FRD Activities Report
October 2003

Research Programs

ET Sphere

Analysis has started on the ET probe data collected during September in Hurricane Isabel. Water was observed in the probe's tubing right after the hurricane (Figure 1), so it was clear that the pressure measurements may have been affected by the water. The raw pressure measurements do indeed show the effects of water fouling. Some of the sensors showed large pressure offsets, and the dynamic response was also affected. A controlled test was performed back at FRD in which water was purposely injected into the tubing of one sensor. The pressure offset was found to be related to the weight of the water in the tubing. If the tubing sloped upward, there was a positive pressure offset; if it sloped downward, there was a negative offset. The sensitivity of the sensor was also slightly affected. However, the controlled test only looked at the sensor response to static pressure loading, and not to the dynamic pressure fluctuations that would be present in a hurricane.

One approach being investigated to compensate for the water fouling is to use nearby sensors that are not fouled. Normally, the wind is computed using the pressure sensors that are closest to the stagnation point. Data from road tests here at FRD indicate that the winds can still be computed, with some additional noise, using sensors up to about 36° from the stagnation point. If the sensors closest to the stagnation point are fouled by water, it may therefore be possible to compute the winds using nearby sensors that are somewhat distant from the stagnation point. In some cases this appears to work with the Hurricane Isabel data.

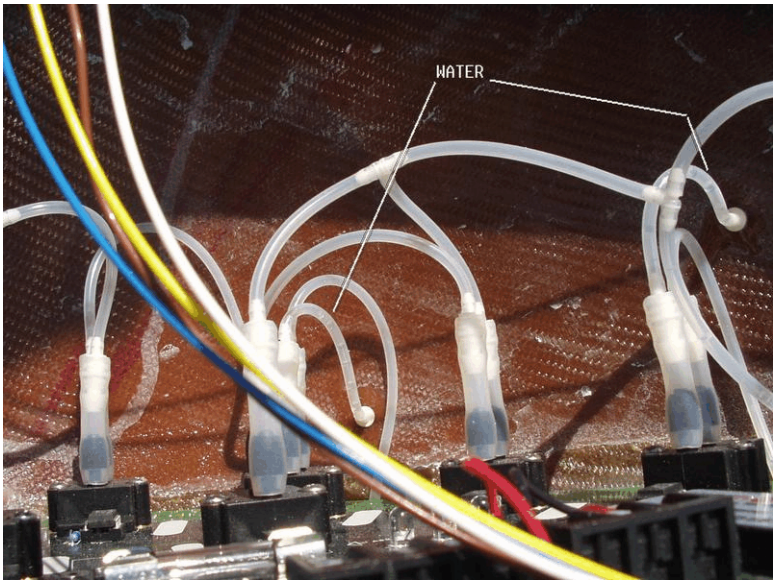

Figure 1. Photo of inside of ET sphere shortly after Hurricane Isabel deployment. Water fouling shows up as light-colored stripes in the plastic tubing.

The ultimate solution to the water fouling problem is to keep it from happening in the first place. We are investigating a couple of different approaches. FRD is investigating a passive system partly inspired by pitot tubes on aircraft. Pitot tubes are very similar to the differential sensors used on the ET probe, and water fouling does not seem to be an issue with them (although ice can be a problem). They use much

larger diameter tubing than the ET probe, and the tubing is sloped upward. We therefore plan to modify one ET probe to use large-diameter tubing and to route all the tubing upward into a harness near the top of the sphere. The idea is that gravity will keep the sensors from becoming fouled with water. ATDD is investigating an active system which uses an air pump to flush out the tubes. It is not clear at this point whether either of these approaches will actually work well in the field. The passive approach is obviously preferred if it works, since it avoids the need to power an air pump. (Richard.Eckman@noaa.gov and Tom Strong)

CBLAST-High

Work continues on the reduction, processing, and initial analysis of data from this year's field deployments. Recent work focused on merging high frequency NOAA P-3 data and data from the BAT system. Presently, no tools exist to read the high frequency P-3 data. The software currently being built will be disseminated to other CBLAST investigators.

