NOAA ARL Monthly Activity Report

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Contents

Highlights

1. Measurements During the Presidential Inauguration. At the request of the DOD's Defense Threat Reduction Agency, ATDD installed and operated two wind measurement systems in the Washington, DC area to provide wind speed and direction data in near-real-time to support dispersion evaluations during the Presidential Inauguration. ATDD's Remtech sodar was installed at Fort Myer, just west of Arlington National Cemetery. As feared, the ambient noise levels (especially from aircraft from National Airport) interfered with reliable operation. During quieter periods, wind data up to about 2km AGL were obtained. The data were transmitted by a wireless ("Ricochet") modem to the Internet and placed on ATDD's server in Oak Ridge, where they could be downloaded by the numerical modelers. A pair of 3-D sonic anemometers, powered by batteries recharged by the nocturnal lighting, were installed on a boom at the Navy Memorial on Pennsylvania Avenue. Data were transmitted by wireless modem to a computer inside the nearby Naval Heritage Center for processing and recording. A dial-up (telephone) modem and a LAN connection were used initially dual path for data retrieval, but the LAN connection proved shaky and was replaced with a wireless Ricochet connection to the Internet. The sonic anemometers provided the only meteorological data near street level along the Presidential Parade route, and supported a Dugway Proving Ground sodar located on the roof of the nearby FBI building. At both Fort Myer and the Navy Memorial, the communications links to the Internet proved to be troublesome, and ATDD staff remained on-site during the entire Inaugural weekend to care for equipment as needed. (hosker@atdd.noaa.gov, Pendergrass, White, Brooks, Meyers, Dumas, Wood)

2. Heavy ARL Involvement in the AMS Annual Meeting. For the first time, an ARL booth was featured in the exhibit hall during the 81st Annual Meeting of the American Meteorological Society (AMS) which was held from January 14-19, 2001, in Albuquerque, New Mexico. ARL technology was the central theme to the booth. Exhibit props included the Extreme Turbulence (ET) probe jointly under development by FRD and ATDD, and a model of the LongEZ. Many brochures were available on programs conducted by each division. The booth provided an excellent opportunity to "show off" various ARL technological products and research programs. The booth was very successful and attracted a lot of interest. Barbara Shifflett (ATDD) and Jerry Crescenti have lead this intensive effort over the last several months. (jerry.crescenti@noaa.gov, Tim Crawford, Jeff French, and Kirk Clawson).

The Eleventh Symposium on Meteorological Observations and Instrumentation (SMOI) was conducted from January 15 to 18, at Albuquerque, in conjunction with the same meeting. The SMOI was organized and chaired by Jerry Crescenti. Overall, this symposium was very successful and included various topics. Oral sessions included:

- calibration methods
- quality assurance and quality control techniques
- sonic anemometers and extreme wind measurements
- surface energy
- fluxes
- radio- and rawinsondes
- aircraft platforms and aircraft
- clouds and visibility
- meteorological measurements in harsh environments
- quality assurance and quality control for meteorological networks
- rainfall
- water vapor and precipitable water
- radar wind profilers
- satellite measurements of the Earth's surface
- solar radiation

Eleven papers were contributed by ARL. Tim Crawford and John Deluisi were also session chairs. (jerry.crescenti@noaa.gov)

Finally, in response to the lack of an instrumentation curriculum at most universities with meteorology programs, a one-day short course on meteorological instrumentation and observation techniques was organized. The focus was on the basics of *in situ* monitoring. This course was held on Sunday, January 14, 2001, also in conjunction with the 81st Annual Meeting of the American Meteorological Society. The short course lecture notes and slides can be found at http://measure.noaa.inel.gov. The short course instructors included C. Bruce Baker (NOAA / National Climate Data Center), Robert A. Baxter (Parsons Engineering Science), Paul M. Fransioli (Science Applications International Corporation), Scott J. Richardson (University of Oklahoma), Yvette P. Richardson (University of Oklahoma), Melanie A. Wetzel (Desert Research

Institute), Daniel E. Wolfe (NOAA / Environmental Technology Laboratory). The short course was a tremendous success and exceeded all expectations. A total of 56 participants enrolled for this one-day “crash” course. (jerry.crescenti@noaa.gov)

