



NOAA ARL Monthly Activity Report



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Highlights

1. *Highlight -- New Volcanic Ash Dispersion Capability now Operational.* At the request of the NWS Alaska Region and in anticipation of a possible eruption of Mt. Augustine, a program was initiated to automatically compute trajectories from the volcano and post them to the ARL website, http://www.arl.noaa.gov/ready/traj_alaska.html. A new ARL product is now operational at NCEP – using the 45-km NAM (North American Meso) data for operational volcanic ash or other dispersion forecasting by the NCEP Senior Duty Meteorologist (SDM). The SDM began regular HYSPLIT dispersion runs every day using the new enhanced capability for contingency planning by meteorologists at the Anchorage Volcanic Ash Advisory Center. barbara.stunder@noaa.gov

2. *Highlight -- Integrated Lagrangian-Eulerian Modeling System.* Air Resources Laboratory (ARL) research related to air quality modeling has consciously followed a path involving both Lagrangian and Eulerian models. The former follow a puff of pollution as it moves downwind from some selected source; they are well suited for relating sources to downwind effects. The latter takes a gridded view, with sources combined across grid cells, and with application well suited to the analysis of complex chemistry where emissions from various sources are interacting. These techniques should yield similar answers, but because their applications are generally quite different it is rare that opportunities for comparisons arise. A recent

model intercomparison, performed by the European community, resulted in a first verification that the two approaches were consistent with each other. Current projects within ARL are serving to use these complementary modeling approaches in combination to create more powerful analysis capabilities.

The ARL Lagrangian HYSPLIT model has been used for many years and by many user groups world-wide to track long-range transport of effluent from volcanoes, major forest fires, and large scale dust events. The Eulerian Community Multiscale Air Quality (CMAQ) model is a mesoscale numerical model simulating regional and local photochemical ozone smog, fine particulate matter, acid/nutrient/mercury deposition, and air toxics. Recently, both models have been used by the NWS for air quality forecasting of smoke from wildfires and regional ozone. Research is now being conducted to use both models in combination for air quality forecasting and assessment, with HYSPLIT tracking and quantifying large-scale transport of primary pollutants from large wildfires and dust storm events occurring outside of the continental U.S. gridded CMAQ domain. The HYSPLIT model will simulate the transport of pollutant mass to the boundaries of the CMAQ model domain and define the spatial and temporal variations of boundary mass fluxes while sources within the U.S. model domain will be accounted for by the CMAQ model processes.

The feasibility of developing an urban hybrid modeling system is being investigated. In this system, grid-based modeling of meteorology and atmospheric chemistry would be conducted by models such as WRF and CMAQ with horizontal grid cells of 1-5 km size. The resulting fine-scale urban meteorological fields would then be used to drive multiple HYSPLIT trajectories from selected source locations within the urban area to define a probabilistic envelope of trajectory ensembles and resulting dispersed pollutant concentrations. The combination of CMAQ's deterministic concentration fields and HYSPLIT's ensemble probabilistic concentration fields can then be used to better describe atmospheric dispersion within an urban area with a robust modeling framework. The combined CMAQ-HYSPLIT modeling system can be a powerful tool for understanding the processes affecting atmospheric transport, dispersion, transformation, and removal of pollutants and for predicting the concentration distributions over multiple scales, spanning local-to-urban-regional-to-continental in a consistent manner. roland.draxler@noaa.gov; james.godowitch@noaa.gov; vlad.isakhov@noaa.gov

Silver Spring

3. Tropopause Height a Poor Indicator of Climate Change? Preliminary analysis of a global radiosonde dataset to study variations and trends in the tropopause is yielding some interesting findings. Although temporal homogeneity of the data is a problem that cannot be ignored, the observations show (1) significant correlations between tropopause height and upper-tropospheric temperature, and anticorrelation between tropopause height and lower-stratospheric temperature, on monthly synoptic time scales, (2) coherent upward trends in tropopause height (and downward trends in tropopause pressure and temperature) during 1980-2004, (3) negative correlation between tropopause trends and stratospheric temperature trends, and (4) lack of correlation between tropopause trends and tropospheric temperature trends. This latter finding raises questions regarding use of the tropopause as a sensitive indicator of climate change, as proposed by recent studies. dian.seidel@noaa.gov