Of the six hurricane research flights, usable data were obtained from five. Problems related to the intrusion of water into the BAT probe were eliminated between the two field deployments. Analysis will focus on data collected in the first two flights of Hurricane Fabian and the three flights from Hurricane Isabel. (Jeff.French@noaa.gov)

JOINT URBAN-2003

During the past three months, our efforts have focused on preparing the data from the continuous SF_6 analyzers for release and also on understanding the data collected with the new Super PIGS bag samplers. The work with the continuous analyzer data is progressing well. We have completed QC checks of all data and have identified and extracted the SF_6 measurements from the raw data files. We are currently reviewing all data and identifying problems in the data that will require quality flags to be set. Before final data files may be generated, we must also establish correct positions for the continuous analyzers during each test. Each continuous analyzer was equipped with a GPS unit to provide positions. However, positions provided by GPS units in close proximity to tall buildings are very suspect and most of the position information we have can not be trusted. We must identify a way to get correct position information.

The data from the Super PIGS (or "plastic samplers" as we refer to them internally) presents a more difficult challenge. The first indication of problems was very poor results from the QC samplers during field deployment to Oklahoma City. These QC samplers consisted of field controls and field blanks. Both types of QC samplers were deployed just like normal samplers, collected after each test, and analyzed with the rest of the samplers. They were used as indicators of method performance. The difference between these and the typical plastic sampler is that the QC samplers were equipped with a source box containing bags of gas with known concentrations of SF_6. In the case of field blanks, the source bags contained UHP Nitrogen. For field controls, the source bags contained calibration standards of known concentrations. The comparison of the analysis of these samples to the true concentration values provides an indication of how well the sampling process performed in the field.

During field deployment, some of the results from the Super PIGS field control QC samplers were sub-standard compared with those collected using the PIGS. On the other hand, Super PIGS field sample results looked very good in comparison to their neighboring PIGS samplers. Adding to the confusion was the observation that the results from duplicate or collocated Super PIGS samplers were very similar and exhibited none of the problems observed in the field blanks and field controls. We became aware of the discrepancy immediately after the first IOP and proceeded to examine the samplers for mechanical problems. We also conducted Super PIGS operational tests periodically as time permitted throughout the rest of the study. The designer of the samplers flew to Oklahoma City for several days to help with this process. Several defects were found and repaired, but these failed to solve the problem with the QC samples. The time constraints imposed by the schedule of IOPs during the field study simply prevented us from doing more intensive testing required to more fully identify the problems. To meet the schedule of the field study, we had no choice but to continue sampling and assume that we could resolve or at the very least, quantify the problems later.

Since the study ended, we have conducted 14 tests with the Super PIGS plastic samplers. All the tests were done using a test box. Samplers were placed on the ground, as seen in the photo, then a sturdy insulated cover was placed on top. A fan was run during all tests to ensure that the air was homogenous. These tests looked at QC sampler handling methods, the effect of elevated temperatures on the samplers, the effect of humidity on the samplers, the effect of holding times, the effect of high concentrations of SF_6 on field blanks, and direct comparisons of PIGS and Super PIGS in controlled concentrations of SF_6. The intent of these studies was to determine what was wrong with the QC samplers and how it affected the data collected with the samplers.

During our testing, we discovered that two of the samplers used for QC purposes during the field experiment were assembled incorrectly. The inlet tubing to the sample pump inside the sampler was not connected. This was likely the result of a manufacturing process defect. Thus, these two samplers really did not sample from the source bags as intended. When the analyzed sample data from these two samplers were removed from the QC database, the overall results improved greatly and showed reasonable values of Method Limit of Detection (MLOD) and Method Limit of Quantitation (MLOQ). However, MLOD and MLOQ were still much higher than those calculated for the old PIGS. Following the discovery of the missing tubing in the two QC samplers, all remaining Super PIGS samplers were also inspected and none were found to have the manufacturing defect.

Figure 2. Sampler test box.

Although the missing inlet tubing was the major problem identified to have caused the poor Super PIGS field QC performance in two samplers , we discovered several other minor problems with the Super PIGS during our testing. For example, we found that all

Super PIGS samples tracked very well and were extremely comparable to their PIGS counterparts, but there were indications of some minor leakage into bags from the outside air when the cartridge was connected to the sampler. Diffusion of SF out of the bags during storage was observed to be significantly higher than those of the old cardboard PIGS and can be a significant factor when samples are stored for more than a week–something that did not occur in Oklahoma City. The results of the holding time studies on the Super PIGS and the PIGS showed that the concentration in the bags for the Super PIGS does not change enough to move out of standard QC limits for up to one week after collection and the concentration in bags for the PIGS shows no measurable change up to three weeks after collection. All samples were analyzed within four days after collection for the JUT 2003 study therefore, the data was not compromised due to holding time issues. None of these effects appear to be large enough to significantly reduce the usability of the JUT field data. Still, we will attempt to quantify the discrepancies so that the reported MLOD and MLOQ values for the Super PIGS accurately reflect the true quality of the field data collected during JUT.

