



# NOAA ARL Monthly Activity Report



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## Highlights

*1. UW/NOAA Collaboration is Discovery Magazine's Top Science Story.* Discover Magazine lists its picks for the top 100 science stories of 2004 in its January 2005 issue. Their choice for #1 story is the "Turning Point" on global warming, citing collaborative work by Qiang Fu, Celeste Johanson and Steve Warren, all of University of Washington, and Dian Seidel of NOAA. The study, published in Nature, found a tropospheric warming trend in satellite data after removing the effects of stratospheric cooling.

The magazine article states: "...Computer models can't explain that trend without factoring in a man-made greenhouse effect, but skeptics have long argued that the models also can't explain why the lower

atmosphere has apparently warmed less than Earth's surface. That argument took a knock in 2004. Reanalyzing the satellite temperature measurements, Qiang Fu of the University of Washington and his colleagues concluded that a cooling in the upper atmosphere had been masking what is in fact a large warming of the lower atmosphere".

The full citation for the Fu et al. article is: Fu, Q., C.M Johanson, S.G. Warren, and D.J. Seidel, 2004: Contribution of stratospheric cooling to satellite-inferred tropospheric temperature trend, Nature, 249, 55-58. [dian.seidel@noaa.gov](mailto:dian.seidel@noaa.gov)

**2. Surface Observation "Insertion" Method for DCNet added to READY.** A routine that inserts DCNet tower observations into the Eta gridded meteorological model data, is now implemented in the HYSPLIT emergency response (ER) section of READY. This routine interpolates the temperature, wind direction and speed, and turbulence observations (if available) to the surrounding model grid points (lowest 3 model levels) using a  $1/r^2$  weighting method. The ER READY user has the option of turning on/off the temperature correction and setting the number of surrounding grid points to apply the correction. The user can also choose the gridded meteorological data set type to use, the type of observations to insert (DCNet, select NWS stations, or all NWS observations in the sub-domain), and can select the sub-domain from the original gridded model domain. One application that may greatly benefit from this application is when the initial surface wind direction or speed is incorrect in the gridded model data set, as the plume may start off in the wrong direction. By entering in an observation near the release point, the plume will be "nudged" in the appropriate direction that the gridded model may not have been able to resolve due to local effects of terrain, frontal timing, etc. Ideally, a true data assimilation of the additional observations should be performed, however this technique could be used as a first attempt to correct for local effects in an emergency. [glenn.rolph@noaa.gov](mailto:glenn.rolph@noaa.gov)

## Silver Spring

**3. Comprehensive Test Ban Treaty Test.** The Comprehensive Test Ban Treaty Organization (CTBTO) conducted another real-time test at the end of January. The purpose of the test was to determine how many and how quickly various participating national meteorological services (as arranged by agreement with WMO) could provide estimates of potential source locations in the event of a clandestine nuclear test. A real-event would be detected by an above background measurement in the CTBTO radiological monitoring network. Eleven meteorological or data centers participated. [roland.draxler@noaa.gov](mailto:roland.draxler@noaa.gov)

**4. Evaluation of Wildfire Smoke Forecast.** A real-time HYSPLIT smoke forecast verification is being developed using the NESDIS HMS fire location and smoke observational archive. Because we only maintain a 30-day rotating data archive, the Alaskan fires case of July 2004 is being rerun to provide test data for the verification system. The intent is primarily to verify the emission factors used by the model to determine the extent of the smoke plume. [roland.draxler@noaa.gov](mailto:roland.draxler@noaa.gov)

**5. Reconfigured MM5 to Initialize with NCEP GDAS/GFS Files.** Many applications require fine-grid data derived rapidly. To this end, our LINUX cluster version of MM5 has been restructured to be able to quickly provide higher resolution data fields using NCEP GDAS archives for initial and boundary conditions. Data reconstruction, rather than maintaining archives, is the trend for the future. A two-nest 36/12-km simulation takes about 40-min clock time per simulation day. [roland.draxler@noaa.gov](mailto:roland.draxler@noaa.gov)

**6. Radiosonde Atmospheric Temperature Products for Assessing Climate (RATPAC).** A preliminary version of the Radiosonde Atmospheric Temperature Products for Assessing Climate (RATPAC) and programs used to produce it were transferred to the National Climatic Data Center in Asheville. The basic dataset consists of time series of temperature anomalies for 13 atmospheric levels for the Northern Hemisphere, Southern Hemisphere, tropics and globe from 1958 through the present. The series are derived from data for 85 radiosonde stations. Before 1995, the data have been adjusted for inhomogeneities by John Lanzante and Stephen Klein of GFDL and Dian Seidel of ARL. After 1995 the data are adjusted using an automated method based on first differences. NCDC is planning to archive and update the dataset in the future.

