NOAA ARL Monthly Activity Report

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Highlights

1. ARL-NCEP coordination. ARL and NCEP have agreed to proceed with the installation of a single "unified" emergency response model that will be capable of handling both volcanic ash and radiological

simulations. One key advance over previous versions is that we will be testing a new graphical user interface that can be used by operational staff to configure and launch the model calculations. Sections of the code have been installed and compiled on NCEP's SP and we are now waiting for their operational staff to complete installation of system software to support the graphical interface. (roland.draxler@noaa.gov, barbara.stunder@noaa.gov)

2. CO_2 and Energy Balance network expansion. Final approval was given for the installation of a NOAA carbon/energy flux tower site at Goodwin Creek, MS, which is collocated with the NOAA SURFRAD facility. The site should be on line in less than a month. Software for real-time processing of the data continues to be developed so that site data and fluxes will be available in a near real-time mode on the NOAA/ATDD web site. (meyers(@atdd.noaa.gov)

Two additional sonic anemometers and infrared gas analyzers have been placed on the Walker Branch tower to investigate flux divergence of energy, water and $C0_2$ fluxes before and after leaf expansion. A Fortran version of a model to predict canopy fluxes is being developed and is expected to be used in near real time with the Walker Branch data this summer. (wilson(@atdd.noaa.gov)

3. Salt Lake City dispersion results now available. Two ARL divisions participated in the recent study of dispersion, in Salt Lake City (October, 2000). Six realtirne SF_6 analyzers were simultaneously deployed for six tracer dispersion tests. Four analyzers were mobile, and placed at distances of 1, 2, 4, and 6 km from the downtown release point. Two other units were stationary, and were deployed near the release point to monitor plume temporal variability. Plots of the kind shown in Figure 1 were generated to show the locations of the peak concentrations of each pass through the plume and to indicate the time of the plume crossing. The dot size indicates the SF_6 concentration, while the hue (dark to light) indicates the passage of time. The location of maximum concentration was quite variable, as was to be expected. (kirk.clawson@noaa.gov, Neil Hukari, Roger Carter)

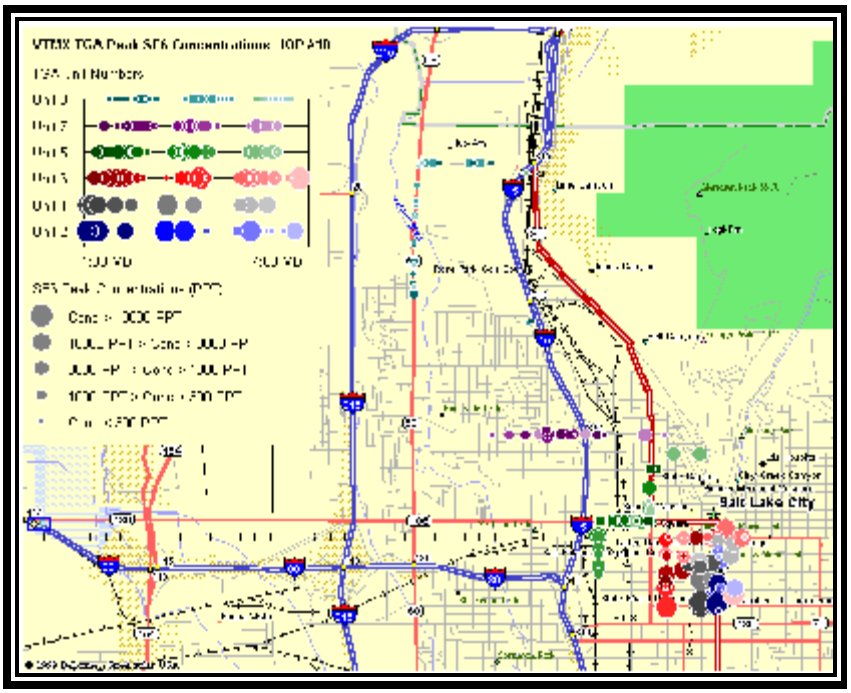

Figure 1. Salt Lake City, UT – showing peak SF_6 locations as measured by six realtime analyzers during one experiment. The release was from downtown, within the hole left on the southern edge of the array of downtown samplers. There is very little order in where the material went.

