FRD Activities Report
June 2001

Research Programs

CBLAST-Low

The LongEZ research aircraft and its suite of *in situ* and remote sensors are in final preparation for the upcoming Coupled Boundary Layer Air-Sea Transfer (CBLAST-Low) light-wind research pilot study which will be conducted in Martha's Vineyard, Massachusetts, from July 20 to August 10, 2001. Following are summaries of the progress made over the last month on hardware and software modifications. A project description is available at http://www.noaa.inel.gov/projects/cblast/. (Jerry.Crescenti@noaa.gov, Jeff French, and Tim Crawford)

Laser Altimeter Array

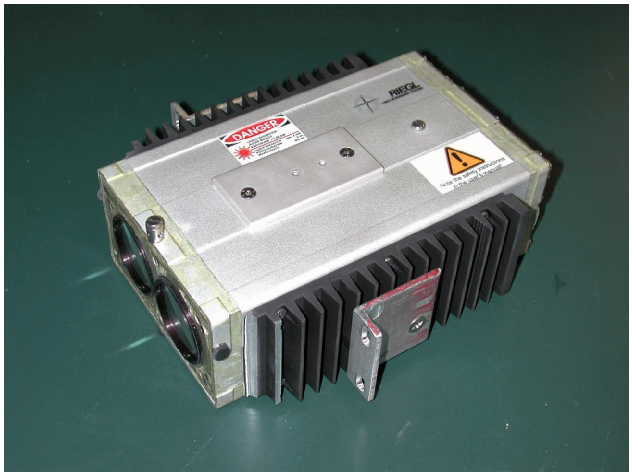

Figure 1. The new ultra-fast 12-KHz laser altimeter to be used in CBLAST on the LongEZ.

In previous air-sea interaction research studies, the LongEZ has carried three high speed (2-KHz) laser altimeters. These sensors form an equilateral triangular array 0.9 m on each side. The data acquired by this array has been used to quantify sea surface long waves (> 1 m) which include height, frequency, phase, and speed. A fourth laser has been added to this array to further improve longwave quantification. A new ultra-fast (12-KHz) laser altimeter has arrived at FRD (Figure 1) which is six times faster than the original three sensors. This new laser will be placed in the nose cone of the instrument pod to improve 1-D wave spectra fidelity. The data storage frequency on the three-element laser array has also been increased from 50 Hz to 150Hz. This will improve fidelity of the 2-D amplitude, wave number and direction spectra by a factor of three. The original laser which resided in the nose cone of the instrument pod has been moved to under the left wing of the LongEZ. This laser is oriented at an angle of 15° from vertical. This oblique angle laser will "look" at the texture of very short capillary waves under very light wind conditions to quantify "slick" surface fraction. Finally, a fifth slow response laser altimeter has also been added to the LongEZ as a supplemental altitude reference for the autopilot system. This laser will allow precise flight altitudes to be flown. This is critical to understanding the stable marine atmospheric boundary layer which tends to be very stratified. Thus, better altitude control will reduce the variance in turbulent flux measurements.

Global Positioning Systems (GPS)

For the first time, we will have a fully integrated dual-frequency differential carrier-phase global positioning system (GPS) on the LongEZ. This Ashtech GPS marks a dramatic improvement over the previous single-frequency system used in prior air-sea interaction field studies. Fixed position and velocity information will be acquired at a rate of 5 Hz and extended to 50 Hz with fast-response accelerometers. The new GPS hardware improves position accuracy to a few millimeters and velocity accuracy to better than 2 cm s^{-1}. In addition, many of the GPS antenna cables required enhanced shielding in order to minimize any radio frequency interference problems with the Ashtech dual-frequency system. Software modifications are also complete for the new Ashtech ground station computer used for differential corrections. These data are collected at a rate of 5 Hz while the LongEZ is in flight and are used to differentially correct the aircraft GPS data. Finally, a new self-survey and line bias calibration was conducted with the TANS Vector GPS system. These procedures allows the TANS to determine aircraft attitude (i.e., pitch, roll, and heading) to ±0.05° at 10 Hz. Like the Ashtech GPS data, the aircraft attitude data determined by the TANS is also extended to 50 Hz with accelerometers.

Infrared Sea Surface Temperature (SST) Sensor

The difference between air and sea surface temperature is one factor that controls heat flux. The Everest 4000.4GXL infrared surface temperature sensor, now insulated and temperature-controlled at a constant value of 30 °C, has been moved from its traditional location in the strake of the LongEZ to the nose cone of the instrument pod. This was done to make extra room for an additional laser altimeter. With these modifications, we are confident that this infrared sensor will be able to acquire sea surface temperature to an accuracy of better than 0.25 °C.