Silver Spring

3. Smoothing the Radiosonde Temperature Record. Dian Seidel visited GFDL on Jan 5, 2001 to discuss ongoing collaboration with John Lanzante and Steve Klein on adjusting radiosonde temperature data for artificial jumps due to changes in instrumentation, etc. Recent results suggest that the adjustment scheme, and the deletion of data that are too poor to adjust, eliminates most outlier stations in an 87-station network. Temperature trends after adjustment are somewhat different that before, but the main patterns of change in the vertical temperature profile (tropospheric warming and stratospheric cooling) remain. Comparisons with independent satellite data for the period since 1979 indicate better agreement with the adjusted radiosonde data than with the unadjusted, both in terms of variability and trend, suggesting that the adjustments (which extend back to 1958) are indeed improvements. Plans for two manuscripts documenting the technique and the results were developed. (dian.seidel@noaa.gov)

4. Climate Change at High Elevations. Plans were developed for an analysis of multi-decadal changes in tropospheric and surface temperatures at high elevations, both in mountain regions and in the free atmosphere. The original motivation for this study was the puzzling finding that, during the past two decades, as tropical mountain glaciers have retreated rapidly, atmospheric freezing level heights in the free troposphere have not changed much. This radiosonde data analysis will address whether free air temperatures are representative of mountain sites, whether surface and upper-air temperature changes at low elevation sites are well correlated with those over mountains, and whether the structure of the boundary layer varies with elevation. Data have been obtained from NCDC for a network of more than 60 radiosonde sites, including pairs of stations at high and low elevations. (dian.seidel@noaa.gov and melissa.free@noaa.gov)

5. Simple Dispersion Forecasts Available on READY. A simple dispersion program, originally published in 1981 by Roland R. Draxler as NOAA Technical Memorandum ERL ARL-100, titled, "Forty-eight hour Atmospheric Dispersion Forecasts at Selected Locations in the United States," has been updated to produce quick forecasts of atmospheric dispersion via the READY website (www.arl.noaa.gov/ready/mosdisp.html) by combining the simple techniques of estimating dispersion from Bruce Turner's Workbook of Atmospheric Dispersion Estimates with National Weather Service (NWS) forecasts of wind direction, wind speed, cloud cover, and cloud ceiling. The NWS forecasts come from the NGM and new AVN Model Output Statistics (MOS), which are statistically derived surface conditions produced for over 1000 locations in the Continental U.S., Alaska, Puerto Rica, and Hawaii, twice per day, beginning with the observation times (00 and 12 UTC) and extending up to 60 hours into the future.

Six-hour, straight-line flow, dispersion forecasts at 0.5, 1, 2, 5, 10, 20, 50, and 100 km downwind are produced independently for each 3-hour forecast time given by the MOS forecast. That is, a continuous 6-hour emission is assumed to occur every 3 hours. The user chooses the dispersion forecast time to display on a graph (all the other forecasts are available in a text file) as well as the release height, receptor height, and the maximum daytime and nighttime mixing heights. (glenn.rolph@noaa.gov)

6. Meteorological Augmentation of Historic Tracer Studies.. ARL is collaborating with the US Air Force on the preparation of an augmented data record for past tracer studies. Production of meteorological data

CD-ROMs for each experiment should begin next month. As part of the sigma-level data testing, pressure level re-analysis data were obtained from the CDC web site to compare with the sigma-level data. A program was designed and written to convert the CDC data (yearly files by variable) in netCDF format into monthly files for all variables in ARL format. These reformatted data can be used directly by READY or HYSPLIT. This now provides us with the capability to easily perform transport and dispersion calculations back to 1948. A PC version of the program will be developed later. (roland.draxler@noaa.gov and Nick Heffter)

Boulder

7. SURFRAD. The interpolated sounding display utility on the SRRB web site has been improved. In addition to plotting the interpolated sounding for the desired SURFRAD station location, the nearest NWS sounding to the SURFRAD station is also plotted. This helps judge the quality of the interpolated sounding. The two should not match exactly because the nearest NWS sounding may be 50 to 150 km away from the SURFRAD station. Also, the interpolated soundings are vertical, whereas the actual NWS soundings drift downwind as they ascend.

