NOAA ARL Monthly Activity Report

April 2004

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Contents

Highlights

1. Particle Deposition Velocities Revised. Two decades ago, there was a loud and energetic argument about the rate at which small particles deposited from the air to natural surfaces. The particles in question are those in the inhalable size range. The models then available predicted very small rates of deposition, corresponding to deposition velocities of the order of 0.1 cm/s. However, field studies conducted over forests (and other surfaces) using micrometeorological methods yields values typically an order of magnitude greater. The experimental results were largely discounted by the modeling community. Now, new measurement methods developed at Oak Ridge have tended to confirm the earlier experimental findings.

The repercussions could be very important, since models predict air concentrations of any trace quantity in the air as the balance between input (emission and production) and removal (deposition) rates. A useful first approximation is that the removal rate is proportional to the concentration in air, with removal by rainfall dominating. The new results indicate that the wet removal may not be as dominant as has been thought, and that the models will likely overpredict atmospheric concentrations of small particles. tilden.meyers@noaa.gov, Bruce Hicks

Silver Spring

2. Estimating Mercury Deposition. An initial analysis was completed of the likely deposition of mercury to approximately 15 selected lakes and other susceptible regions throughout the U.S. under different emissions scenarios. Analyses for 1996 and 1999 based on current emissions inventories were completed to establish baselines. Analyses for 2010 and 2020 were performed, estimating the effect of different regulatory regimes on emissions from coal-fired power plants.

The earlier Great Lakes analysis was updated, using new emissions inventory information. Maps and charts showing the updated estimates of top contributing individual sources, source categories and source regions to the Great Lakes have been prepared, supporting the development of the IJC's Biennial Report.

In the case of the Chesapeake Bay, a combined measurement/modeling project analyzing atmospheric mercury is being planned for this summer, involving the NOAA Oxford Cooperative Laboratory and a number of contributors from three ARL locations. The planned activities include measurements of elemental, particulate and reactive gaseous mercury, ozone, sulfur dioxide, and carbon monoxide at two sites on the eastern shore of the Chesapeake Bay (most likely Wye MD and at the Oxford Lab). The HYSPLIT-based mercury model will be used to assist in data interpretation, and, the measurements will allow a comprehensive evaluation of the mercury simulations.

In parallel with this work, participation continues in the mercury model comparison project – Phase II involves the comparison of models against short term mercury measurement campaigns. Work has begun on the Phase III analysis, involving comparison of long-term deposition and transboundary mercury budgets in Europe. mark.cohen@noaa.gov

3. HYSPLIT Backup Procedures. The meteorological data GUI interface and associated programs were revised to support a more stand-alone PC version without requiring links to the ARL data server. Automated FTP links for both AVN and ETA forecasts and FNL archives on the NCEP server are now available through the GUI. An additional menu was provided to access the ARL server archives. A new interface was added to permit conversion of ECMWF ERA-40 GRIB files, now freely available through the internet. A menu was added to convert locally available MM5V3 output files. The meteorological display programs (*profile*, *contour*, and *showgrid*) were modified from a prompted standard input entry to command line options, permitting the creation of a "mouse-click" GUI interface for viewing the contents of the meteorological data files. The upgraded stand-alone PC version provides a more independent backup capability. Other enhancements include a restructuring of the model's file unit assignments to open a much larger number of meteorological data files and therefore permit full-year simulations in one-pass. As a further enhancement of the PC's backup capability, automated TCL scripts were written to FTP data and run HYSPLIT from the PC's scheduler, thereby reproducing on a PC some of the functionality now only available on our UNIX workstation. roland.draxler@noaa.gov

4. Study of Tropospheric Temperature Trends from Satellite Data. A paper on the "Contribution of Stratospheric Cooling to Satellite-Inferred Tropospheric Temperature Trends" by Qiang Fu, Celeste Johanson, Steve Warren (all of University of Washington) and Dian Seidel (NOAA/ARL) appeared in the May 6, 2004, issue of *Nature*. The study removes the influence of stratospheric cooling is from Microwave Sounding Unit (MSU) channel 2 temperature time series, using results from radiosondes and MSU channel 4 data, to obtain observations representative of the 850 to 300 hPa tropospheric layer. After this removal, the MSU data show warming comparable to observed surface warming. Previously, the much smaller tropospheric trends obtained from MSU channel 2 (and from derived lower-tropospheric data products) compared with strong upward surface temperature trends have raised questions about all of the relevant measurement systems and about our

understanding of the nature and cause of changes in the atmospheric vertical temperature profile. Prior to the publication, talking points for NOAA senior managers were prepared. dian.seidel@noaa.gov