While performing the tests on the Super PIGS, it was discovered that after the PIGS are exposed to a concentration over 20,000 ppt during sampling of one bag, later sampling bags show higher concentrations instead of an accurate reflection of background levels. At this time it is unknown if this is an artifact of the way in which our tests were conducted in an artificial release environment, or if this is indeed a field related issue. We are now extracting all the PIGS data points, graphing them and running programs to pick out small deviations in the data that might give a better indication of this possible error. If this is found to be an issue, we may need to raise the PIGS MLOD and MLOQ slightly to compensate for this carryover.

We hope to be finished conducting the required experiments very soon and to be able to make the necessary calculations on expected errors. Once the MLOD and MLOQ can be set, we can begin the process of setting data flags and generating final output data files. (Roger@noaa.inel.gov, Debbie@noaa.inel.gov)

Rain In Cumulus over the Ocean (RICO)

The NSF Observing Facilities Advisory Panel (OFAP) met on October 13 to consider a request to deploy the University of Wyoming King Air and 95 GHz cloud radar to Antigua in winter 2004/2005 in support of the RICO project. The request for the King Air, submitted jointly by NOAA/ARL, University of Wyoming, and organizers of RICO, was approved. We are presently awaiting a decision from the NSF physical meteorology division for support of a proposal submitted in July to participate in RICO. (Jeff.French@noaa.gov)

Smart Balloon

Several 6.597 inch inside diameter by 6.667 inch outside diameter by 10 inch long fiberglass cylinders have been received from our fiberglass filament winding contractor, Janco Composites. Some of these tubes will be used to prototype and test different subsystem layouts inside the transponder tube/enclosure. If prototyping and testing are successful, the remaining tubes will be used for further lab testing, flight tests and actual deployment in field experiments during 2004. A

mechanism for centering and holding the fiberglass end cap in place during the assembly is being developed and tested at this time. (Randy.Johnson@noaa.gov)

BRACE

An oral and a poster special session covering results of the Bay Region Atmospheric Chemistry Experiment (BRACE) Intensive Field Program will be held at the Fall American Geophysical Union Meeting December 8-12 in San Francisco. The goal of BRACE was to improve our understanding of atmospheric nitrogen deposition to Tampa Bay. Tampa Bay is one of the most important Gulf Coast estuaries. There has been a reduction of 72 per cent in the sea grass coverage in the bay over the last 70 years caused by anthropogenic nitrogen inputs. Twenty-nine per cent of this nitrogen input is estimated to come from direct atmospheric deposition. BRACE was executed during the month of May, 2002, and involved more than 50 researchers from 12 Federal and State agencies and universities. ARL scientists flew over 80 hours on the NOAA Twin Otter making chemical and meteorological measurements in conjunction with ground-based flux and deposition measurements, and will test models against the measurements. The BRACE AGU special sessions will present the results of the experiment and promote cooperation, collaboration, and interdisciplinary connections between interested researchers and institutions involved in the program. The sessions will consist of 8 talks and 11 posters with the following ARL authors: Winston Luke, Richard Artz, Robin Dennis, Tilden Meyers, and Tom Watson (Tom.Watson@noaa.gov).

Cooperative Research with INEEL

Emergency Operations Center (EOC)

INEEL Emergency Response Organization requalification training sessions were held in October. Every FRD employee who is involved in emergency operations attended one of the sessions where the policies and procedures governing emergency response operations were reviewed. FRD has four teams who rotate assignments to the EOC. Training sessions were held on October 2 (Team C); October 9 (Team D); October 16 (Team A); and October 23 (Team B).

