NOAA ARL Monthly Activity Report

August 2004

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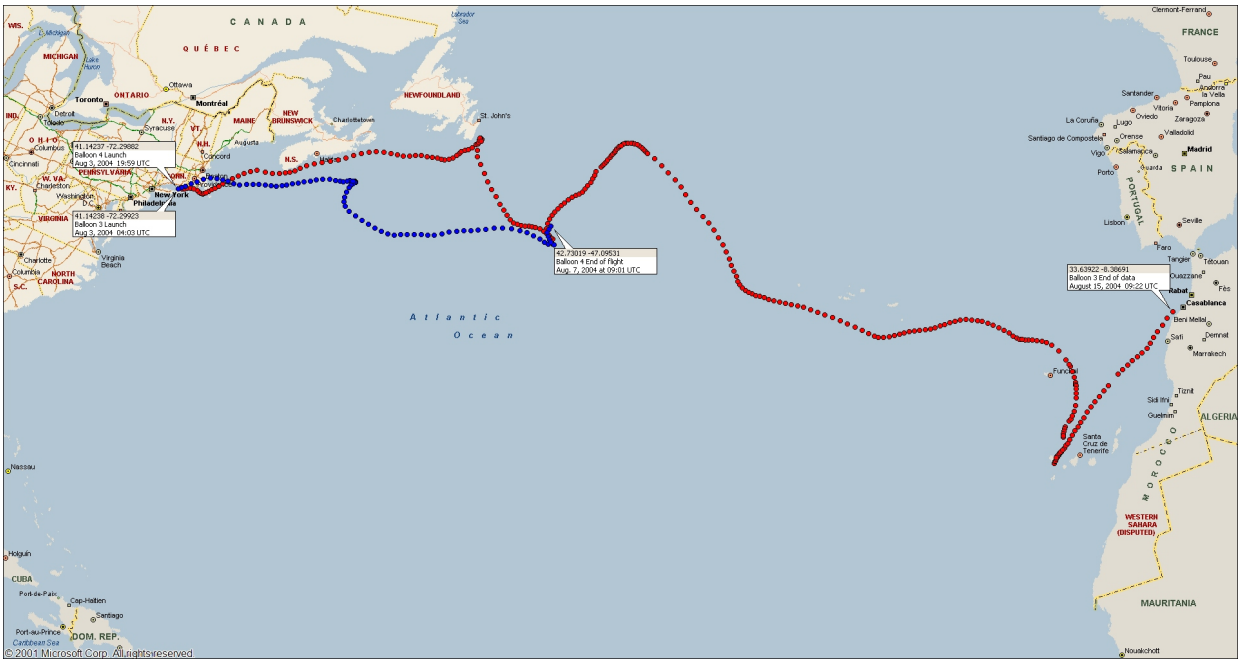
1. Highlight – Hurricane P3 Turbulence Studies. The first 2004 deployment of the ARL turbulence system on a NOAA P3 occurred at the end of August/beginning of September for Hurricane Frances. One of the NOAA P3s (N43RF) was deployed to Barbados in order to fly missions on successive days through Frances as the storm passed north of the inward Islands, Puerto Rico, and into the Bahamas. Because of the storm's proximity to land the P3 was tasked by the National Hurricane Center (NHC) on several days, limiting the number of CBLAST research missions. We did fly one research mission as the storm passed to the north of St. Croix. The BAT system operated flawlessly for the 9-hour mission. Several legs were flown at the top of the boundary layer on the storm's periphery in a region of 25-30 m/s surface winds. The measurements in Frances provide critical data needed to understand the transfer of energy from the boundary layer into the hurricane. These data are now being analyzed in conjunction with measurements made in Hurricanes Fabian and Isabel in '03. We expect more opportunities in the following weeks as the '04 season gets into full swing. jeff.french@noaa.gov