A preliminary report of in-situ turbulence measurements made from the Long-EZ airplane has been finalized. The predawn flights (0300 MST to 0700 MST) were about 300 m above terrain. Turbulence on the east side of the valley showed the influence of air draining from the canyons of the Wasatch Range. Turbulence was locally strong near canyon mouths. These local maxima blended and lost their identity further into the valley. Wind on the east side was relatively light with a suggestion of a minimum over the downtown area. Primary flow was from the south, strongest on the west side of the valley, flushing the air toward the Great Salt Lake at night. This flow is known to reverse in the daytime, following the usual diurnal lake-breeze circulation. (dobosy@atdd.noaa.gov)

Silver Spring

4. Air Force Weather Agency (AFWA) MM5 forecasts available via READY. MM5 mesoscale model forecasts from the Air Force Weather Agency (AFWA) for the United States are now available via READY (http://www.arl.noaa.gov/ready.html) for use in HYSPLIT and other graphical utilities. An agreement between AFWA and ARL was signed in February that allows ARL to access 45 km (North America) and 15 km (United States) forecasts for use in HYSPLIT and to provide access to AFWA and other users through the READY web site. Once available on READY, users will be able to run HYSPLIT using the MM5 forecasts as well as to display the meteorological data using READY graphing utilities. The 45 km forecast for North America is run 4 times per day (00, 06, 12, 18 UTC) and extends out to 72 hours. The 15 km forecast for the CONUS is run twice each day (06 and 18 UTC) and extends out to 48 hours. For more information on the AFWA MM5 forecasts see, ftp://ws-ftp1.afwa.af mil/pub/aboutmm5/index.html (glenn.rolph@noaa.gov)

5. Ensemble plume dispersion products. The operational Kilauea plume forecast is now running on a fairly regular basis at the Maui High Performance Computing Center (http://www.mhpcc.edu/projects/contrib/ensemble/). An ensemble trajectory was added to the product suite. The operational scripts required considerable fine tuning to accommodate the rather erratic completion schedule of the mesoscale spectral model. (roland.draxler@noaa.gov)

6. Global temperatures updated through 2000. There appears to have been little change in global tropospheric and low-stratospheric temperatures between 1999 and 2000, a period of weak La Nina. The 63-station radiosonde network data reveal that during 2000, the global surface temperature is 0.4K above the 1961-1990 average, slightly less than the record 0.6K above average observed in 1998 at the time of a strong El Nino. In the low stratosphere the global temperature in 2000 is marginally the coldest of record, continuing the tendency since 1983 for a fairly uniform decrease of this temperature with time, except for a 1K warming following the Pinatubo eruption in 1991. The record-cold low-stratospheric temperature in the north polar zone in 2000 is not accompanied by record cold above Antarctica, due mainly to the modest cold in austral spring owing to the relatively short duration of the Antarctic ozone hole in 2000. (Jim Angell, 301 713-0295, x127)

7. Tropical tropopause climatology dataset made public. Climatological data for the tropical (30 deg N to 30 deg S latitude) tropopause, based on radiosonde observations for the period 1961-1997, have been made public via the SPARC (Stratospheric Processes and Their Role in Climate) Data Center. SPARC is a program of the WMO's World Climate Research Programme. This is the most comprehensive analysis of the tropical tropopause ever compiled, both in terms of temporal and spatial coverage, and the number of tropopause characteristics examined. The dataset includes monthly means and monthly anomalies of

temperature, potential temperature, pressure, height, and saturation mixing ratio at the following levels, all used in studies of the tropopause: the conventional lapse-rate tropopause, based on the WMO definition; the cold point tropopause (or minimum temperature level); the minimum saturation mixing ratio level; and the 100 hPa level. Data for several tropospheric and stratospheric levels are included for comparison. The data, including numerical values and animated graphical depictions of the climatological annual cycles, can be accessed at

http://www.sparc.sunysb.edu/html/noaa/noaa_trop.html

The dataset is described and analyzed in a paper soon to appear in the *Journal of Geophysical Research*. (dian.seidel@noaa.gov and rebecca.ross@noaa.gov)

