NOAA ARL Monthly Activity Report

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1. Highlight – Smoke Forecasts Operational. For the last few years, NOAA ARL has been developing a smoke forecasting tool in collaboration with the National Environmental Satellite, Data, and Information Service (NESDIS) and the National Weather Service (NWS). This tool, which has been running in experimental status at the NWS for the last year, was recently moved into operations (forecasts can be viewed at: http://www.weather.gov/aq/). Smoke forecasts are currently produced with the ARL HYSPLIT model, which is preconfigured to run over the entire country once a day to produce a 24-hour analysis and a 48-hour forecast with the NOAA NCEP NAM/WRF 12 km meteorological forecast data. These forecasts were made available last year to air quality forecasters, to get feedback on the usefulness of the product. Based on their feedback and verification statistics, the product has been moved into operations for the upcoming fire season. Additional HYSPLIT development and verification using a new GOES aerosol optical depth product will continue in a parallel mode.

Development has already started on the next update which will use the native sigma level data from the NAM WRF-NMM output. These files are much larger than those originally used, tripling computational time for a smoke forecast. After substantial revision of the supporting scripts, initial testing was started using a multiple processor version of HYSPLIT, resulting in wall-clock times

similar to the original single processor calculation. Further testing and comparison with the production runs are planned. roland.draxler@noaa.gov and glenn.rolph@noaa.gov

2. Highlight – Emissions of Nitrogen Oxide from Lightning: Using lightning strike data from the National Lightning Detection Network, emissions of nitrogen oxide from lightning (LNO_x) have been estimated for the summer of 2004. LNO_x emissions are estimated to be approximately 21% of the anthropogenic emission total, or approximately equal to NO_x emissions from power plants. These findings are consistent with previous studies on a continental and global scale. However, nearly all of the LNO_x emissions occur in the range of 6-12 km above the surface and during relatively clean conditions, so their impact on episodic urban ozone is expected to be small. Because LNO_x is the dominant source of NO_x in the upper troposphere, accurate emission estimates are needed to properly evaluate air quality simulations of nitrogen and oxidant concentrations in the free troposphere. Future work will use surface, aloft, and space-based observations to compare calculation methodologies and examine uncertainty in LNO_x emissions. rob.pinder@noaa.gov

Air Resources Laboratory Headquarters, Silver Spring

3. PC HYSPLIT Training. HYSPLIT is among the most widely used atmospheric dispersion models, having been adopted by NWS and by the meteorological services of several other countries as their operational dispersion code. Training classes have been offered several times within the last 4 years and have been quite popular, but attendance is intentionally kept small. On May 16-18, another training workshop will be held at the NOAA facility in Silver Spring. The coming class will be made up of PC HYSPLIT users from NWS, Federal and state governments, private companies, and several universities. Past workshops have involved a similar mix of attendees. The class is developed and offered by Roland Draxler, Glenn Rolph and Barbara Stunder from ARL Silver Spring, MD. glenn.rolph@noaa.gov

4. SPARC Temperature Trends Panel Meeting. The World Climate Research Programme's (WCRP) Stratospheric Processes and their Role in Climate (SPARC) program has undertaken a new assessment of stratospheric temperature changes. The international assessment panel will be meeting in Washington 12-13 April 2007. The team is analyzing observations of stratospheric temperature from a number of sources, and a review paper is in progress. The second stage of the assessment will involve evaluation of model simulations of the observed changes. Dian Seidel is a member of the panel and is organizing the April meeting. Melissa Free and Jim Angell will be participating, as will NOAA colleagues from NWS/NCEP and GFDL and panel members from Europe, Japan, and the U.S. dian.seidel@noaa.gov

Atmospheric Turbulence & Diffusion Division (ATDD), Oak Ridge

5. Climate Reference Sites in the South. The Climate Reference Network (CRN) gained three new sites in February on the southern margin of the US in Big Bend National Park, Texas, Las Cruces, New Mexico, and near Everglades National Park, Florida. Sites are now installed at about 100 locations, remote from development and representative of their area. Eight of these locations have paired sites separated by several kilometers. The Integrated Station Information System has absorbed the information in the data base "CRNSites." All CRN instruments' characteristics and

event history will now be reported in this new, more general and flexible data base. tilden.meyers@noaa.gov