2. Highlight – Smart Balloon Sets Distance Record During NEAQS - ITCT. During the month of July, two Smart Balloons equipped with ozone analyzers were launched in Lagrangian experiments as a part of the New England Air Quality Study - Intercontinental Transport and Chemical Transformation (NEAQS-ITCT). An additional two Smart Balloons were launched in early August. The two balloons each carried a miniaturized atmospheric ozone detector built by the University of New Hampshire (UNH) in addition to the FRD suite of air temperature, relative humidity, pressure, etc. One of these two balloons set what is believed to be both a time aloft and a distance world record for neutrally buoyant scientifically instrumented balloons (see figure below). Balloon 3 ended its atmospheric research mission after a 12-day journey across the Atlantic Ocean and traveled a total distance of over 5,000 miles. The transatlantic flight marks the first time a low-level balloon has drifted in air masses from one continent to another while continuously measuring ozone and meteorological conditions.

Balloon 4 traveled a similar path to that of Balloon 3 but its flight was terminated after 85 hours. A leak in the ballast portion of the balloon caused the balloon to use almost all onboard battery power in a vain



Path of Balloon 3 (red) and Balloon 4 (blue).

attempt to maintain altitude. Therefore, the decision was made to ditch the balloon in the ocean while sufficient power remained.

Quoting Dr. Robert Talbot, Chief Scientist of the NOAA funded Atmospheric Investigation, Regional Modeling, Analysis and Prediction (AIRMAP) Cooperative Institute, "Balloon flights were more successful than we ever imagined several months ago during the initial planning stages. It's not only a question of understanding the intricacy of the chemistry, but the transport as well. These balloon measurements will not only improve our understanding of ozone distribution over the ocean, but will improve our ability to model and forecast it."

The balloon flights indicate that ozone concentrations over the North Atlantic may be much higher than have previously been thought. It will take additional flights over the Atlantic during the next few years to determine the persistence of the high ozone levels. (Randy Johnson, 208-526-2129, and Shane Beard)

3. Highlight – Evaluation of the Eta-CMAQ Air Quality Forecast Model. A suite of statistical metrics that facilitates evaluation of both *discrete-type* forecasts (observed versus modeled concentrations of O_3) and *categorical-type* forecasts (observed versus modeled exceedances of the maximum 8-hr standards for O_3) have been calculated in order to characterize the performance of this model system. O_3 data from more than 600 monitors obtained from EPA's AIRNOW monitoring network are being used in the evaluation.

Preliminary results from the summer (June, July, August) of 2004 indicate that the system performed fairly well, despite anomalously wet and cool conditions (unfavorable for the formation of ozone) dominating the region. As seen in the table, correlations ranged from 0.51 to 0.62. The biases were positive and rather large, as were the errors. Examination of the meteorological conditions during the summer indicated that the model generally performed very well when the domain was dominated by anticyclones (correlations ranged from 0.6 to 0.8, NMB and NME < 15%), but poorly when the domain was experiencing cloudy conditions with precipitation.

				Discrete Statistics				Categorical Statistics			
	Obs Mean	Model Mean	r	MB ppb	NMB %	RMSE ppb	NME %	A	B	POD	CSI
June	46.1	53.9	0.51	7.8	16.9	14.1	24.0	99.5	0.79	25.3	16.5
July	47.4	57.3	0.55	9.9	20.8	16.2	27.2	98.0	1.9	50.5	20.7
August	43.4	55.1	0.62	11.7	27.1	16.5	30.9	98.7	5.2	39.6	6.8

Legend for the Table

MB:	Mean Bias	A:	Accuracy
NMB:	Normalized Mean Bias	B:	Bias
RMSE:	Root Mean Square Error	POD:	Prob. of Detection
NME:	Normalized Mean Error	CSI:	Critical Success Index

These results were presented at the NOAA sponsored Air Quality Focus Group Workshop held in Silver Spring September 8th and 9th. (Brian Eder, 919 541 3994)