Radar Scatterometers

The 36-GHz Ka-band radar scatterometer (developed by Doug Vandemark of NASA) has been "repackaged" and delivered to FRD. Electronics for the new 96-GHz Ku-band radar scatterometer are still being developed; however, they are expected to be ready for the CBLAST-Low pilot study. The Ku-band antenna has been incorporated into a fiberglass mount (Figure 2) and will be mounted beneath the fuselage of the LongEZ just forward of the instrument pod.

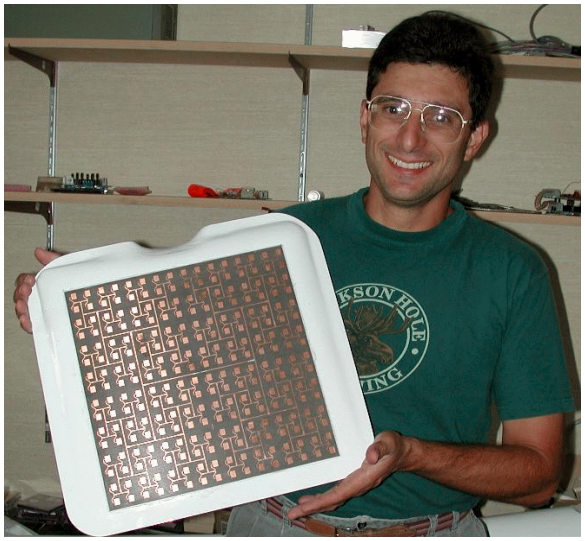

Figure 2. Jerry Crescenti holding the new Ku-band antenna which has been mounted into a fiberglass plate.

Infrared Gas Analyzer (IRGA)

Measurement of latent heat and carbon dioxide flux depends on accurate high-frequency water vapor and carbon dioxide observations. Data acquired by the infrared gas analyzer (IRGA) exhibited a 2-Hz

voltage increase and decrease of ~ 0.5 volt about the baseline of the signal. After testing of the instrument and data acquisition system, it was learned that the power supply was injecting a small, but not insignificant AC voltage signal over the 15 volt DC power to the sensor. The power supply has been repaired. Data from subsequent test flights has shown the IRGA to reliably acquire water vapor data.

LongEZ Test Flight

A test flight of the LongEZ and its instrument suite was conducted on June 15. With the exception of a couple of minor problems, the data acquisition system and all of the sensors worked flawlessly. At least two more test flights are anticipated in early July before deploying for the CBLAST-Low pilot field study.

Model Validation Program (MVP)

Processing of the MVP Session 4 Long-EZ data was completed in June. The final data set contains 23 different flights. These data have been sent to ATDD in Oak Ridge for archiving on the MVP server. The one remaining task with the MVP Session 4 data set is to write a data report. There is a good chance that this will end the FRD involvement in the MVP. Overall, funding for the MVP is winding down. The Air Force is searching for additional funding to keep it going, but current indications are not promising. One reason for declining interest within the Air Force is that they are developing a new generation of rockets that are supposed to produce less toxic effluent than current rockets such as the Titan IV. (Richard.Eckman@noaa.gov)

Tracer Technology

We are continuing our efforts to improve our tracer measurement technology. Our existing continuous SF_6 analyzers have always had a baseline drift problem which appeared to be related to instrument temperature. This required careful environmental control during field experiments. We have now isolated the problem to the Electron Capture Detector and the electronics packaged with it. The instrument baseline tracks the temperature of these very well. Since these are both housed in a closed aluminum box, they tend to change temperature slowly, so the problem appears as slow baseline drifts. We are currently experimenting with ventilating the box or temperature controlling it to reduce this problem. (Roger.Carter@noaa.gov, Shane Beard)

We are also investigating new technology for tracer measurements. With support from the Army, we will be working with the scientists from the INEEL to examine the feasibility of using Ion Mobility Spectrometry to detect SF_6 and perfluorocarbons. (Roger.Carter@noaa.gov)

VTMX/URBAN 2000

Work continues at a slower pace to complete our responsibility to the sponsors. The SF_6 release mechanism data, stationary SF_6 sampler data, mobile real-time SF_6 analyzer data, radar profiler data, sodar data, and tower meteorological data have all been submitted to the VTMX/URBAN database and web site. The only data remaining to be submitted are the tower sonic anemometer data, which

is now in the quality control phase. (Kirk.Clawson@noaa.gov and Neil Hukari)

Cooperative Research with INEEL

INEEL Funding

Funding for FRD's support to the INEEL was finally obtained after months of working to complete the agreement. Although a cut in funding was received for our regular duties, additional funds were obtained for other projects that offset the base funding cuts. We also received notice that the INEEL is slated for a 17 per cent congressional funding reduction and that all cooperating agencies and contractors will face an across the board cut. In the interim, work is underway to write a new Interagency Agreement with new work and safety requirements that will be acceptable to both DOE and NOAA. (Kirk.Clawson@noaa.gov, Tim Crawford, and Paula Fee)