5. Update of Global Temperature Through Last Winter. Based on a 63-station radiosonde network, global surface, troposphere, tropopause-layer and low-stratosphere temperatures have been updated through the winter of 2003-2004. Globally, this winter is indicated to be the warmest of the 47-year record at the surface and in the troposphere,. Furthermore, following close-on the record-breaking spring warmth of the Antarctic low stratosphere at the end of 2002 (accompanied by almost complete disappearance of the Antarctic ozone hole), last winter's warmth in the Arctic low stratosphere tied the 1985 record, and resulted in complete disappearance of the less pronounced Arctic ozone hole. There may be discussion as to whether this anomalous polar stratospheric warmth only 5 seasons apart is coincidental, or reflects a change in atmospheric circulation. (Jim Angell, 301 713 0295, x127)

6. Global Tropopause Study. Extending previous work on the climatology and variability of the tropical tropopause, we are undertaking a study of the global tropopause. The work is motivated in part by recent research suggesting that the tropopause may be a sensitive indicator of climate change. The project is a collaborative effort among Bill Randel (NCAR), Andy Dessler and Dan Kirk-Davidoff (University of Maryland) and Dian Seidel (NOAA/ARL). Preliminary analysis is underway in preparation for writing a proposal on the subject. dian.seidel@noaa.gov

Boulder

7. SURFRAD/ISIS. On April 5, 2004, the instruments at the Desert Rock SURFRAD station were exchanged. This trip was the first to switch the Total Sky Imager (TSI) operating system from Windows to Linux. All went well. All TSI computers will be replaced this year with Linux systems.

On April 15, 2004, SRRB, and the world radiation monitoring community, were informed that the SURFRAD Network became an official member of the Global Climate Observing System (GCOS), through its relationship with the Baseline Surface Radiation Network (BSRN). The formal notification letter was sent to SRRB from Dr. Soroosh Sorooshian, Chair of the GEWEX Scientific Steering Group. john.a.augustine@noaa.gov

Research Triangle Park

8. Community Multiscale Air Quality Mercury (CMAQ/Hg) Model. A mercury version of the Community Multiscale Air Quality (CMAQ) modeling system (CMAQ/Hg) has been successfully implemented on the Division''s Linux cluster. Four test periods have been run and the transfer to the Linux platform appears to be complete. Model run time tests have been performed using two vs. eight Linux processors with the following results:

I. Standard CMAQ, 2 processors, 5 days: 4.1 hrs/model day
II. CMAQ/Hg, 2 processors, 5 days: 5.8 hrs/model day
III. Standard CMAQ, 8 processors, 16 days: 1.5 hrs/model day
IV. CMAQ/Hg, 8 processors, 16 days: 2.4 hrs/model day

A single-column version of the model is being developed to support multi-media code development. Initial development will focus on the addition of process algorithms facilitating dynamic bi-direction flux characterization. (Ellen Cooter, 919 541 1334)

9. Tests of CMAQ $PM_{2.5}$ Outputs using MODIS Aerosol Optical Depth. MODIS aerosol optical depth (AOD) data from the Terra satellite instrument have been collected for the year 2001, and are being qualitatively compared with the CMAQ $PM_{2.5}$ surface concentration fields and observed surface level concentrations of fine mass. Several fire and sulfate episodes during 2001 were identified using GOES. These episodes are the focus periods for comparing satellite AOD and thermal products with CMAQ and surface networks. Results from these analyses will contribute to the comprehensive model evaluation efforts underway for the annual 2001 CMAQ simulation. (Dev Roy, 919 541 5338; Alice Gilliland, 919 541 0347)

10. Climate Impacts and Regional Air Quality (CIRAQ). During April, emission processing for current and future climate scenarios was started. Downscaled 10-year (1995/6-2005/6) baseline GISS-driven climate scenario data, and meteorological data for the period 1997 through 1999 now reside in-house. The 1999 downscaled meteorology data have been provided for emissions processing. The remainder of the meteorological data for 1999-2003 will be processed as they are received, making 10 years of data available for simulation with the CMAQ modeling system. (Rob Gilliam, 919 541 4593; Bill Benjey, 919 541 0821).

11. Global Climate Change and NOMADS. Electronic access to the global climate change scenario results database generated by the U.S. Forest Service continues to be a concern. A conference call was arranged between the U.S. Forest Service and the NOAA/NOMADS (NOAA Operational Model Archive and Distribution System) Framework coordinator. NOMADS is intended to address model data access needs as outlined in the U.S. Weather Research Program (U.S. WRP) *Implementation Plan for Research in Quantitative Precipitation Forecasting* and data assimilation to "redeem practical value of research findings and facilitate their transfer into operations." The NOMADS framework is also intended to facilitate comparisons of climate model and observational data as discussed in documents provided by the Intergovernmental Panel on Climate Change (IPCC 1990; 1995; 2001) and the U.S. National Assessment (2000). NOMADS is being developed as *a unified climate and weather archive* so that users can make decisions about their specific needs on time scales from days (weather), to months (El Nino), to decades (global warming). At the close of the conference call, the U.S. Forest Service expressed considerable interest in using NOMADS. (Ellen Cooter, 919 541 1334)