The evaluation has indicated that specification of lateral boundary conditions (LBCs) can result in systematic differences in model predictions. A higher bias in ozone forecasts was noted for the eastern United States domain, which employed lateral boundary conditions derived from seasonal mean values from prior CMAQ continental scale simulations for 2001. These LBCs for ozone were higher than the default profiles employed in the northeast domain by about 3-5 ppb through the depth of the boundary layer. Consequently, higher ozone is maintained aloft through much of the domain;

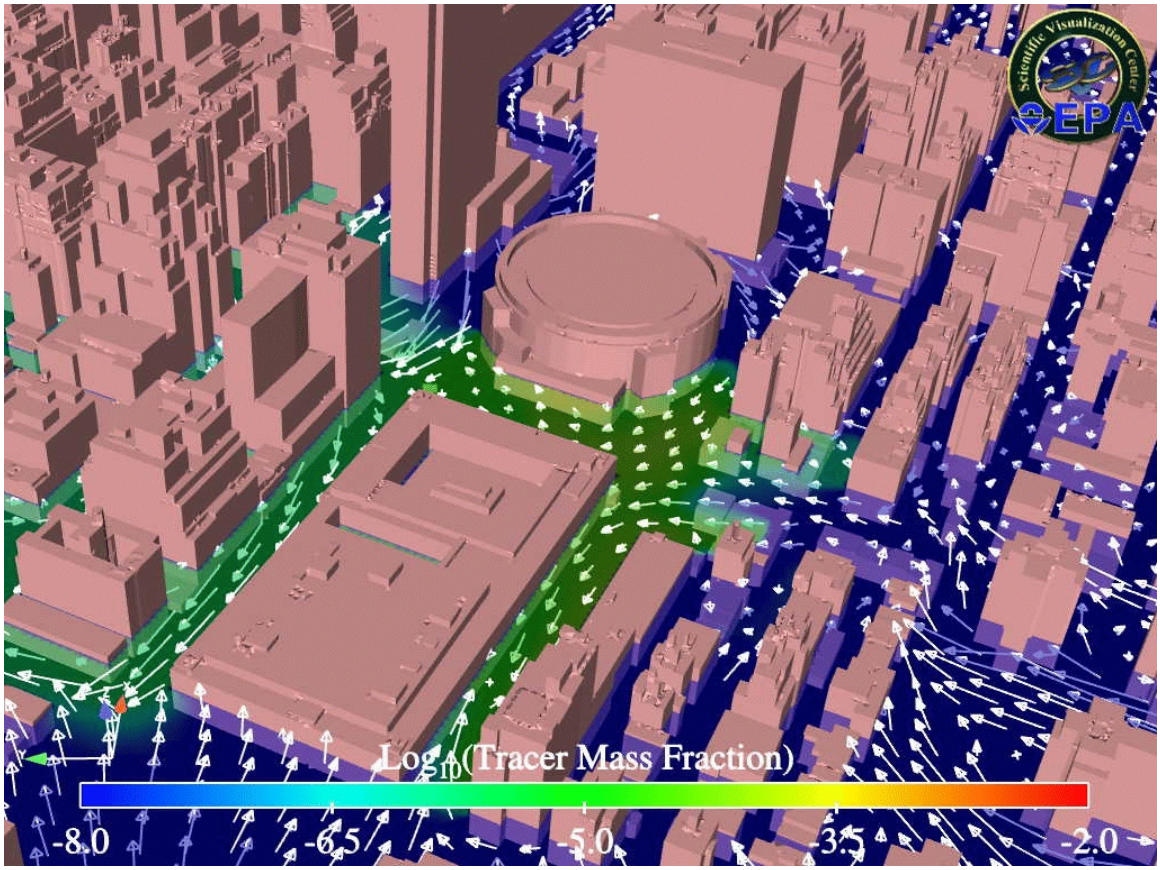
this is then entrained to the surface as the boundary layer grows resulting in the systematic differences.

