ambient nitrous acid concentrations by a large margin. Photolysis of nitrous acid through the generation of the OH radical plays an important role in atmospheric photochemistry. Recent studies recommend that emissions, heterogeneous reaction, and surface photolysis may produce additional nitrous acid in the atmosphere. These sources have been implemented into the CMAQ modeling system and their effects on nitrous acid predictions are being evaluated. Predicted nitrous acid with and without these sources were compared with observed data in northeast Philadelphia. Preliminary results indicate that the incorporation of these

sources can help reduce the model bias for nitrous acid. sarwar.golam@epa.gov

13. Mercury Modeling. EPA's Office of Air Quality Protocols and Standards (OAQPS) requested guidance regarding unrealistic mercury species concentrations in their simulations using a version of CMAQ incorporating ozone, PM, sulfur, nitrogen, various air toxics and mercury that was recently developed by the Division. Unlike the previous version of the CMAQ mercury model that was used to support the Clean Air Mercury Rule, this multi-pollutant version of CMAQ simulates dry deposition of elemental mercury gas. In order to avoid an artificial depletion of elemental mercury gas in model simulations, all sources of its emissions to air must also be treated. The lack of dry deposition of elemental mercury gas in the previous version was cited as a weakness by the CMAQ peer review in May 2005. However, that previous version also did not treat the re-emission of mercury from recent deposition. This re-emission would be in the form of elemental mercury gas. By omission, the previous versions treated dry deposition and re-emission of elemental mercury gas as being in balance, always and everywhere. Recent versions of the CMAQ model employed for mercury simulation require that re-emissions of mercury be accounted for, something that OAQPS has not considered in their recent testing of the multi-pollutant model. It appears that they also made some simple units conversion errors in their model results analysis for reactive gaseous mercury (oxidized mercury gas) and for particulate mercury, as their results for these species show air concentrations three order of magnitude higher than expected. o.russell.bullock@noaa.gov

14. Surface Exchange of Ammonia. Several members of the Division are collaborating with scientists from the EPA National Risk Management Research Laboratory, the NOAA/ARL Atmospheric Turbulence and Diffusion Division, the NOAA/ARL Headquarters, the North Carolina State University, and the University of Maryland to study the surface exchange of ammonia and to improve bidirectional surface exchange modeling capabilities. A field study is underway in Lillington, North Carolina, where extensive meteorological, soil chemistry, leaf chemistry and atmospheric chemistry and flux measurements are being taken over a corn field from pre-planting (early April) through senescence (September). In addition to the instrumentation provided by U.S. institutions, an Ammonia Measurement by ANnular Denuder sampling with Analysis (AMANDA) system has been loaned to the study by the Centre for Ecology and Hydrology (CEH) in Edinburgh, Scotland. Deployment of this system is being overseen by Division's post-doc Matt Jones. This is the first time that the AMANDA system has been field-tested outside of Northern Europe, and operational deployment has proved challenging in the heat and humidity of the southeastern United States. Routine measurements are ongoing and an intensive experiment is planned for late May. donna.schwede@noaa.gov

15. Wind Tunnel Modeling of Near-Road Flow and Dispersion. As part of the Near-Road and School Infiltration Research Initiative, Division scientists have used wind-tunnel measurements to examine the concentration distributions for several major highway configurations. The four cases completed to date include the following: (1) a flat roadway with no surrounding obstacles (base case); (2) an upwind sound barrier; (3) an upwind and downwind sound barrier; and, (4) an upwind porous barrier intended to simulate a single row of vegetation. Preliminary results show that the solid sound barriers near roadways can have a substantial effect on downwind concentrations by decreasing ground-level concentrations immediately downwind of the road. For a single upwind barrier, downwind concentrations (near the edge of the roadway) decreases by a factor of four compared to the base case. By adding a second solid barrier on the downwind edge of the roadway,

the downwind concentration decreases by a factor of six compared to the base case. Experiments are continuing on three configurations of depressed roadways (road cuts) configurations and one elevated roadway configuration. It is anticipated that these physical modeling results will be used to improve dispersion parameterizations in near-roadway air quality and exposure models. steven.perry@noaa.gov, david.heist@noaa.gov

Field Research Division (FRD), Idaho Falls

16. Research Program. For the third time in only 5 months, scientists from FRD have co-authored scientific research articles that have been featured on the cover of the Bulletin of the American Meteorological Society (BAMS). The new April issue discusses the progress being made in the Coupled Boundary Layer Air-Sea Transfer (CBLAST) program. One article in this latest issue describes how observations are being combined with numerical models to better understand the transfer of heat, mass, and momentum between the ocean and the atmosphere. A second article in the same issue discussed the use of the ARL Best Aircraft Turbulence (BAT) probe used on the NOAA P-3 in hurricane penetrations that have resulted in a better understanding of drag coefficients and other air-sea exchange properties in hurricanes. The two earlier BAMS featuring FRD research on the covers were the November 2006 and the February 2007 issues. The NOAA "Smart Balloon" and the Pentagon Shield experiments were described in detail in accompanying articles. kirk.clawson@noaa.gov