8. SPARC water vapor assessment released. The SPARC (Stratospheric Processes and Their Role in Climate) *Assessment of Upper Tropospheric and Stratospheric Water Vapour* has recently been released. The report is the result of a two and one-half year effort, involving scores of scientists from around the world. Dian Seidel (ARL) contributed to the report, as did several other NOAA Research scientists from the Aeronomy Laboratory and the Climate Monitoring and Diagnostics Laboratory. The report critically reviews measurements of water vapor in the stratosphere and upper troposphere, in order to consolidate our knowledge and understanding of the distribution of water vapor and its variability on time scales ranging from the seasonal to the long-term inter-annual. Quoting from the report, key findings are:

- A significant increase in the number and quality of stratospheric water vapour measurements has occurred over the past 25 years, particularly with the advent of satellite observations. The stated accuracies cluster within a $\pm$10% range.

- The concentration of stratospheric water vapour in the "overworld" is determined by dry air upwelling through the tropical tropopause, methane oxidation in the stratosphere, and transport by the poleward-and-downward (Brewer-Dobson) mean circulation. At the tropical tropopause, air transported into the stratosphere is dried by a complex combination of processes that act on a variety of spatial and temporal scales. Water vapour in the upper troposphere is controlled by local and regional circulation patterns and seasonal changes of upper tropospheric temperature.

- There has been a 2 ppmv increase of stratospheric water vapour since the middle 1950s. This is substantial given typical current stratospheric values of 4-6 ppmv. The increase in the concentration of tropospheric methane since the 1950s (0.55 ppmv) is responsible for at most one half of the increase in stratospheric water vapour over this time period.

- Upper tropospheric relative humidity (UTH) has been monitored for about 20 years by instruments on operational satellites. In the upper troposphere, no major inconsistencies were found between existing satellite-based measurements that would preclude their use in describing the long-term behaviour of upper tropospheric humidity. The data are of sufficient quality for climatological and process studies.

- Assessing long-term changes in the UTH is difficult because of high variability during El Niño - Southern Oscillation events, other natural modes of variability in the large-scale circulation, and the competing effects of changes in water vapour concentration and temperature. Although both positive and negative statistically significant long-term changes can be found in different latitudinal bands, no striking global trend emerges from preliminary analyses.

- The operational radiosonde network does not produce water vapour data that can be used for either analyses of long-term change, process studies in the upper troposphere, or for validation of UTH measurements. However, emerging data sets from improved quality, quasi-operational aircraft and ground-based instrumentation show promise and should be used more extensively for process studies, climate analyses and validation of satellite data.

The report is available at http://www.aero.jussieu.fr/~sparc/ by clicking on "Wavas Report." (dian.seidel@noaa.gov)

Boulder

9. SURFRAD. A sophisticated clear envelope fitting and data quality control software for surface solar measurements is now in use at SRRB. The software (developed by Chuck Long) uses empirical means to identify totally clear sky periods in a particular day. If enough points are identified, it then fits a daily envelope to the global solar and diffuse solar clear-sky data, thus providing a good estimate of the clear-sky irradiance for the entire daylight period. Taking the difference between the clear-sky fit and the measurements gives a quantitative estimate of cloud forcing for diffuse and global solar radiation. Side products of these calculations are unique data quality control parameters and estimated hemispheric cloud fraction. The software as delivered was programmed to run on a PC. It was successfully converted to run on the SRRB Unix workstations, and will be run on a monthly basis. (John Augustine, 303 497 6415)