Global mean temperature data from RATPAC through 2004 were provided to the authors of NCDC's Annual Climate Review for 2004. The review will appear in the Bulletin of the American Meteorological Society later this year. [melissa.free@noaa.gov](mailto:melissa.free@noaa.gov)

**7. NCEP HYSPLIT Upgrade; VAFTAD is Retired.** The HYSPLIT package was upgraded at NCEP. All dispersion runs at NCEP, including volcanic ash, radiological (RSMC), or any other forecasts, will use the HYSPLIT package. Any of the dispersion runs may use 1 degree global, 12 km NAM (formerly Eta), or 4 km NMM model output. VAFTAD, specific to volcanic ash, and the associated meteorology on 191 km hemispheric grids have been retired. [barbara.stunder@noaa.gov](mailto:barbara.stunder@noaa.gov)

## **Boulder**

**8. SURFRAD/ISIS.** It was recently discovered that during the annual instrument exchange at the Fort Peck station on October 13, 1999, the downwelling pyrgeometer case and dome temperature connections at the data logger were swapped, but the processing code was not changed to accommodate that switch. On January 19, 2005, this problem was corrected and the Fort Peck data for the affected period were reprocessed. As of January 19, 2005, the Fort Peck downwelling infrared from October 13, 1999 to the present are correct. Errors in the previously reported data (when the case temperature was used as the dome temperature, and vice versa), were on the order of 18 watts per square meter, depending on the dome and case temperatures.

While assessing the extent of the downwelling infrared problem caused by the case-dome swap, an oddity was discovered in the downwelling infrared data at Fort Peck between December 10, 2000, and July 24, 2001, where the case thermistor of the downwelling pyrgeometer lost sensitivity. A comprehensive analysis of the case and dome temperatures of the downwelling pyrgeometer showed that during that 8-month period, the dome temperature was correct, and the case thermistor was reading about 3 to 5 deg. K low, causing a low bias on the order of 20 W/m<sup>2</sup>. A novel way to correct these erroneous data was devised. Using periods when the case and dome temperatures were known to be good, a linear relationship was established between the case-dome temperature difference and thermopile reading of the affected downwelling pyrgeometer. That relationship was applied to the dome temperature and thermopile reading of the pyrgeometer during the erroneous 8-month period to generate estimated case temperatures. The corrected case temperatures were then used to re-compute the downwelling thermal infrared for that period. Errors in the downwelling infrared associated with the use of these generated case temperatures were computed to be less than +/- 0.1 W/m<sup>2</sup> at the 95%

confidence level. These corrected data were also entered into the SURFRAD data record on January 19, 2005. [john.a.augustine@noaa.gov](mailto:john.a.augustine@noaa.gov)

## **Oak Ridge**

**9. DHS Model Evaluation Planning.** ATDD scientists took part in the Dept of Homeland Security Meeting on Model Evaluation on January 13, 2005 in Washington, D.C. A small number of invited experts met at the DHS building on Vermont Ave and discussed model evaluation methods and accreditation criteria. An advisory committee with those present was set up to guide the DHS in future. This task is said to be among the top five for DHS, though there is no current funding. (Rao)

**10. U.S. Climate Reference Network.** According to NCDC's latest statistics, the average data ingest rate for the 70 operating USCRN sites is 99.7% for the last five months. No stations have a data ingest rate less than 98%, and 31 stations have achieved 100% data capture. ATDD is proud of its role in this achievement. (Hosker)