Idaho Falls

12. Pentagon Shield. Pentagon Shield is the name for the atmospheric tracer study being conducted at the Pentagon this coming May. The project has now grown to such an extent that we will use all of our operating real-time SF_6 analyzers (8) and all of our cardboard bag samplers (100). In addition, the number of test days has expanded from three to five and now includes and indoor as well as an outdoor component. All preparations for deployment to the field were completed by April 23, and the caravan of trucks and equipment departed for Washington, DC the next day. The road crew arrived on April 27 and the remainder of the FRD crew arrived the following day by air. The final two days in April were dedicated to unloading equipment and preparing for the field tests. By the end of the last day of April, everything was prepared for an initial shake-down test the next day. This was a

remarkably short time for field installation and is one for the FRD record books. kirk.clawson@noaa.gov and staff

Preparations for the Pentagon Shield project were completed and the equipment shipped to Washington D.C. on April 24. The continuous analyzers will be run during transport to maintain their conditioning for the study. All cartridges for the Programmable Integrating Gas Samplers (PIGS) were cleaned and checked before shipping. They will be returned to Idaho Falls for analysis after the study. roger.carter@noaa.gov, Debbie Lacroix

13. CBLAST-High. Analysis continues on data collected during Hurricanes Fabian and Isabel in September 2003. Final archived data were made available to the CBLAST community this month. Initial calculations of sensible and latent heat and momentum fluxes have been made and are to be presented at the 26th AMS Conference on Hurricanes and Tropical storms in early May. The results are very encouraging as co-spectra and total covariances from several independent instruments agree rather well. Preliminary results indicate a nearly constant profile for latent heat flux and momentum flux through the boundary layer, and a decrease with height for the sensible heat flux.

Preparations are under way for the upcoming 2004 hurricane season. Included in these preparations are new instrument circuit boards, slight modifications to the BAT housing to alleviate erosion in rain and graupel, and modest upgrades to the data system software. We are now completing calibration of the BAT and will begin assembly at FRD in early May. The system is scheduled for installation on the P3 during the last week of May with test flights scheduled for the third week of June. jeff.french@noaa.gov

14. Extreme Turbulence Probe. A rain storm on 8 April provided an opportunity to field test the newly modified ET probe at FRD. As discussed last month, the new ET probe has enlarged pressure ports designed to minimize the effect of rain water on the pressure measurements. The probe has been mounted on a pickup truck along with a Gill 3D sonic anemometer. On 8 April the truck was driven through a moderate rain cell to the east of Idaho Falls. The sonic data clearly show the effects of the rain, with many spikes in the wind data. The ET probe faired much better. In fact, the ET probe performance within the rain is basically indistinguishable from its performance when it was not raining. One issue that did come up in these road tests is that the velocity spectra for the v velocity component rolls off too steeply in the inertial subrange. It is not clear what causes this, although it is not related to the rain problem. richard.eckman@noaa.gov

15. Uncertainties in Dispersion Modeling. Studies of worst-case dispersion scenarios at INEEL have resulted in the preparation of a manuscript entitled "Uncertainty in Dispersion Modeling as Derived from Bayesian Probability Theory." Bayesian probability theory has been used to explore the sources of uncertainty in dispersion modeling. The approach leads to significantly different results compared to the more conventional approaches to uncertainty. As one example, the Bayesian approach indicates that the uncertainty associated with a particular model can change with time as users gain experience with the model. This dependence on past model experience does not appear in the conventional descriptions of uncertainty. richard.eckman@noaa.gov

Las Vegas

16. Underground Testing Preparedness. New methods are being investigated for depicting potential debris clouds and fallout patterns from underground nuclear tests. These methods include utilizing generalized dispersion and cloud growth as a function of time. These new methods will help streamline graphics production for depicting accidental releases into the atmosphere, and will help to facilitate the realistic depiction of time-based predictions of exposures to radioactive contaminants. (Doug Soule', 702 295 1266, and Darryl Randerson, 702 295 1231)

17. Climatology/NTS Wind Roses Request. New plots were generated for displaying both monthly and annual wind roses for the NTS. These new wind roses were created in response to a request from Bechtel Nevada (BN), for input into the Annual Site Environmental Report. The new versions of the monthly/annual wind roses utilize the full, speed delimited color scheme for selected locations on the NTS. Additionally, to fulfill the request from BN, a Geographic Information System background provided by them was used for overlaying wind roses. The new versions of these wind roses are available on SORD's Web Page. (Doug Soule', 702 295 1266)