10. Arctic climate impact assessment (ACIA). Betsy Weatherhead was one of four chairs of the ACIA Modeling and Scenarios Workshop in Stockholm, Sweden. The meeting's purpose was to evaluate climate models and scenarios for use in ACIA, particularly in chapters related to terrestrial, marine, infrastructure and other impacts. The meeting resulted in a 33-page summary detailing the group's recommendations. Dr. Weatherhead took the lead role in writing and coordinating comments on this report. (Elizabeth Weatherhead. 303 497 6653)

11. Second International Pyrgeometer Comparison. An SRRB pyrgeometer will again be included in the forthcoming intercomparison in Barrow, AK, in early March -- The Second International Pyrgeometer/Sky-scanning Absolute Radiometer Comparison (IPASRC-II). This is the next step in what is hoped to be the development of an international IR irradiance reference standard. Last year's intercomparison involved ten pyrgeometers and was run by Rolf Philipona at Davos, Switzerland. However, its results are only representative of the mid-latitude fall conditions experienced at that time. In an effort to go to one important extreme, it was suggested that an Arctic winter version of the comparison be held. This is an important extreme because of the large departure of the atmospheric spectral curve from blackbody due to the dryness, as well as the shift in maximum wavelength. These are representative of conditions in the upper atmosphere included in all climate models. (John DeLuisi, 303 497 6824)

12. EPA ultraviolet network. Analysis of the Brewer ultraviolet data collected by the EPA network run by the University of Georgia has progressed on several fronts. Work by this group has resulted in completion of a paper addressing temperature corrections to the Brewer data. After final approval by co-authors at the University of Georgia and at the U.S. EPA, the paper will be submitted to the Journal of

Geophysical Research. Other work involves showing how well the solar noon UV value can be used to estimate the daily integrated dose. This finding has particular relevance for biological effects researchers as well as for the instrument operation, and is expected to lead to another paper for journal submission. (Elizabeth Weatherhead, 303 497 6653)

Oak Ridge

13. Canaan Valley. An AIRMoN site is now operational at the ARL field site in the Canaan Valley. Plans for the installation of a number of additional instrument suites are progressing through meetings between investigators from ATDD and U.S. Fish and Wildlife Service. The additional instruments will measure energy balance, dry deposition, and SURFRAD parameters. Plans are progressing toward installation of a Linux cluster to run RAMS and eventually the new Weather Research and Forecasting (WRF) model for the Canaan Valley area. (vogel@atdd.noaa.gov, Hall, Meyers, Pendergrass)

14. Climate Reference Network. Discussions and planning continued, in collaboration with NCDC staff for the assembly, calibration, testing, and installation of the first 50 stations of the new Climate Reference Network. Several iterations on a statement of work and a budget were performed. Ray Hosker participated in a meeting with the Regional Climate Center directors at NCDC on February 21, to help brief them on the new network. Finalization of agreements and transfer of funding is anticipated by late March. (hosker@atdd.noaa.gov,Meyers, Hall, Baker-NCDC)

15. Dispersion studies - Washington DC. Measurements of wind and turbulence data were taken around Washington DC in March 2000 to support studies on the potential spread of hostilely-introduced air contaminants. Data in half-hour averages have already been supplied to DTRA. More detailed quality control on the raw data is now in progress for transmission to DTRA in the near future. (gunter@atdd.noaa.gov)

16. Mercury in the Arctic. The ongoing sampling program continued in February at Barrow. Snow samples were collected from the surface and from cores, and water samples from the sea. January's surface snow, under Arctic night, had mercury levels below detection limits, as expected. (brooks@atdd.noaa.gov)