## **Research Triangle Park**

**11. Community Multiscale Air Quality (CMAQ) Model.** The Meteorology-Chemistry Interface Processor is being modified to ingest output from the Eulerian Mass (Advanced Research) core of the Weather Research and Forecast Model (WRF). A prototype code was developed at the University of Houston, and work is being done to integrate that code into MCIP and prepare it for general use. After several modifications to make both MCIP and the prototype code more general, initial tests with the updated MCIP alpha code have been able to replicate the University of Houston results. Several minor changes are still required before the code can receive beta testing. The new MCIP with WRF capability will be released to the CMAQ community along with the 2005 version of CMAQ in August. (Tanya Otte, 919 541 7533)

Development has been completed for a dynamic vertical layer methodology to be incorporated in the next major CMAQ model release, which will allow one compiled version of CMAQ to access varying sets of meteorological and emissions files that have different numbers of vertical layers as well as different vertical structure. A successful implementation has been achieved in the initial concentrations (ICON) and boundary concentrations (BCON) pre-processing models and in the CMAQ chemistry-transport model. Also, a simple methodology has been developed to mimic nocturnal urban heat island effects in the vertical mixing process in CMAQ. This "minimum KZ" method has been implemented as a run time option and is available provided that an urban fraction parameter has been produced by the Meteorology-Chemistry Interface Processor (MCIP) in the gridcro2d input file. (Jeffrey O. Young, 919 541 3929)

Further development and enhancement of various components of the Eta-CMAQ forecast model were initiated in preparation for the 2005 ozone forecast season. These include: (1) optimization of the PREMAQ module (interface between the Eta and the CMAQ models), (2) incorporation and testing of a module in PREMAQ to compute the clear-sky radiation fields, (3) updates to the emission processing modules in PREMAQ to reflect enhancements in the latest version of Sparse Matrix Operator Kernel Emission (SMOKE) system, (4) modifications to the photolysis rate attenuation calculations in the

CMAQ model based on the downward shortwave radiation and its corresponding clear sky value, and (5) detailed examination of the CMAQ sub-grid cloud mixing scheme to rectify top-down mixing problems associated with modeled downdrafts. (Rohit Mathur, 919 541 1483)

The Eta-CMAQ air quality forecast model has been upgraded to reflect the latest public release of the base model, CMAQv4.4, and also includes an improved photolysis algorithm that accounts for below cloud radiation attenuation derived from data provided by the driving Eta meteorology model. This upgrade has been delivered to the National Centers for Environmental Prediction (NCEP) to be used in the daily recast runs for the upcoming ozone season. (Jeffrey O. Young, 919 541 3929)

**12. Particulate Matter Forecast Simulations.** In 2004, developmental simulations were initiated over the eastern United States to assess the ability of the Eta-CMAQ system to provide particulate (PM) matter forecasts. A daily 24-hour simulation initiated using the 12Z Eta run was performed. Model forecasts for surface PM<sub>2.5</sub> are being compared with measurements from the AIRNOW data. Analyses are also underway to compare modeled speciated PM data with available measurements from the Speciated Trends Network (STN), Clean Air Status Trends Network (CASTNet), and the Interagency Monitoring of PROtected Visual Environments (IMPROVE) network. The ability of the model to simulate the columnar PM distributions is also being assessed through comparisons with spatial distributions of modeled and satellite-derived aerosol optical depth. (Rohit Mathur, 919 541 1483)

**13. CMAQ -- Atmospheric Mercury.** Progress was made in performing the global model simulations for the North American Mercury Model Intercomparison Study (NAMMIS). A teleconference involving all study participants was held on January 25th during which it was reported that Atmospheric and Environmental Research, Inc. had completed its simulation of mercury transport and deposition using their global chemical transport model (CTM). The CTM used the updated global mercury emission inventory was described in the December 2004 highlights. That inventory was updated to represent emissions in the 2001 reference year for the study. However, the CTM used synthetic meteorological inputs from the Goddard Institute for Space Studies (GISS) general circulation model and did not use meteorological data specific to the year 2001. This one-year synthetic data set was used repeatedly for multi-year simulations until steady state was achieved. Environment Canada reported that they are currently benchmarking their chemical transport models on a new computing platform, and the start of their global mercury simulation with their Global and Regional Atmospheric Heavy Metals (GRAHM) model would not occur until February. During the teleconference the possible participation of Harvard's GEOS-CHEM global model was discussed. The GEOS-CHEM model is a global three-dimensional model of atmospheric composition driven by assimilated meteorological observations from the Goddard Earth Observing System (GEOS). Subsequent communications with the Harvard University Department of Earth and Planetary Sciences led to a tentative agreement to include their GEOS-CHEM model in the global model suite of the NAMMIS. Negotiations among the project participants are continuing to address this scheduling issue. It appears though that the July delivery date for GEOS-CHEM results will be acceptable by going forward with continental-scale modeling based on CTM and GRAHM results, followed by a second round of continental-scale modeling based on GEOS-CHEM results. (Russell Bullock, 919 541 1349)