4. Public Launch of RATPAC Datasets on the Web. The new Radiosonde Atmospheric Temperature Products for Assessing Climate (RATPAC) datasets are now available to the public at <http://www.ncdc.noaa.gov/oa/cab/ratpac> along with descriptions of the products. The datasets are derived from the Lanzante-Klein-Seidel (LKS) adjusted data (Lanzante et al. 2003) and the Integrated Global Radiosonde Archive (IGRA) dataset. They include hemispheric, tropical and global mean temperature anomalies from 1958 to the present and station data from the LKS dataset extended from 1997 to the present using the IGRA archive. RATPAC was a collaborative effort between the ARL Climate Variability and Trends group and scientists from NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) and the National

Climatic Data Center (NCDC). The datasets are updated routinely and used for climate monitoring by NCDC. melissa.free@noaa.gov, and Dian Seidel

5. Comparisons Between RATPAC and GCM Upper-air Temperatures. Melissa Free presented a paper at the AGU Fall Meeting comparing temperature changes in the RATPAC dataset to those in simulations of twentieth century climate from coupled ocean-atmosphere models. In the extratropics, the models show no consistent signal in the vertical profile of tropospheric temperature trends. In the tropics, the models all show surface warming amplified in the troposphere, but the RATPAC data since 1979 show tropospheric trends no greater than the trends at the surface. The homogeneity adjustments contained in the RATPAC dataset do, however, improve the model-data agreement for almost all regions and models. melissa.free@noaa.gov

6. A Very Warm 2005. Based on the long-running ARL radiosonde network analysis, the global tropospheric temperature in 2005 was the second warmest of the 48-year record (0.64K above the 1961-1990 average), exceeded only by the tropospheric temperature anomaly of 0.78K in the El Nino year of 1998. After accounting for the impact of the powerful 1997-98 El Nino on 1998 tropospheric temperature (based on a linear regression between 48 years of 850-300 mb temperature and Nino3 SST), 2005 becomes the warmest year of record by 0.03K. The 2005 tropospheric temperature anomaly is twice as great in the Northern Hemisphere as the Southern Hemisphere, and is best expressed in the north temperate climate zone where the annual anomaly exceeds 1K, peaking at 1.2 K in summer. While the global troposphere (850-300 mb layer) and tropopause layer (300-100 mb) have basically warmed during the last decade, the temperature of the global low stratosphere (100-50 mb layer) has remained essentially the same. (Jim Angell, 301 713 0295, x127)

Results from the new RATPAC dataset are similar, with 2005 the warmest on record in the NH troposphere and the second warmest for the globe. As in the Angell 54-station dataset, the greatest tropospheric warming occurred outside of the tropics in the NH, particularly in spring and summer. In the RATPAC data, 2005 was also the second warmest year in the tropics, while in the Angell data several earlier years were warmer, including 2002, 1995 and 1988. In both datasets, the tropical stratosphere was the second coldest on record, while global mean temperatures in the stratosphere were not unusual. melissa.free@noaa.gov

7. WMO Dispersion Modeling Literature Review. A review was conducted for the WMO to determine if suitable recent reference materials were available that could be linked to the WMO emergency response web page to provide an on-line resource for national meteorological services. Such information is in demand for developing expertise in dispersion modeling or analyzing dispersion model products. There are a few on-line or public domain sources. Most sources are in printed copyrighted formats only available through purchase or libraries. The ARL READY web site is a popular source for related material. roland.draxler@noaa.gov