In compliance with contractual agreement with the NASA EOS validation program, the SURFRAD network data distribution site was registered at Mercury, which is a Web-based system to search for metadata and retrieve associated data. The mercury system web site is located at Oak Ridge National Laboratory; its URL is http://mercury.ornl.gov/. Mercury supports a truly distributed environment via the Internet. All of the data, documentation, and metadata reside with the individual data providers' servers. Mercury uses the Internet to form a "virtual system" interconnecting those servers and its central system. (John Augustine, 303 497 6415)

8. EPA Brewer UV Network. On the 22nd of January Patrick Disterhoft, Betsy Weatherhead, David Theisen, and John DeLuisi met with members of the EPA Brewer UV Network support team to review progress on the work being conducted by members of both ARL/SRRB and University of Georgia scientists. The Georgia staff's presentations were focused on the eventual production of a spectral UV data base composed of observations made by 21 instruments located in national parks and in or near a few cities. The Georgia team described the corrections needed to improve the quality of data base before final archival and release for public use.

David Theisen presented SRRB results which bore similarities to the Georgia results. The SRRB results clearly reveal instrument calibration shifts, often seen each time a new calibration was applied to the raw data. Also revealed in these checks were occasional time dependent drifts in the observed values, sometimes extending over a several month period. The SRRB field calibration and data quality evaluation work is expected to be included as a quality control check in Georgia's final UV data products. Overall, the discussions were believed to be very useful and are expected to lead to an improved EPA UV research-quality data base. (John DeLuisi, 303 497 6824)

Oak Ridge

9. Arctic – North Slope Fluxes. Re-analysis of the summertime aircraft-measured fluxes over the past few summers has shown that carbon dioxide is lost from the surfaces of rivers flowing northward from the Brooks Range in Alaska peaks just after snowmelt, when turbulence and organic suspended sediments levels are high, and when clear skies coupled with 24 hour sunlight increase river water temperature. (brooks@atdd.noaa.gov)

10. Arctic – Mercury in Air and in Deposition. Snow and lead water samples were collected at Barrow, Alaska for mercury, methyl-mercury, and dimethyl-mercury analyses. Early 2001 atmospheric mercury trends are following the 1999 and 2000 patterns. The study's initial paper on the conversion of gaseous elemental mercury to reactive gaseous mercury in the Arctic was accepted for a special *Water, Air, and Soil Pollution* journal issue on the Air/Surface Exchange of Gases and Particles. (brooks@atdd.noaa.gov, Meyers, and Lindberg-ORNL).

11. Italian National Research Council Sky Arrow Research Aircraft. Final assembly and testing of the new MFP system for the Italian National Research Council's Sky Arrow aircraft was completed this month. Delivery to the Sky Arrow factory in Rome, Italy is expected by the first of next month. (brooks@atdd.noaa.gov, Dumas)

12. Extreme Turbulence Probe. The Extreme Turbulence (ET) probe is being developed by the Field Research Division (FRD) and ATDD for use in very severe weather. At ATDD the primary responsibilities are software and electronics. The probe uses pressure anemometry for ruggedness in strong wind and heavy rain. Pressure anemometers have traditionally accepted winds only from a narrow range of directions. Our design expands this acceptance angle by using many sensors. Several modern resources make this approach tractable. One is a high-frequency A/D converter, changing analog signals to high-precision digital (16 bit) at 10^5 samples per second. Software developed this month allows this converter to be configured and to return digital output. The next software steps are to de-spike the incoming signal, and to convert the input information to meteorologically relevant base parameters and fluxes. (dobosy@atdd.noaa.gov)

Research Triangle Park

13. NEXRAD Stage IV Data for Multimedia Modeling of Pollutant Transport. The Multimedia Integrated Modeling System (MIMS) cycles pollutants and nutrients between the atmosphere and the earth's surface, including water bodies and groundwater. Our ability to accurately model both atmospheric, hydrological and surface processes that transport chemicals is highly dependent on precipitation types, rates, and totals. Of special interest are precipitation extremes and subsequent flooding, which can greatly enhance the movement of such chemicals. During such events, these chemicals can enter the surface water bodies via groundwater recharge as well as overland flow. For example, the extreme flooding associated with Hurricane Floyd, which made landfall in North Carolina during September of 1999, transported tremendous amounts of agricultural and industrial waste and pesticides into area estuaries and rivers. This hurricane, which made landfall shortly after an earlier hurricane (Dennis) inundated sections of eastern North Carolina with more than 20 inches of rain.