**14. Emissions Support for Air Quality Forecast Modeling.** For the upcoming 2005 ozone season, work continues on updating the Eta-CMAQ air quality forecast modeling system. The first change to

the emissions processing involved replacing SMOKE version 1.4 with version 2.1. The emissions portion of the PREMAQ code has been optimized and run times have been reduced by ~50%. Additional optimizations and updates should be implemented in time for the 2005 ozone season. Retrospective evaluations of the new emissions system using data from 2004 will begin in February. (George Pouliot, 919 541 5475)

**15. Meteorological Model Evaluation Methods.** Work is progressing well on the Climate Impact on Regional Air Quality project. Specifically, the current scenario MM5 regional climate simulation is being compared to observations to determine how well the climate simulation represents the climate of the past 10 years. Variable distributions (model and observations) of wind speed and direction, temperature, and mixing ratio are being compared, and characteristics like the mean and interannual variability have been examined thus far. The modeled temperatures are significantly cooler, especially at the lower temperature range (winter), than the observations over the past 10 years. However, the interannual variability in the temperature distribution is almost the same in both observations and model. Further analyses have, and will be, conducted for other areas around the country, and for other air-quality related meteorological variables. (Robert Gilliam, 919 541 4593)

**16. Climate Impact on Regional Air Quality (CIRAQ).** A decade of present-day summer season (JJA) downscaled MM5 regional climate model 700mb u and v wind component climate scenarios has been processed and compared with a corresponding decade (1985-1994) of National Centers for Environmental Prediction (NCEP) reanalysis results. A comparison of the two databases reveals significant differences in 700mb transport direction and speed. During the summer season, the regional climate model shows a persistent subtropical high pressure area (with closed anti-cyclonic circulation) over the southeastern quadrant of the United States. The majority of the NCEP realizations show stronger zonal (west-to-east) transport over a larger portion of the Continental United States. In addition to these persistent features, one regional climate model year indicates the presence of a mid-July Atlantic hurricane event. No similar event is evident during the NCEP baseline time period (1985-1994), but development and movement of the regional climate model tropical system compares favorably with NCEP 700 mb characterization of Hurricane Fran during 1996. Another notable difference is that the average NCEP 700 mb wind speeds associated with Fran are only 75% of those in the regional climate model. (Ellen Cooter, 919 541 1334; Rob Gilliam, 919 541 4593).

## **Idaho Falls**

**17. First Hurricane Turbulent Kinetic Energy Measurements.** The ET probe data collected in Hurricane Ivan have been passed through a series of quality assurance procedures, and the processed data are now available. Turbulence data from the probe indicate that the turbulent kinetic energy (TKE) increased by roughly a factor of 10 from the time the system was activated to the storm's peak. To our knowledge, this is the first directly measured TKE from a hurricane. The vertical momentum flux to the surface experienced a similar increase. The peak wind gust detected by the system was 50.3 m/s. Although the radar images indicate the probe passed through the eastern edge of Ivan's eye, the wind data do not show any abrupt drops of wind speed during the eye's passage. It appears that the probe stayed close enough to the eyewall to experience high winds throughout the storm's landfall. (Richard Eckman, 208 526 2740)