17. Urban Dispersion Program. The Urban Dispersion Program continues to make headway. A teleconference presentation with accompanying PowerPoint slides was presented on 20 April to several NYC officials from city departments including the Office of Emergency Management, NYPD, FDNY, Transit Authority, and Health and Mental Hygiene. Other participants represented Federal agencies such as the FBI, DHS, and two DOE national laboratories. The presentation was given by Dr. Jerry Allwine of the Pacific Northwest National Laboratory, who serves as the Principal Investigator of the program. Our atmospheric tracer work in Midtown Manhattan and subsequent related data analyses were a major component of the presentation. The presentation provided new urban dispersion results and recommendations for future research. kirk.clawson@noaa.gov and Dennis Finn

In response to reviewer comments and reconsideration of the approach used to develop the topics in the manuscript, the existing Joint Urban 2003 paper describing atmospheric tracer results from Oklahoma City, was significantly revised. The revisions have been completed in draft form and the paper is now titled "Atmospheric flow decoupling and its effects on urban plume dispersion". dennis.finn@noaa.gov

18. Extreme Turbulence (ET) Probe. Page proofs for the *Journal of Atmospheric and Oceanic Technology* paper on the ET probe were received in early April. Only a few minor edits were required to the proofs, and the edited proofs were quickly sent back to the American Meteorological Society for further processing. richard.eckman@noaa.gov

19. Perfluorocarbon Tracer Analysis Development. The long-term perfluorocarbon (PFC) sample stability (aging) tests for low (250 pptv), middle (4,000 pptv), and high (100,000 pptv) concentrations are still in progress. Each set of cartridges has been analyzed over periods of several

weeks and indications are that the concentrations in the sample bags are maintaining their original concentrations. These will continue to be analyzed intermittently over the next several months to complete this particular study. Some follow-up tests are still required to complete the evaluation of some of the artifacts identified last month, in particular, the artifacts associated with very high concentrations. dennis.finn@noaa.gov and Roger Carter

20. NOAA INL Weather Center Web Page. Work has begun on a new one-stop weather web page for the INL. The page is called the NOAA INL Weather Center and includes current data and summaries previously available only on multiple web pages. It has been designed to simultaneously provide meteorological information to both emergency and daily operations managers. The highlight of the new weather page is the presentation of severe weather hazard information generated by the local FRD weather forecaster as well as that from the National Weather Service in Pocatello. Other weather information available at the single click of a mouse button includes the INL weather forecast, wind speed trends, radar loop and satellite loop. While the web page will be a work in progress for a few months, we are planning to make the web page live sometime in late May or early June in time for the severe and fire weather seasons. brad.reese@noaa.gov, Jason Rich, Neil Hukari, and Roger Carter

Special Operations and Research Division (SORD), Las Vegas

21. WRF Model. The method used to create graphics for the SORD website was changed and the graphics now are processed in parallel using four processors instead of using just one processor.

A script was modified to automatically download upper-air and METAR data from the Meteorological Assimilation Data Ingest System (MADIS) after the NCEP model data that is used to initialize WRF is downloaded.

MADIS files required by the WRF variational data assimilation system for ingesting of MADIS data were downloaded and installed. One bug was fixed which prevented compilation of some programs. A missing type variable definition prevented some of the WRF-VAR programs used to calculate background errors from being compiled.

A comparison between ETA MOS and WRF temperature, dewpoint, and wind speed predictions was completed for DRA. WRF temperature forecasts were slightly more accurate than the ETA MOS forecasts. In contrast, the ETA MOS dewpoint and wind speed predictions were noticeably better than the WRF predictions.

A problem was identified in the vertical interpolation of potential temperature from the NCEP model domain (input data) to the WRF domain. When the NCEP model surface pressure is less than, i.e. at lower pressure and higher altitude, than the WRF model surface pressure; the interpolation routine uses NCEP levels below the surface that contain fictitious values which sometimes result in the creation of superadiabatic lapse rates in the first few levels of the WRF model. kip.smith@noaa.gov

22. Department of Energy and NOAA Safety Activity. Nevada Test Site (NTS) Deputy Fire Chief J. Rynes was contacted to discuss implementation of the NTS Fire Weather Forecasts for weekends and holidays. The meteorological information required by fire dispatch was reviewed as well as the

identification of the proper communication procedures. It was decided that the NTS Fire Weather Forecasts would commence on May 4. darryl.randerson@noaa.gov

23. Lightning Safety. An NTS lightning safety meeting was convened by the Director, SORD, at Mercury. The objective of this meeting was to review NTS hazardous weather notification procedures, including lightning alerts, and to coordinate communications links. The Deputy Director, SORD, gave the presentation to a wide variety of NTS safety personnel. walter.w.schalk@noaa.gov and Darryl Randerson

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ARL is considering how to best keep its stakeholders informed about its activities. You could help the Lab share information with you more effectively, by sending a brief note to betty.wells@noaa.gov indicating if you find information in the monthly activity reports useful and if you have any suggestions for how we could more effectively provide the information that you need.