During the development of MIMS, we are investigating the use of the National Weather Service NEXRAD (NEXt generation RADar) State IV precipitation estimates in our modeling efforts. The NEXRAD State IV data consist of precipitation data fields that have assimilated both rain gage data and WSR-88D (Weather Surveillance Radar 1988 Doppler Version) data into a comprehensive hourly, national data set with a 4-km^2 resolution. The purpose of this research will be to evaluate the quality and identify limitations of the NEXRAD data through a comparison with "ground truth" data obtained from a network of ten closely spaced rain gages. The evaluation, which will use visualization tools and statistical analyses will determine if the spatial resolution of NEXRAD data is adequate to capture the spatial variability of precipitation on the watershed that is used in the surface hydrology models associated with MIMS. (Brian Eder, 919 541 3994)

14. First Internal Release of the Multimedia Integrated Modeling System Framework. Final work is in progress on the first internal release of the Multimedia Integrated Modeling System (MIMS) framework to the project team and selected customers. The 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 is planned to deliver new versions every few months so useful functionality will be delivered to users as soon as possible and so the software can better track users demands. The first release is scheduled for the end of February and will include basic functionality for creating sequences of programs to be executed (in a visual programming environment) and executing the programs. Based on high-level designs created by the MIMS architecture team, the implementation of the framework started a few months ago. Since then more than 13,000 non-blank, non-comment lines of Java code have been written and partially tested. This code includes a substantial amount of framework infrastructure. For example, a database layer was developed that allows us to change database technologies without changing all of the code that stores and retrieves objects. Code review is underway and further testing will be performed before the release. After this release we will begin incorporating Argonne National Laboratory's Dynamic Information Architecture Software (DIAS) into MIMS. DIAS provides a flexible paradigm for coupling models that is based on identifying entities that are to be simulated (e.g., air, people, chemicals), specifying attributes and behaviors of those entities, and connecting data and programs to the attributes and behaviors. The existing MIMS framework has been designed to follow and complement DIAS. (Steve Fine, 919 541 0757)

15. Standalone Version of Models-3/CMAQ. The new standalone version of Models-3/CMAQ was made available for download from the Models-3 website (http://www.epa.gov/asmdnerl/models3). The scripts are set up to run the same Carbon Bond 4(CB4), 36 km tutorial that was provided with the earlier version. There is a version for a Sun or SGI workstation and a separate version for Windows NT.

There are several changes that are included in the present version. The addition of the Modified Euler Backward Interactive (MEBI) solver is used with the CB4 gas-phase mechanisms. The Integrated Process Rate (IPR) analysis is functional with this solver, but the Integrated Reaction Rate (IRR) analysis cannot be used. There is a new module for horizontal diffusion "multiscale."

The CMAQ Chemistry Transport Model (CCTM) can be built with either the new or old aerosol module. The tutorial uses the second aerosol module (AE2). (AE2 will run with or without a current speciated inventory, the first aerosol module (AE1) needs non-speciated inventory). There is continuation capability in which additional time steps of data can be appended to the output files. The sparse matrix operator kernel emissions (SMOKE) is provided for emissions processing along with tutorial inventories and supporting datasets for the Unix version. The emissions-chemistry interface processor (ECIP) is not required with use of SMOKE.

There are some changes that were not completed in time to be included but will be made available in the near future. SMOKE will be provided for emissions processing along with tutorial inventories and supporting datasets for Windows NT. Complete new inventories and supporting datasets will be available with the release of the updated framework version planned for the end of February for the Unix version. The update for the NT will follow. The meteorology-chemistry interface processor (MCIP) is being modified to read output files from MM5 version 3 as well as version 2.