It is also found that ozone overpredictions are most severe during cloudy conditions when observed values are typically below nominal background levels. Diagnostic simulations focusing on representation of cloud processes in CMAQ have indicated that representation of (1) top-down mixing and (2) photolysis attenuation due to presence of clouds play a crucial role in dictating the extent of ozone predictions at low values. Two modifications to the photolysis attenuation scheme are being tested: (1) modifications in the representation of cloud fraction and (2) deriving below-cloud attenuation factors from modeled radiation fields. (Rohit Mathur, 919 541 1483; Jonathan Pleim, 919 541 1336)

4. Highlight – The Las Vegas Urban Test Bed. In early August, the NOAA Cooperative Institute for Atmospheric Sciences and Terrestrial Applications (CIASTA) conducted a wide-reaching meeting in Las Vegas to bring together agencies and scientists working on issues related to urban climate, air quality and emergency response in southern Nevada. Participants included several local government agencies, several federal agencies (EPA, USGS, DOE, NOAA) and variety of other scientific groups (e.g. national laboratories). Five ARL Divisions participated. The meeting was constructed to generate a larger, multi-organizational Urban Atmospheric Research program, building upon the initial opportunities provided by Clark County. Clark County is currently working with CIASTA to study ozone exceedances and their causes in the Las Vegas valley. ARL/SORD already operates a mesonet in southern Nevada, and the urban meteorological activities now proposed by CIASTA are seen as an urban extension of this existing mesonet. The new consolidated program now appears to be a reality, essentially serving as the first extension to the west of the philosophies of DCNet.

Representatives of several interested politicians were present at the meeting. There appears to be great political interest in the program. (Darryl Randerson, 702 295 1231, Walt Schalk, and Bruce Hicks)

5. Highlight – Urban Dispersion – New York City. A building model and CFD (Computational Fluid Dynamics) simulation was set up for the area surrounding Madison Square Garden to support the ongoing planning for a field tracer study during the Fall 2004. This initial case study evaluated the potential plume paths from ground level emissions near Madison Square Garden with winds from the southwest. Interestingly, winds from the southwest will not result in plume paths towards the northeast for any near-ground emissions on the south or west side of Madison Square Garden. This is a result of large downward mass flow along the windward faces of the tall buildings north and east of Madison Square Garden. This mass flow added to the baseline flow near the ground is directed along the ground toward the south and east over Madison Square Garden before moving toward the north. The diagram illustrates an example of the wind field and simulated plume. The plume is initially transported westward around the U.S. Post Office building before moving northward. The winds are both complex and unique for each street canyon. Simulations for other wind conditions are ongoing and a summary report will be prepared during September. (Alan H. Huber, 919 541 1338)



Silver Spring

6. Global Umkehr-Ozone Data Updated Through 2002. As in the case of ozonesonde data, the Umkehr data are by far the best in the north temperate zone. Thus, the most noteworthy finding of this update is that in the high-stratospheric 32-48 km layer of this zone (above the reach of the sondes) the Umkehr data indicate that in 2002 the ozone amount was the lowest in the 35-year record, except for the artificially low amounts resulting from Chichon and Pinatubo eruptions. The much sparser Umkehr data in the tropics and south temperate zone do not show anomalously low ozone values, and neither do the ozonesonde and Umkehr values from lower levels in the atmosphere, so the region of record low values may be limited in extent. (Jim Angell, 301 713 0295, x127)

7. Urban Dispersion – METREX Revisited. ARL's Metropolitan Tracer Experiment of the 1980s remains one of the most detailed investigations ever conducted of urban dispersion. The study was conducted in Washington, DC. Today, with the evolution of DCNet and the growing awareness that Washington is a terrorist target, a re-examination of METREX data is being conducted, using modern mesoscale model outputs as drivers. Initial tests using ETA turbulence fields showed concentration under-prediction due too much vertical turbulence. Normally the turbulence field is partitioned into its vertical and horizontal components based upon surface layer similarity relationships, with the ratio of vertical to horizontal turbulence ranging from 0.3 to 0.7. A new equation was added to force the ratio to a fixed value. To reduce the METREX under-prediction required a ratio of 0.1. roland.draxler@noaa.gov