Periods of enhanced gaseous elemental mercury concentrations, well above global background, were examined in measurements from Spring and early Summer of 2000. The episodes were found to favor long periods between snowfalls when the snow surface was progressively darkened by wind-blown dust. We hypothesize the creation of local warm areas above 267 K (-6 C) through absorption of sunlight by the dust particles trapped in the first few millimeters of snow. At these temperatures microscopic liquid water layers form on the individual snow particles. The liquid water layers have been shown to induce the re-emission of previously accumulated mercury to the atmosphere, perhaps causing these local enhancements to the atmospheric gaseous elemental mercury concentrations. (brooks@atdd.noaa.gov, Meyers, Lindberg-ORNL)

Mike Goodsite, a visiting researcher from the National Environmental Research Institute in Denmark, began the development of a relaxed eddy accumulation (REA) system at ATDD to measure reactive gaseous mercury fluxes. Barrow, Alaska typically has significant surface fluxes of reactive gaseous mercury in the springtime. This new REA system is to be taken to Barrow in late March, where it is anticipated to provide the first direct measurement of reactive gaseous mercury fluxes. Preliminary tests at ATDD have shown promising results. (Goodsite-Denmark, brooks@atdd.noaa.gov, Meyers, Hall, Lindberg-ORNL)

17. Land Surface Hydrology -- collaboration with NASA. Water budgets for the convective mixed layer over Oklahoma during the Southern Great Plains Experiment (SGP97) have been computed for 2 and 12 July 1997, using data from the flux airplanes alone. On 12 July, local patterns appear to have dominated. Hydration of the boundary layer through evaporation from the surface gave way later to dehydration. The drying was produced by rapid entrainment of dry air from above after the nocturnal inversion had been overcome. On 2 July there was also morning hydration due to evaporation from the surface. Later in the day, however, there were strong changes in moisture content, not related to the local flux divergence. First there was sharp drying of the mixed layer, then strong moistening. This suggests advection effects that have so far not been explored. (dobosy@atdd.noaa.gov)

18. SURFRAD and ISIS. The 1997 data for ISIS level 1 were published in four issues of "Solar Radiation and Radiation Balance Data - 1997" by WMO World Radiation Data Center, St. Petersburg, Russia. (matt@atdd.noaa.gov)

Research Triangle Park

19. Ozone and particle simulations by Models-3/CMAQ. The Models-3 Community Multiscale Air Quality (CMAQ) model is a multi-pollutant and multi-scale air quality model that contains state-of-science techniques for simulating all atmospheric and land processes that affect the transport, transformation, and deposition of atmospheric pollutants and/or their precursors on both regional and urban scales. It is designed as a science-based modeling tool for handling all the major pollutant issues (including photochemical oxidants, particulate matter, acidic, and nutrient deposition) holistically. CMAQ's modular design promotes incorporation of several sets of science process modules representing different algorithms and parameterizations of physical and chemical processes. The modularity follows a time-splitting numerical integration method. In the time splitting method, the effect of each science process is computed by updating pollutant concentrations sequentially one at a time. The final concentration at each computational time step (i.e., synchronization time step) is obtained by cycling through all the science processes involved. Unlike a model that utilizes an implicit numerical method where all the science processes are solved simultaneously, CMAQ's concentration predictions are affected by the sequence in which different science processes are called. With the current version of CMAQ, the level of science modularity is subordinated by the way the science process codes are archived in the Models-3 system.

Several considerations have been taken when we initially designed the CMAQ configuration. Certain science process modules, such as horizontal and vertical advection and aerosol species require use of mass concentration units (i.e., $\mu g\ m^{-3}$) while vertical diffusion and chemistry modules prefer concentrations in molar mixing ratio units (i.e., ppm). CMAQ utilizes a pair of couple/decouple calls to convert between these units and, therefore, the interchange of process module calls is limited among the modules with the same concentration unit. For this reason, CMAQ allows the emissions, which by themselves are not defined as an independent process, to be incorporated either as a part of the vertical diffusion process or the gas-phase chemical reaction process. We tested the effects of injecting emissions in the vertical diffusion process or the chemistry process and found significant differences in predicted ozone and aerosol concentrations depending upon the location of emissions injection. Then we reduced the synchronization time step (time at which all process results are combined) of CMAQ from 600 seconds to 300, and then to 60 seconds and compared the results between the cases. The results showed that the cases with emissions in the vertical diffusion compared well with the numerical solution to the very fine synchronization time step of 60 seconds. At present we are continuously testing different CMAQ configurations to study the effects of the time splitting and sequence of science process calls to establish a better model configuration that produces

accurate simulation results without incurring excessive computational cost. (Daewon W. Byun, 919 541 0732, and Jerry Gipson, 919 541 4181)