Each standalone system has its own readme files and reference output files. The readme's can be downloaded separately without downloading the entire package. There are some differences in the CMAQ output between the Sun/SGI system and the Windows NT system. We are looking into this in order to provide guidance, and will address this later. Users are encouraged to share their experiences with other users through use of the Models-3 list serve (m3list@tempest.rtpnc.epa.gov). (Sharon LeDuc, 919 541 1335)

16. Physical Modeling of the Flow and Dispersion in Urban Areas. A wind-tunnel study of the flow and dispersion in idealized urban areas by scientists at the RTP Fluid Modeling Facility in collaboration with modelers at Los Alamos National Laboratory and Lawrence Livermore National Laboratory has been completed. Three-dimensional, turbulent flow fields were measured with a pulsed-wire anemometer for both an array of two-dimensional buildings and an array of cubical buildings. In addition, for the array of cubical buildings, the concentration field resulting from a point source of a tracer located just downwind of the most upstream building in the array was determined from concentration measurements at various locations within the array. The goal of this effort was to develop a data base for use in the design and evaluation of 3-D fluid dynamic codes for predicting the fate of pollutants released in and around groups of buildings arranged as in urban areas. A comprehensive data report that describes the experimental techniques, contains all raw and reduced data and presents selected features of the data has been completed and submitted to the collaborators. The data report is available from the principal investigators and includes all the data on compact disc. (Roger S. Thompson, 919 541 1895; Steven G. Perry, 919 541 1896)

Idaho Falls

17. Hurricane Balloons. The balloon/bladder interface for the top of the balloon is complete. The main purpose for the top balloon bladder interface is to provide a means to quickly release helium (cut-down device) to bring the balloon back to the ground. However, it also provides a platform for solar radiation and precipitation measurements, and for a slower, controlled helium release valve that is separate from cut-down device. Figure 1 shows this interface turned upside down to better illustrate the cutdown plug. The black plug is inflated to 20 psi with air to seal the helium inside the bladder. To release the helium, a small valve releases the air from the plug, allowing the plug to drop free of the 4-inch PVC pipe and allow the helium to escape. Release of the balloon super-pressure takes less than one minute. A subsequent soft landing of the balloon is calculated to occur in 2 to 5 minutes, depending on the balloon altitude. We have tested this in the lab and expect to flight test this during the next month. The longer 1.25 inch PVC pipe (Figure 1) provides a place for measuring precipitation with a small pressure transducer. A 12-inch dome will be mounted on the top of the balloon bladder interface to provide rain protection for the balloon/bladder interface. The solar radiation sensor is also mounted in the dome. Signal and power for all of the sensors are provided via a cable from the transponder package (lower balloon/bladder interface) inside the base of the balloon.

Figure 1. Top Balloon/ bladder interface.

The first prototype design of the transponder electronics is complete (see Figure 2). This provides an interface between all of the balloon sensors, balloon altitude controls, GPS receiver and the microprocessor based data acquisition system. The microprocessor and GPS receiver plug in on the solder side of the printed circuit board while all of the other electronics are mounted on the component side of the board. The electronics on the board provide the necessary amplifiers, solid state

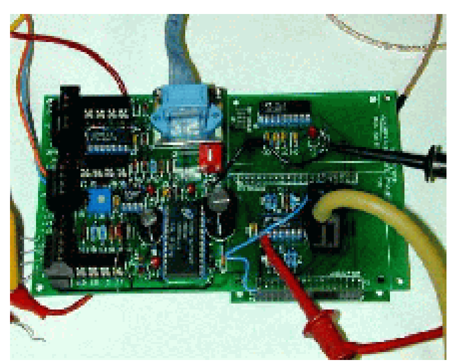


Figure 2. Transponder interface electronics.

switches, power conversion, and some of the transducers and communications interface electronics to allow automated and remote operator control from the ground. (randy.johnson@noaa.gov)

18. Tracer Studies at Dugway. Preparations are in progress for the upcoming AFTAC and Devine Umpire projects to be conducted this spring at Dugway Proving Ground, Utah. The main AFTAC field project will be conducted during a 3-week period in April. Three mobile SF_6 analyzers will be used to detect SF_6 at distances up to 80 km from the release site. The real-time SF_6 analyzers are being refurbished for this project (see below). We are also responsible for the SF_6 release, and an upgrade to the current release SF_6 mechanism is in progress. Plans call for the mechanism to support the simultaneous release of six 50 kg net wt. bottles of SF_6 on a mobile platform. Technicians at Dugway have developed a mobile stack which can be moved and set up in about one-half day to take advantage of prevailing wind conditions. Thus, our release system must also be mobile. (kirk.clawson@noaa.gov and staff)