8. HYSPLIT Calculations Using Combined Archive/Forecast Meteorology. A new capability has been added to the registered online version of HYSPLIT accessed through READY. Users can run trajectories and concentrations with a combination of analysis and forecast data in the same run. On a few datasets (Eta 40 km, GFS, and AVN) we create a 2-day archive of model analysis and concatenate it to the current forecast. This allows us to start a run 1 or 2 days prior to the current forecast initialization time and continue running through the forecast in the same calculation. Access to this new capability can be made by choosing a forecast dataset when running HYSPLIT under the registered users section of our READY website. glenn.rolph@noaa.gov

Boulder

9. SURFRAD Lightning Protection. The Goodwin Creek SURFRAD station has had a persistent power problem that has plagued that station and data collection since the middle of July. Also, all but one tower instrument has been reporting bad values. Several attempts by our technical contacts in Mississippi to mitigate the problem by replacing critical components in the data logger enclosure failed. The tower was lowered during a recent visit by a team from Boulder, revealing that the temperature & RH probe likely took a direct lightning strike. Initially, that instrument was not suspected because it had been replaced six weeks before, because of another lightning strike. Based on past experience, a direct lightning strike would have disabled several instruments and other electronics, costing the program about $10,000. However, two such strikes this summer only affected the temperature & RH probe, indicating that the lightning protection system that was installed in October 2003, protected the station well and possibly saved our program $20,000. john.a.augustine@noaa.gov

10 . EEO/SOARS – Boulder. SRRB's Significant Opportunities in Atmospheric Research for Students (SOARS) student, Carlos Medina, made his final presentation to the SOARS students and mentors on August 9. His project on improving and expanding the SURFRAD aerosol optical depth algorithm was well received. Afterwards, he returned to the Colorado School of Mines for his last semester. john.a.augustine@noaa.gov

11. SURFRAD in China. Dr. Xiangao Xia from the Institute of Atmospheric Physics, Chinese Academy of Sciences, visited Colorado during the third week in August. His visit was for training in regard to setting up and operating a Baseline Surface Radiation Network (BSRN) station. He will operate the first BSRN station in China and one of only a couple in all of Asia. He was trained by staff from CMDL, ARL/SRRB, and by staff at the Department of Energy's National Renewable Energy Laboratory in Golden. He will operate the first station 80 km northeast of Beijing in cooperation with NOAA and NREL staff and Zhanqing Li of the University of Maryland. joseph.michalsky@noaa.gov

12. Issue with Solar Calculations. An outstanding problem with solar calculations is that they produce higher results than are observed. The results are typically about 10% high relative to measurements for clean, clear-sky conditions. An important input to models that attempt to calculate downwelling solar irradiance is the albedo, or reflectivity, of the surrounding surface. Using spectral albedos rather than broadband albedos improve the results about 30% for clean, clear-sky cases. The other possibility for non-closure is that measured single scattering albedos (a confusing name, which is a measure of how likely a photon encountering an aerosol is to scatter versus being absorbed), that are used as inputs to models are too high relative to what is needed to get agreement with measured

irradiances. An intensive study near the ARM Oklahoma central facility was held in May 2003. Many and duplicate measurements of the inputs needed for models and of irradiances that the models predict were obtained and validated by the SRRB staff in cooperation with members of the ARM science team and ARM infrastructure staff. We are using these measurements to attempt to bring closure on this fundamental issue that is the basis for radiation codes used in the general circulation models that attempt to predict climate change.
joseph.michalsky@noaa.gov