INEEL Transport and Dispersion Modeling

Additional discussions were held with INEEL personnel in June regarding the maximum ground-level concentrations that can be expected from a proposed effluent stack at the site. For surface releases, the "worst-case" dispersion scenario is usually associated with stable conditions and light winds. However, the stack in question is expected to produce a plume with an effective centerline height of nearly 300 m. Close in to the source, standard Gaussian modeling for such a plume actually gives the highest ground-level concentrations under unstable conditions rather than stable conditions. The reason for this is that the stable stratification keeps the plume from reaching the ground close to the stack, even though the centerline concentrations are high. A two-page memo outlining these issues was sent to INEEL. (Richard.Eckman@noaa.gov)

INEEL Mesoscale Modeling

With the MM5 forecasts for Southeast Idaho now running on a daily basis at FRD, focus is shifting to upgrading the output graphics and integrating the output into other aspects of the INEEL support, such as the dispersion modeling. A series of MM5 animations are available on the FRD web site at http://www.noaa.inel.gov/frd/Personnel/Rick/MM5/, but there has been no public link to these images during the development stages of the FRD modeling effort. A public link will be added in the near future under the "Weather" menu of FRD's main web page. Some investigations are also being made into providing some enhanced graphics, possibly including some 3D visualization. One possibility being investigated is a software library called The Visualization Toolkit, which provides some advanced 3D visualization techniques for fluid flow. (Richard.Eckman@noaa.gov)

Other Activities

Safety

FRD's safety officer worked with NRC and Idaho Department of Environmental Quality to dispose of used tritium foils from the trace gas analyzers (TGA's) that were refurbished. A NOAA Corporate Assessment Team teleconference focused on budgetary issues concerning assessment visits, training

for NOAA personnel to perform assessment visits, and findings from the NOAA Environmental Compliance and Safety Assessment System (NECSAS) visit. (debbie@noaa.inel.gov)

Proposals

A proposal entitled, "Air velocity measurements on the WB-57F during CRYSTAL-FACE" was submitted for consideration to NASA. The proposal seeks two years of funding to instrument the NASA high altitude jet for wind measurements. If funding is approved, we will be part of a larger effort to determine the microphysical and dynamic character of tropical cirrus clouds and their effects on the earth's radiation balance. (jeff.french@noaa.gov and Timothy Crawford)

A new CASES proposal is being written together with Dr. Carmen Nappo at ATDD for submission to the Army Research Office. The original CASES-99 funding obtained by ARL supported the field deployment and some data postprocessing, but did not leave much for data analysis and interpretation. The new proposal involves using the existing CASES-99 data set to investigate intermittent turbulence episodes in the stable boundary layer and to look at the importance of gravity waves in creating these turbulence episodes. (Richard.Eckman@noaa.gov, Carmen Nappo, ATDD)

Papers

Crawford, T. L., J. R. French, G. H. Crescenti, and D. C. Vandemark, 2001: Atmospheric turbulence and ocean surface wave field measurements with a small environmental research aircraft. Proc., *Fifth International Airborne Remote Sensing Conference and Exhibition*, San Francisco, CA, Sep. 17-20, Veridian Systems International, *abstract submitted*.

Crescenti, G. H., J. R. French, T. L. Crawford, and D. C. Vandemark, 2002: An integrated airborne measurement system for the determination of atmospheric turbulence and ocean surface wave field properties. Preprint, *Sixth Symposium on Integrated Observing Systems*, Orlando, FL, Jan. 13-17, Amer. Meteor. Soc., *abstract submitted*.

Air Quality Research Subcommittee of the Committee on Environment and Natural Resources (CENR) (Thomas B. Watson, Subcommittee member representing NOAA). *Intercontinental Transport of Air Pollution: Relationship to North American Air Quality, A Review of Federal Research and Future Needs.* April 2001.

Papers Reviewed

Leclerc, M. Y., N. Meskhidze, and D. Finn, 2001: Experimental validation of flux footprint predictions over a rough canopy of intermediate roughness. *J. Geophys. Res., submitted, reviewed by Jerry Crescenti*.

Travel

Roger Carter traveled to the UDMWG meeting in Salt Lake City, Utah, on June 20 to discuss possibilities for using IMS for atmospheric tracer measurements.

Training

Debbie Lacroix attended the “Conference for Women 2001" on June 13-14. The conference entailed discussions of ways that women in the workforce can balance career and family. Topics focused on career enhancement, organizational skills, ways to handle stress and money related issues.

Visitors

Andrew T. Jessup and Michael L. Welch of the Applied Physics Laboratory of the University of Washington visited FRD on June 28 to test their infrared and visible camera systems on the LongEZ for the upcoming CBLAST-Low pilot field study.