20. First internal release of the Multimedia Integrated Modeling System framework. The first internal release of the Multimedia Integrated Modeling System framework was completed and is now being reviewed and tested by the project team along with a small number of customers. The first release consists of the basic GUI screens for defining model parameters and processes, with the capability of executing a sequence of programs (only test programs now in place). The system is being developed mostly in the Java programming language and is targeted to run on a variety of platforms including Windows-NT and Unix.

At completion this framework is intended to provide a software infrastructure for constructing, composing, and applying multiscale, cross-media models and evaluating results and related information to support EPA regulatory and research needs.

The development team plans to release an internal test version about every two months. These frequent releases
allow new features and enhancements to be evaluated by our customers, and allows needed modifications to be made in a timely manner. The next internal release is scheduled for May. (Steve Howard, 919 541 3660)

21. A next generation compartmental model under the MIMS/DIAS framework. In collaboration with the Department of Chemical Engineering, University of California, Los Angeles, Dr. Ellen Cooter will explore several topics through implementation of a pilot next generation model under the proposed MIMS/DIAS framework. Studies will include the definition and execution of an integrated three compartment multimedia model directly under the MIMS/DIAS framework, exploration of modularity and component reusability under the framework, the development of a user friendly interface that is flexible enough to accommodate model building in a community environment and the application of expert system technology to assist in multimedia scenario building and sensitivity analyses. (Ellen Cooter, 919 541 1334)

Idaho Falls

22. Air-sea exchange studies. Existing parameterizations of heat, moisture, and momentum fluxes in the marine atmospheric boundary layer (MABL) perform poorly under weak wind regimes, especially in regions of inhomogeneity. These problems are due to a variety of processes including averaging techniques, gravity capillary wave spacing, surfactants and surface tension, free convection effects, and frequency-dependent differences between wind, waves, and stress. In order to address these various forcing mechanisms, high-resolution, high-fidelity atmospheric and surface wave data are needed to describe energy exchange across the air-sea interface. The LongEZ research aircraft will be an integral part of the upcoming Coupled Boundary Layer Air-Sea Transfer (CBLAST) light-wind research study which will be conducted in Martha's Vineyard, Massachusetts, from July 20 to August 10, 2001. These data will support the test and refinement of parameterizations used in air-sea models. In addition, such measurements provide important boundary conditions to determine boundary layer turbulence and other atmospheric processes controlling the exchange of energy across the air-sea interface.

Over the last month, considerable progress has been made on the following measurement systems: infrared sea surface temperature, fast response air temperature, laser altimetry, and scatterometers (to measure the roughness of short ocean waves).

A new Ku-band (96 GHz or 2.3 cm) nadir-viewing scatterometer is now being deployed, alongside the Ka-band system expressly for support of the light wind observations. One anticipates a wave environment often characterized by 5- to 15-cm scale carrier waves having parasitic capillary waves governing their growth. Recent dual-frequency TOPEX altimeter satellite studies have shown that a C- and Ku-band nadir-viewing combination provides a useful tool for probing these characteristics at light wind speeds. We have procured a customized 30-cm microstrip antenna which will be mounted under the LongEZ fuselage just forward of the instrument pod. (jerry.crescenti@noaa.gov)