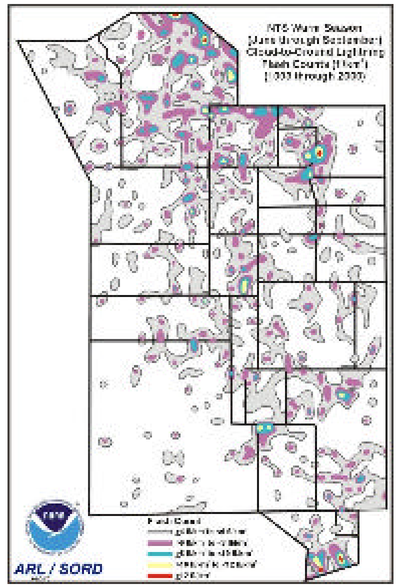
Although our initial efforts at obtaining funding for Devine Umpire failed, we are now being funded to provide a ground-based real-time SF_6 detection system for the one day affair, scheduled for 28 February. Two hundred pounds of SF_6 will be released instantaneously in an explosive puff. We plan to track the invisible puff out to a distance of 80 km from the release site. To aid in tracking the puff, we plan to release a Hurricane Balloon (see previous article) into the puff. The balloon will transmit its position back to the control center, and this position will then be relayed to the driver of the van-mounted SF_6 detection system for the purpose of vectoring the van into the puff. The balloon will be used at no cost to the Devine Umpire project, because a suitable test bed is needed prior to actual deployment in hurricanes. (kirk.clawson@noaa.gov, Randy Johnson, Roger Carter, and staff)

19. Refractive Turbulence. The final phase of the Refractive Turbulence Study-2000/01 was completed in mid-January. From mid-November through January, 15 research hours were flown. Data analysis continues, but preliminary results indicate that the objective, to test the re-design of the Fast, Ultra-Sensitive Temperature (FUST) probe, was successful. The new probe responds to 0.01 C temperature fluctuations on time scales less than 20 ms. Comparisons with the BAT probe indicated good agreement, but at frequencies higher than roughly 7 Hz, fluctuations from the two devices showed little or no coherence. Closer examination suggests fluctuations in the BAT temperature measurement do not respond to small temperature differences (at higher frequencies) and hence results in a quite noisy signal superimposed on one with only a few larger fluctuations. Work has begun to focus on integrating the new FUST sensor into the existing BAT framework. This will require some modification to both the BAT sensor boards and the housing. (jeff.french@noaa.gov, Tim Crawford, Randy Johnson)

20. INEEL Mesoscale Modeling. Extensive efforts were made in January to track down the cause of the problems associated with downloading MM5 initialization files from the main National Weather Service ftp server. Often, the transfer of individual files is terminating prematurely. This started occurring several months ago and has been getting worse over time. The problem does not appear to be within FRD's own network domain. Both the INEEL network administrators and the administrators for the NWS server have so far not be able to find the source of the problem. Oddly, the same files that cause problems at FRD can be downloaded without incident at ATDD. These files can then be downloaded from ATDD to FRD without any problems. Possibly, the NWS server is treating the noaa.inel.gov domain differently from the noaa.gov domain. (richard.eckman@noaa.gov, Jerry Herwehe, ATDD)

Las Vegas

21. Cloud-to-Ground (CG) Lightning Study. A detailed analysis of CG flashes on the Nevada Test Site (NTS) was completed for the 1993 through 2000 warm seasons. The eight-year analysis was completed for 1 km^2 areas. The results of this analysis can be seen in the accompanying figure or by accessing the SORD webpage. The analysis shows that the largest measured flash counts occurred to the south of Mercury (11 to 13 fl/km^2) in the extreme southern part of the NTS and over the high terrain in the northern part of the NTS (10 to 12 fl/km^2). (Darryl Randerson, 702 295 1231)



New map backgrounds were produced for use with the lightning graphics. These map backgrounds were produced utilizing the USGS DEM 1 arc-second data files along with the Kashmir 3D software that SORD obtained. These map backgrounds show the terrain features in the Southwest, and should help the user in understanding where the lightning activity is occurring relative to topography and population centers. These map backgrounds are initially only available for the main lightning maps due to their size and the short time available to produce them [all lightning maps (~120 of them) are produced every minute]. (Doug Soule', 702 295 1266, and Rick Holmes, 702 295 1252)