13. Instrument Mentor for the Atmospheric Radiation Measurement Program. Gary Hodges has taken on the responsibility of instrument mentor for all of the Atmospheric Radiation Measurement Program (ARM) Multi-Filter Rotating Shadowband Radiometers (MFRSR). The main roll of an ARM instrument mentor is to be the technical point-of-contact for an instrument system. The mentor provides routine operation and corrective maintenance procedures and documentation, and consultation for instrument problem diagnoses. Gary will be working closely with ARM management, the ARM data quality office and data users in fulfilling this role. gary.hodges@noaa.gov

Oak Ridge

14. East Tennessee Ozone Study (ETOS). The ETOS intensive study continued with six additional measurement sites, making the total now twelve. All sites are in the east Tennessee ridge/valley region, but extending into the Great Smoky Mountains National Park. The pollutants measured are S02, HNO3, NO3, SO4 and O3. To view raw data, visit http://airquality.atdd.noaa.gov, which is updated on a daily basis. TEOM Series 1400a ambient particulate (PM-2.5) monitors have been deployed at three sites. will.pendergrass@noaa.gov

15. University of Alabama Sky Arrow Instrument Integration. Work continued this month on the installation of scientific instrumentation on the University of Alabama (U-AL) Sky Arrow. Ground testing and calibration of scientific instrumentation and the data collection system was completed at ATDD. The Sky Arrow arrived at Knoxville's Downtown Island Airport on August 6. ATDD personnel installed the instrumentation and data collection system. Sensors and antennas were installed on aircraft structures. Power and data cables were routed throughout the airframe, requiring the removal of the aircraft tail on several occasions. Sensors were mounted on the instrumentation plate and installed in the aircraft. The aircraft supplied power scheme was modified to meet safety requirements. All modifications were coordinated with an IA A&P (FAA Certificate Airframe and Powerplant Mechanic with Inspector Authorization) certified maintenance technician. Calibration, testing, and trouble-shooting will continue in September. A U-AL contract pilot will then fly the aircraft back to U-AL. steve.brooks@noaa.gov, Dumas, J. French, Ludwig, P. Hall, and Senn

Research Triangle Park

16. Community Multiscale Air Quality (CMAQ) Model. In preparation for the upcoming release of CMAQ, a number of code updates and documentation activities were performed. First, a release note describing how to include process analysis in CMAQ simulations has been prepared. Second, the molecular weights for the aerosol compounds in the chemical mechanism data files have been revised so that they are consistent with values used elsewhere. Third, work on a new gas-phase chemistry solver has been completed and the code entered into the source code archive. As part of

this effort, integration reaction rate analysis has now been fully implemented and tested with the solver, and testing on the IBM eServer was performed. CMAQ change logs describing the code updates have been completed and added to the CMAQ source archive. Finally, preparation of release notes that discuss the various changes that have been made to the CMAQ array of chemistry solvers is underway and will be included in the final release. (Gerald L. Gipson, 919 541 4181)

A version of the Plume-in-Grid submodel capable of simulating aerosol processes is included in this latest version of CMAQ. Final updates to CMAQ are being incorporated into the model archive prior to the September official release of CMAQ4.4 (the FY-2004 version). (Shawn Roselle, 919 541 7699; Jeffrey O. Young, 919 541 3929)

17. Testing New Planetary Boundary Layer (PBL) Model. The MM5 model is being run just behind "real time" for the summer of 2004 on a 12-km grid covering the eastern US. These runs include Four-Dimensional Data Assimilation (FDDA) using 6-hourly Eta analyses with intervening 3-hour forecasts for upper air FDDA. 3-hourly surface observations are ingested and processed by objective analysis for surface data assimilation. Surface data is used for boundary layer wind assimilation and for indirect soil moisture nudging. The new (PBL) model being tested in these simulations is an extension of the Asymmetrical Convective Model (ACM) that has been available in both MM5 and CMAQ for many years. The new model (ACM2) includes both local (eddy diffusion) and non-local components and produces more realistic vertical profiles and a smooth transition from stable to unstable conditions. These MM5 simulations will be evaluated in comparison to field data from the International Consortium for Atmospheric Research on Transportation and Transformation (ICARTT) study, which includes many aircraft and ground based profiles. CMAQ simulations with ACM2 will also be made based on these MM5 results and evaluation against chemical measurements from ICARTT. (Jonathan Pleim, 919 541 1336)