INEEL Support

The FCC is requiring all Federal Agencies to switch to narrow banding for radio communications by January 1, 2005. In response to this requirement FRD is in the process of switching to a new RF telemetry system. This will require new radios and new communications software. We are in the process of implementing and testing new hardware and software from Campbell Scientific. The old RTMS system will be replaced by a product called LoggerNet.
We have discovered our current version of LoggerNet (ver 2.1b) does not support table-based communications, which is our current implementation with RTMS. The alternative is to use Telcom to retrieve the data, but this can take up to 30 minutes to poll all stations, which is an unacceptably long collection period. The table-based approach takes less than 5 minutes. CSI is promising a table based system by January or February 2004. We are anxiously waiting to see if

the next revision will fill our needs. (Brad Reese@noaa.gov)

Other Activities

FRD Retreat

On October 7, FRD staff retreated to the conference room to hold a day-long review and brain-storming session. Bruce Hicks participated as guest speaker via telephone at the beginning of the meeting, which set the tone for the rest of the day. The retreat agenda continued with discussions on past achievements in the areas of DOE support, tracer technology, and aircraft research capabilities. Concerns about each of our major capabilities were discussed, solutions for many of those concerns were determined, and assignments were subsequently made to appropriate staff members. The employee association also provided a delicious lunch for the division. (Kirk.Clawson@noaa.gov and staff)

NAERS

The second international workshop for the Network of Airborne Environmental Research Scientists (NAERS) was held in Trento, Italy, on October 20-22**.** The inaugural meeting was held in Idaho Falls in January, 2002 with FRD as host. The NAERS group contains over 35 members from ten countries and four continents operating more than twelve SERAs for atmospheric research. The second workshop had in attendance 25 members, nine of whom did not attend the first workshop. NAERS scientists formed this working group to discuss issues unique to SERA operations, to cooperate in the use of SERAs and airborne instrumentation, and to promote the use of SERAs as viable options to investigating difficult environmental issues.

ARL once again played a key role in the organization of the workshop. A total of seven presentations were given by ARL staff at the meeting. Six sessions during the two-day workshop covered topics ranging from individual members' programs to sensors and instrumentation to software development. Reports of data collected from SERAs were presented by various groups, illustrating the wide scope of problems the platforms are used to investigate. Ongoing collaborations within the group continue to pay dividends to all

Figure 3. NAERS workshop attendees at Trento, Italy..

members. Discussions have lead to refinements in both data system software and processing algorithms, a better understanding of the physics of our instrumentation, including the first significant results from wind tunnel tests of the BAT probe, and continued evolution of our instrument development capability. The third workshop is tentatively scheduled for Spring 2005. (Jeff.French@noaa.gov)

Figure 4. NAERS session in progress.

ARL Dispersion Modeling System

ARL has been developing a laboratory-wide dispersion modeling system that is flexible enough for various applications at the various divisions. One issue that has come up is a desire to assimilate data from a variety of observation platforms and update the wind and turbulence fields based on these observations. Dugway Proving Ground (DPG) in Utah is using a data assimilation system developed by a group called 4DWX (http://www.4dwx.org). FRD staff visited DPG in late October to see how their system works. It is based on rapid updates of the MM5 mesoscale model. They assimilate data from several different sources, including their own tower network, MesoWest, satellite-derived winds, and commercial aircraft (ACARS). Every three hours MM5 is restarted and nudged using the real-world meteorological data that have come in since the last update. The model is cold started only once per week using output from the Eta model. Thereafter, it is warm started using its own output. DPG uses four nested grids, with the highest resolution grid having a 1.1 km spacing. One issue with adapting something like the 4DWX system to ARL use is that it may require significant computer resources. DPG is using a 32-node Linux cluster, and are upgrading to a 64-node cluster. (Richard.Eckman@noaa.gov and Kirk Clawson)

Safety

The safety video, “Holiday Safety, At the Top of Your List” was shown at the monthly meeting. (Debbie@noaa.inel.gov)

Deputy Director

Thomas B. Watson was appointed Deputy Director of the Field Research Division on October 29. The previous Deputy Director, Kirk Clawson, was appointed FRD Director in June and the Deputy Director position has been vacant since then. Dr. Watson is a research chemist and has been with FRD since 1992.

Travel

Jeff French, October 18 to October 26, to Trento, Italy, for the Second Network of Airborne Environmental Research Scientists (NAERS) Workshop.

Kirk Clawson and Rick Eckman, October 20, to Dugway Proving Grounds, Utah, to discuss dispersion and transport modeling and return equipment.