8. Associate Editor – Journal of Climate. In January Melissa Free was appointed an associate editor of the Journal of Climate. Associate editors provide additional expertise to the editors in selected cases when editors receive split decisions on manuscripts. dian.seidel@noaa.gov

Oak Ridge

9. Ion Mobility Spectrometer for Ammonia Measurement. Development of a new ion mobility spectrometer for real-time field measurement of ammonia has been completed. Tests conducted as part of the BRACE program in Florida have proved successful. A manuscript detailing the field deployment of the system to measure ambient ammonia in real time has been submitted. Using the new system, no samples need be collected, stored, or transported -- all of which can result in contamination. This is a great convenience. latoya.myles@noaa.gov and Tilden Meyers

10 East Tennessee Ozone Study (ETOS). The Congressionally mandated ETOS program has reached a point where results need to be considered by the scientific community before plans for future work can be refined. To this end, a workshop will be conducted in May. An ETOS 2006 Science Workshop website was launched in mid-December. Workshop registration, guidelines for presenters, and student travel award details are available online at: http://www.atdd.noaa.gov/Research_Page_Additions/ETOS_additions/etosworkshop.htm. latoya.myles@noaa.gov and Gabrielle Ridenour

11. Twin Otter ARL Modifications. Rocky Mountain Aircraft in Calgary, Canada has completed installation of an ARL Best Available Turbulence (BAT) probe on one of the NOAA Twin Otters. Flight testing has also been completed. The boom and probe were removed, and then the aircraft was flown to home base in Tampa, Florida. The installation is now being reviewed for formal FAA acceptance. The initial Canadian Supplemental Type Certificate has been approved and currently is being converted to a U.S. FAA certification. philip.g.hall@noaa.gov and Jeff French



New boom and BAT probe installed on NOAA Twin Otter.

Research Triangle Park

12, Linking the CMAQ and HYSPLIT Modeling Systems. Software tools linking components of the Community Multiscale Air Quality (CMAQ) modeling system with the HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model were installed and successfully tested. The new MCIP2ARL interface program retrieves meteorological fields from data sets generated by CMAQ's Meteorological Chemistry Interface Program (MCIP) and creates an output data file for direct application of HYSPLIT modeling components. Additional conversion programs designed to convert HYSPLIT trajectory and concentration outputs into CMAQ-type data files for importation into a CMAQ visualization tool were also implemented. This important step in the joint research effort extends the capabilities of both systems and allows data sets from both modeling systems to be utilized in on-going model analyses, evaluation, and visualization tasks. Specifically, the MCIP2ARL program was subsequently applied to generate input data files for an upcoming HYSPLIT trajectory model application based on existing CMAQ meteorological data sets from the summer months of 2002 and 2004. To identify cases during these summer months when the airflow impacting selected CASTNet (Clean Air Status and Trend Network) sites originated from the Ohio Valley region, the wind fields developed from the CMAQ system will be employed to drive HYSPLIT back-

trajectory analyses. The HYSPLIT results will be used to analyze daily maximum ozone concentrations generated using the CMAQ model. james.godowitch@noaa.gov

13. Air Chemistry and Meteorology – towards a two-way coupling using CMAQ. Work is progressing on developing systems to integrate the air chemistry and meteorological aspects of air quality forecasting. The intent is to permit changes in air concentrations of particles (for example) to affect the meteorological analysis. In conventional systems, the interaction is one-way. The meteorology drives the chemistry. The present effort is intended to yield a two-way coupling. Step one of this development is nearly complete. The initial goal is to overlap CMAQ-F computation with data availability from various input routines so as to reduce the end-to-end cpu time. The coupling will eventually engage the National Weather Service's National Centers for Environmental Prediction (NCEP) North American Meso (NAM) forecast meteorology model and ultimately enable CMAQ to provide feedbacks between meteorology and atmospheric chemistry in an on-line configuration. jeff.young@noaa.gov