6. Air Quality -- ETOS. The East Tennessee Ozone Study (ETOS) has developed an extensive regional ozone database and micrometeorological monitoring network since its beginning in 1999. In 2004 and 2005, the ETOS sampling network was supplemented with annular denuders and filter packs to measure sulfur and nitrogen species. A report completed in February and currently under review characterizes the observed patterns of sulfur and nitrogen aerosols noting distinct diurnal patterns within 440 m of the ground and suggesting that gas-to-particle conversion may be suppressed at certain sites due to SO_2 emissions within the region. In work now being planned for 2007, ozone flux measurements are proposed for a number of ETOS locations, with the intent to study spatial distributions of ozone deposition and the need for advanced analysis techniques when the surroundings are complex. latoya.myles@noaa.gov

7. Urban Dispersion -- Model Output Statistics (MOS). This methodology shows promise for emergency forecast of the spread of hazardous airborne material on the street scale. They are being developed for a feasibility study drawing predictors from the National Weather Service's finer-scale models, and using regressions derived from urban-scale networks' data. The Rapid-Update-Cycle (RUC) system, incorporating new observations each hour will provide the predictors. An urban-scale observing network maintained by AWS Convergence Technologies, Inc will provide the local observations. The response of the wind instruments used by AWS to fluctuating light wind is being characterized in wind-tunnel tests. will.pendergrass@noaa.gov; ron.dobosy@noaa.gov

8. University of Alabama Airborne Measurements Collaboration. The University of Alabama Sky Arrow aircraft will undergo a major computer hardware upgrade in February. A new serial port module, completely Linux compatible, has been found that provides programmable RS-232/422/485 high speed serial ports (up to 960 kbps) with a USB interface to the computer. The original MFP industrial PC (which weighed nearly 30 lbs) will be replaced with a Norhtec HyperClient computer that weighs 5 lbs and consumes approximately 20 watts of power. Software will be identical to that used in the previous system. Installation is expected to begin early next month. ed.dumas@noaa.gov

Atmospheric Sciences Modeling Division (ASMD), Research Triangle Park

9. Community Multi-Scale Air Quality (CMAQ) Model Evaluation. Historically, the evaluation of CMAQ has focused on annual, seasonal or monthly aggregate statistics. While informative, this approach often conceals subtle biases and errors that contribute to poor model performance on smaller temporal scales. Accordingly, cluster analysis has been used to identify the dominant, recurring synoptic-scale flow patterns that impacted the model domain during 2001. Specifically, the analysis was applied to sea-level pressure across the contiguous United States, obtained from Eta 4-D Data Assimilation System (EDAS). A total of eight clusters, each characterizing unique synoptic scale flow patterns, were identified. Separate model evaluation statistics have been calculated for both air quality and meteorology parameters for each of the eight clusters, revealing varying levels of performance. In addition to the cluster-aggregate statistics, single day statistics are being compiled from "key" days or days that are most representative of the clusters. brian.eder@noaa.gov

10. Implementation of Pleim-Xiu Land Surface Model in WRF. More effort was focused on the WRF model in February 2007. We are nearing the complete implementation of the Pleim-Xiu Land Surface Model, the Asymmetric Convective Model version 2 (ACM2) boundary layer model and surface layer scheme into the new 2.2 version. In particular, progress was made on passing the 2-m temperature and moisture analyses from the driving model to the Pleim-Xiu Land Surface Model using the four dimensional data assimilation (FDDA) package. This information is necessary for the soil moisture nudging scheme of the Pleim-Xiu Land Surface Model.

The WRF model was executed for the month of July, 2002 using four dimensional data assimilation. Since the Pleim-Xiu physics package in not fully completed, other land-surface (LSM) and planetary boundary layer (PBL) physics options were chosen to match an MM5 simulation of the same time period. The purpose of this comparison is to assess the performance of the new WRF model *versus* the currently used MM5 model. An initial evaluation indicates the WRF model performs as well, and in many cases, much better than the MM5. Table 1 is a comparison of the two models for July 2002; the North Carolina sites only. The statistics in Table 1 are model performance metrics of 2-m temperature. The Table indicates the mean absolute error of simulated 2-m temperature is 1.46 K for the MM5 and 1.20 K for the WRF model. Additionally, all other performance metrics indicate a much better simulation of 2-m temperature by the new WRF model. robert.gilliam@noaa.gov, jonathon.pleim@noaa.gov

Table 1. Model performance of 2-m temperature (K) for North Carolina and July 2002.