23. Air-sea exchange studies - hurricanes. Initial testing has begun for an upgraded data system for both the LongEZ platform and for the NOAA P3. Some upgrades include an industrial-type PC with back-plane utilizing a single-board computer and a re-designed Auxiliary BOX that will house the system power distribution, signal conditioning cards and one of the system's two BAT-REMs. The new system will utilize Flash memory (PCMCIA/ATA Type II) to record data on the fly. The new upgrades are necessary to be able to handle the increasing CPU/disk access demands resulting from new instruments with higher sampling frequencies and increased data rates. (jeff.french@noaa.gov)

24. CASES-99. During the CASES-99 experiment in October 1999, the Long-EZ aircraft collected about 50 hours of data in stable conditions. Funding for the experiment was sufficient to put the Long-EZ into the field, but not for data processing and analysis. Additional FY 2001 funding is now becoming available through ATDD in Oak Ridge, so processing and analysis of the data is expected to begin in the near future. (richard.eckman@noaa.gov)

25. Lightning detection support. The INEEL Emergency Planning group has been asked by the local DOE office to look into better ways to monitor lightning activity around the INEEL. They have asked FRD for assistance. We will be discussing with them ways to improve lightning monitoring within the current budget constraints. Possibilities include better utilization of existing Electric Field Mills and improvements in existing low cost lightning detectors. (roger.carter@noaa.gov)

26. INEEL Pollutant Transport and Diffusion. Within the past couple of years, an environmental group in Jackson, Wyoming, has started accusing INEEL of releasing radiological and chemical contaminants that are being transported to northwestern Wyoming and harming the environment. The air monitoring performed by INEEL and the State of Idaho within the Snake River Plain shows no indications of such harmful pollutant transport, but INEEL has offered to add an additional air monitoring station in Jackson. A meeting is scheduled in early March with county commissioners in Jackson to discuss the proposed station. INEEL has asked FRD to provide guidance on the meteorological aspects of the controversy. This includes such issues as the expected transport direction of pollutants released from INEEL, the degree of plume dilution that can be expected at the distance Jackson is from pollutants released from INEEL, and the effects of meteorological conditions and mountainous topography on plume transport and diffusion. Meetings were held with DOE and INEEL personnel in late February to discuss these issues. A staff member from FRD will also attend the Jackson meeting in March. (richard.eckman@noaa.gov, Kirk Clawson)

In February, some capability was added to compute and display air-parcel trajectories using output from the FRD MM5 model runs. This effort was partly in response to the Jackson, Wyoming, controversy mentioned elsewhere in this report. The FRD display system can now compute and show forward trajectories for air parcels initially located at INEEL. Backward trajectories can also be computed for specified locations. These backward trajectories can be used, for example, to investigate the paths that air takes in reaching Jackson according to the model simulations. (richard.eckman@noaa.gov)

Las Vegas

27. Cloud-to-Ground (CG) Lightning Study. New lightning detection equipment has arrived and plans are being made for installation and training in March. (Jim Sanders, 702 295 2348, and Darryl Randerson, 702 295 1231)

28. DOE Meteorological Coordinating Council (DMCC). The Director, SORD, chairs this DOE coordinating group. In February, attention was given to the need for a DOE contribution to the Office of the Federal Coordinator for Meteorology Annual Federal Plan for Meteorological Services and Supporting Research, FY2002. Updates from nine DOE field offices were received and input to the new document. The DOE contribution to this document is being prepared with funding support from the DOE Office of Science. Note that in this case, as also in the case of the ARL group at Research Triangle Park, NOAA/ARL employees are responding on behalf of other agencies to requests initiating from NOAA. (Darryl Randerson, 702 295 1231)

29. EEO/Personnel. A conference call was held with the Selection Committee for the directorship for the ARL Atmospheric Sciences and Modeling Division in Raleigh-Durham, NC. Director, ARL/SORD, served as Chairman of the committee. All applicants were reviewed, rated, and ranked. The best qualified applicant was determined and a letter of recommendation, along with the rankings of all applicants, was sent to the Director, ARL, on February 28. (Darryl Randerson, 702 295 1231)