**18. Tracer Analysis Facility (TAF) Adaptation for Perfluorocarbon Tracer Analysis.** All parts on order that are necessary to begin perfluorocarbon tracer analysis have been received. The capillary column fits into the ATGAS oven without any major modifications needed. Extra supports were added to the oven to hold the capillary column in place. A new heater was added to increase the oven temperature to at least 150°C. This new heater was tested and found to easily hold temperatures constant at a set point of over 150°C. However at this temperature, the outside of the oven is too warm to the touch and may need extra insulation depending on the determination of final analysis temperature. Three concentrations of perfluorodimethylcyclobutane (PDCB) were ordered from Scott-Marrin and are scheduled for delivery the end of February. The gas divider will be used to make more concentrations as needed. (Debbie Lacroix, 208 526 9997)

**19. Smart Balloon Improvements.** The balloon lower instrument fiberglass containment enclosure has been redesigned to allow easier access to the electronic equipment. In addition, new modifications to the ballast release valve and ballast pump tubing will provide a faster response to altitude adjustments. Past designs combined the smaller tubing into a single tube before being mounted to the wall of the containment tube, but that took too long for ballast air to be released from the balloon. For example, last year during North East Air Quality Study (NEAQS), balloon one encountered precipitation that nearly brought the balloon to the ground because it was unable to release ballast air fast enough to compensate for the accumulation of rain on the skin of the balloon. Now the tubing from each of the two ballast pump diaphragm ports and the ballast release valve have been replaced by individual and larger diameter tubing that goes directly to the wall of the containment tube. This modification decreases the resistance to airflow from the balloon and will allow quicker altitude adjustments. The new design should ensure that the balloon will be able to quickly compensate for precipitation encounters in the future.

Our first shipment this year of a high strength balloon shell and 3 bladders were received and tested. However, problems with manufacturing were encountered in the balloon shell and with each of the bladders. All parts have been returned to the manufacturer to determine how the problems can be resolved, and to fabricate a suitable balloon for testing. We hope to be testing modified balloons in late February or early March. (Randy Johnson, 208 526 2129, Shane Beard, Vance Hawley)

**20. Idaho Test Site Climatology.** Further work was completed on the updated climatology for the Idaho site. The 1989 edition of the climatology has a dispersion section showing annual-average modeling results for releases from selected locations on the site. In the update, this section is replaced by a discussion based on newer modeling results from a long-term study of dispersion patterns (documented in NOAA Tech Memo OAR ARL-246, by R. M. Eckman). A major difference in the newer work is that dispersion results are provided for four different release points: INTEC, RWMC, TAN, and TRA. The dispersion patterns are generally quite different at these facilities due to the effects of the local topography. (Richard Eckman, 208 526 2740)

## **Las Vegas**

**21. MEDA Maximum Temperature Predictions.** January was a relatively warm month with average temperatures on the NTS being several degrees above normal. Most of the departure was due to higher minimum temperature values, which is consistent with the number of precipitation days at the NTS.

January was wetter than normal on the NTS with more than half of the days reporting precipitation. The statistical maximum temperature predictions for January showed a slight bias to the high side with an average value for all stations of +0.2°C. The average absolute error was slightly greater than in December at 2.3°C. (D. Soule', 702 295 1266)

**22. *New Surface Data Graphics.*** Several new mesonet data presentations are now available on SORD's Web Site. These plots are being updated every 15 minutes, but are not available until about 13 minutes past the collection times (due to limitations in the data communications systems). The plots include winds, temperatures, dew points, and relative humidities. They are available under "weather products, SORD Graphics". In addition, wind roses have been updated for all of the mesonet stations operational in 2004. These wind roses include hourly, monthly, and annual graphics for all stations. They are also available on SORD's Web Site. (D. Soule', 702 295 1266, J. Sanders)

**23. *USDA Air Quality.*** Marc Pitchford (ARL-SORD) is now a member of the USDA Agricultural Air Quality Task Force. The purpose of the Task Force is to address agricultural air quality issues and to provide recommendations to the Secretary of Agriculture on development and implementation of air quality policy, and air quality research needs. The task force is composed of about 30 individuals with air quality and agricultural expertise from government and private organizations including scientists and producers. This first meeting of the two-year term of the Task Force included briefings by four USDA agencies on their air quality programs and plans, briefings by the EPA concerning their role in agricultural air quality issues, as well as the establishment of subcommittees for conducting the work of the Task Force. Dr. Pitchford will work on the Research Subcommittee. (Marc Pitchford, 702 862 5432)