18. Fire Related Emissions using Satellite Data. A group effort is underway to test the operational feasibility of using infrared satellite products to allocate fire-related emissions. These emissions are a substantial source of elemental carbonaceous aerosols. Model simulations are currently underway to test the sensitivity of the CMAQ predictions with refined fire emissions. This work could make a substantial contribution and improvement to the current fire-related emissions in the National Emission Inventory because currently information is limited to the resolution of state boundaries and monthly blocks of time. This work will be presented at the upcoming Community Multiscale Analysis System (CMAS) workshop in October. (Dev Roy, 919 541 5338; Steve Howard, 919 541 3660; Alice Gilliland 919 541 0347)

Idaho Falls

19. ET Sphere. Hurricane Charley provided the first opportunity to deploy the ET spheres this season when it made landfall in Florida on 13 August. The ET sphere deployments are being coordinated with a hurricane interception team lead by Dr. John Schroeder from Texas Tech University. Unfortunately, the track and intensity forecasts for this storm were relatively inaccurate, and nearly all land deployment teams were unable to get equipment into position in time. Based on the guidance through 11 August, the TTU team had decided not to deploy for Charley. One day before landfall, TTU attempted a last-minute effort to deploy one tower, but by that time it was too late for us to get the ET spheres into position. Even if the spheres had been in Florida, it is likely they would have been deployed too far north based on the 48-72 hour position forecast. In fact, this

is exactly what happened with the single tower deployed by TTU. Just hours before landfall, the official forecast had the storm coming ashore near Tampa, which was more than 100 km to the north of the actual landfall.

A second opportunity for deploying the ET spheres arose late in August, when Hurricane Frances was forecast to make landfall on the East Coast of Florida. Ron Dobosy from ATDD planned to depart Oak Ridge with the equipment van on 1 September, whereas Rick Eckman and Tom Strong from FRD made flight reservations to arrive in Melbourne, FL on the evening of the 1st. The plan was to deploy 3 ET spheres along the East Coast of Florida at locations where TTU also was deploying meteorological towers. The deployment was successful and will be reported in next month's report. (Richard Eckman, 208-526-2740, and Tom Strong, FRD; Ron Dobosy and Dave Senn, ATDD)

Las Vegas

20. Test-Readiness Activities. ARL/SORD conducts the research necessary to improve the models used to assist the testing of nuclear weapons and their components. In essence, ARL serves as the senior advisor to weapons testing officials, concerning the dispersion and deposition of fallout. During August, discussions were held with NNSA/NSO regarding modifications to the PIKE Fallout Prediction model to output Total Effective Dose Equivalents (TEDE) and Committed Dose Equivalents (CDE). The focus was on improving predictions of the 1.0 rem TEDE and the 5.0 rem CDE. (Darryl Randerson, 702 295 1231, Doug Soule', and Walt Schalk)

21. Defense Threat Reduction Agency (DTRA). SORD provides specialized dispersion guidance to all activities conducted at the Nevada Test Site. In recent years, the DTRA has been a major user of SORD capabilities. During August, the DTRA studies related to national defense and homeland security issues. In all cases, the SORD contributions make extensive use of the specialized models developed by ARL and the mesoscale data generated by the ARL mesonet operating in southern Nevada. Darryl Randerson, 702 295 1231)

22. North American Monsoon Experiment (NAME). SORD personnel participated in the NOAA NAME Project by collecting 40 upper-air soundings from the Desert Rock Meteorological Observatory (DRA) and additional soundings from the Nevada Support Facility (NSF). These data were promptly compiled and transmitted to the NAME Forecast and Research Center in Tucson, AZ. (Darryl Randerson, 702 295 1231)