MM5
Model Performance Statistics

Data count	13401
Correlation	0.90718
Standard Deviation	1.7948
Mean Absolute Error	1.4641
Mean Bias	0.65543
*Mean Fractional Bias (%)	0.22039
*Mean Normalized Bias (%)	2.6897
*Mean Normalized Error (%)	5.8796
*Normalized Mean Bias (%)	2.6271
*Normalized Mean Error (%)	5.8684
Root-Mean-Sqr-Error	1.9107
Index of Agreement	0.89454

* Stats are normalized by observation range

WRF
Model Performance Statistics

Data count	12815
Correlation	0.93591
Standard Deviation	1.5745
Mean Absolute Error	1.2058
Mean Bias	0.020443
*Mean Fractional Bias (%)	0.0061011
*Mean Normalized Bias (%)	0.090737
*Mean Normalized Error (%)	4.8841
*Normalized Mean Bias (%)	0.082703
*Normalized Mean Error (%)	4.8779
Root-Mean-Sqr-Error	1.5746
Index of Agreement	0.9359

* Stats are normalized by observation range

Field Research Division (FRD), Idaho Falls

11. URBAN 2000 Results Support Need for Dense Network Data. The need for local data to guide dispersion forecasts is well demonstrated by the results of a particularly interesting nocturnal tracer field experiment conducted in the URBAN 2000 studies at Salt Lake City. In this complex terrain setting, nocturnal drainage flows are very common and often dominate plume dispersion. In one especially evident occasion, the plume moved down-valley toward the west and northwest despite the observed winds blowing in very different directions. This particular experiment highlights the great difficulties that can be encountered in trying to reliably anticipate and model urban plume dispersion. A very dense meteorological network would have been required to have satisfactorily defined the flows that actually drove the dispersion. It is also apparent that attempting to anticipate or model an urban dispersion event such as this would be impossible without a dense meteorological network and/or tracer studies to identify such anomalies. dennis.finn@noaa.gov

12. Urban Dispersion Program. FRD's extensive involvement in the NYC Urban Dispersion Program's August 2005 Midtown Manhattan field study is being documented in a NOAA Technical Memorandum, soon to be printed. However, due to the sensitive information within the document, we will publicly limit the distribution of the document until final approval for public distribution is received from DHS and NYC officials. This document will be beneficial to emergency personnel and to the public if there is an accidental or intentional release of a chemical, radiological, or biological agent in an urban environment. kirk.clawson@noaa.gov, Jason Rich, and Dennis Finn

13. Perfluorocarbon Tracer Analysis Development. The long-term PFC sample stability (aging) tests continued. Presently we have low (250 pptv), middle (4,000 pptv), and high concentration (100,000 pptv) aging studies in progress, each represented by six sample cartridges (72 sample bags). While each of these cartridge sets will be analyzed intermittently for several more months, the preliminary indications are that the concentrations in the sample bags are maintaining their original concentrations. The calibration of the detection system has been found to change slightly through the course of a day. The shifts in response, often in the range of 10-20%, often require frequent recalibration after the analysis is begun each day. The PMCH response tends to stabilize much more quickly and drift is much less common although recalibration is occasionally needed. After several hours of operation, the drift in response for all species is much slower or negligible. dennis.finn@noaa.gov

14. Tracer Sampling and Analysis Upgrade. As part of the continuing effort to maintain an unequalled tracer analysis capability, all tracer samplers are being installed in new weatherproof enclosures. A number of the upgraded samplers have been tested to verify that the new enclosures does not cause problems with repeatability, entrapment of tracer within the enclosure, contamination of the quality control samples, and other problems. Approximately 70 samplers have been upgraded.

When the samplers were first designed 19 years ago, a state-of-the-art single chip microcontroller was selected to control all aspects of sampler operation. This allowed operator programming or configuration of the sampler with a small, simple to use, and inexpensive handheld downloader. A very efficient and inexpensive switching power supply integrated circuit was also designed into the sampler which would allow the sampler to run for weeks at a time using a single 1.5 volt alkaline "D" cell battery. Both of these circuits are now unavailable from the manufacturers or normal

distribution, however supplies have been located from distributors that maintain an inventory of discontinued parts. This should allow us to keep sufficient spares on hand for the foreseeable future. roger.carter@noaa.gov, Randy Johnson, Dennis Finn, and Shane Beard

15. StormReady. The National Weather Service (NWS) StormReady designation for INL is up for renewal by the NWS. The StormReady designation (see http://www.stormready.noaa.gov/), which must be renewed every three years, was originally received by the INL three years ago without input from FRD. However, as a part of the renewal process, FRD has been directly involved and has participated in editing the renewal document. As an additional part of the renewal process, Kirk Clawson and Vernon Preston, the Warning Communication Meteorologist from the Pocatello NWS, provided weather spotter training to the INL Emergency Management team on February 22. kirk.clawson@noaa.gov