Idaho Falls

14. Urban Dispersion Program (New York City). Finalizing the tracer data base from the Urban Dispersion study in New York City has proved difficult, because of the unreliability of the GPS due to the tall buildings throughout Midtown Manhattan. Part of December was spent on using photographs and other sources of information to map out the release and sampler locations within a meter of their actual position in a GIS database. After several iterations, the final data files should be ready for analysis within a few weeks. roger.carter@noaa.gov and Jason Rich

15. Smart Balloon. All of the smart balloon instruments have been rearranged and mounted to a lightweight, rigid circuit board for insertion into a new 8-inch fiberglass enclosure. The new arrangement of instruments should not only allow everything to fit inside the fiberglass enclosure, but it should make the balloon preparation and troubleshooting easier during field deployments. randy.johnson@noaa.gov and Shane Beard

16. Mesoscale Modeling – WRF or MM5 for dispersion applications. For several years the mesoscale modeling community has been developing a next-generation weather prediction system called the Weather Research and Forecasting (WRF) model. During much of this time the system did not have the functionality to be a suitable replacement for current systems such as MM5, but this is now changing. The latest versions of WRF contain the features required for applied research such as that conducted at FRD. In December WRF version 2 was downloaded at FRD to investigate its possible use as a replacement for the current MM5 forecast model. Two test cases were successfully run on a Linux system. What stood out most from the test cases was the enormous compile times required for the model. Just one of the modules in the code required over two hours to compile, using nearly 1 GB of memory in the process. However, this might partly be the fault of the FORTRAN compiler rather than the code itself. Further tests of WRF are planned over the next few months. richard.eckman@noaa.gov

Las Vegas

17. Specialized Test Preparations. In preparation for upcoming activities at the NTS, ARL/SORD personnel have needed to develop a refined set of dispersion systems, making use of newer information and more modern computing resources. The old applications ran on outdated computing platforms, and were already in the process of being updated. The need to prepare for a new series of tests elevated this activity to the forefront and significant progress has been made to get the refinements ready for use by the operations teams. The applications are now operational. Development of automated systems to obviate current manual processing are continuing. (Germain)

18. Visualization and Analysis System (C⁴VAS). Many groups are working on 3-D visualization systems, however use in displaying dispersion products remains an area to be explored. In this regard, SORD is partnering with NNSA/NSO and Bechtel Nevada technical personnel to develop a new 3-D visualization and analysis system (C⁴VAS) that will ingest data from SORD and NOAA systems as well as other vital data (e.g. roads, facilities, workers, aircraft, etc.). The assembled data base will be used to display output on one common front-end picture in 3-D space that can:

- Aid in awareness and understanding of multiple activities; and allow quick, accurate response to situational needs or requirements that are weather sensitive.
- Ingest, model, and display multiple static and real-time data inputs, including various sensor, radar, weather, and vehicle/personnel control/tracking feeds.
- Incorporate existing NTS Geographical Information System geospatial data, such as terrain, imagery, and boundary data.
- Integration and visualization of outputs from atmospheric dispersion or plume models.
- Visualization and prompt display of a wide variety of meteorological data relative to personnel, facilities, and experimental activities on and around the NTS.

The final product will provide common, shareable tools capable of integrating multiple dynamic data feeds into one common operating picture of which meteorological and especially dispersion data and information will be a key component. walter.schalk@noaa.gov, James Sanders, Germain, and Darryl Randerson

19. Las Vegas Urban Air Quality Study. Data from the Summer 2005 Field Program are revealing some unexpected features of air quality in the arid west. For example, there are frequently relatively large ozone concentrations aloft, accessed daily by the evolving mixed layer. Upper-air ozone data have indicated that concentrations of 50 to perhaps 100 ppb may occur aloft and appear to be transported overnight toward the Las Vegas Valley. The question arises as to what the contributions of ozone aloft and vertical mixing have, if any, on surface-level ozone concentrations in southern Nevada. walter.schalk@noaa.gov