FRD Activities Report
November 2000

Research Programs

Refractive Turbulence Study

Flights to test the re-designed Fast, Ultra-Sensitive Temperature (FUST) probe (See October Monthly Report) were conducted in November around Idaho Falls (Fig. 1). Goals for these flights were to test the temperature and frequency response of the new design in preparation for a second round of flights for the High-Altitude Refractive Turbulence Study (RTS00-2) to be conducted in Idaho Falls, winter 2000/2001. Preliminary results indicate that the two greatest problems with the original design have been alleviated. The original FUST probe did not respond well to high frequency fluctuations, due in part to the probe housing. The second generation probe utilizes an open-air design, eliminating any contamination of the air stream due to heat conduction from the walls of the housing. Results from flights in August also indicated that the original probe suffered from noise contamination, severely reducing the resolution of the probe. For the most recent test flights, spectra taken from straight and level legs reveal the new probe responds to temperature fluctuations out to at least 20 Hz. This is even more encouraging given the rather

Fig. 1. View from the cockpit of the LongEZ aircraft from a test flight in November. The FUST probe is located on the left, mounted to the BAT. The IRGA is located to right of the BAT. The picture is taken at 1800 ft., looking NE with the Grand Teton in the background.

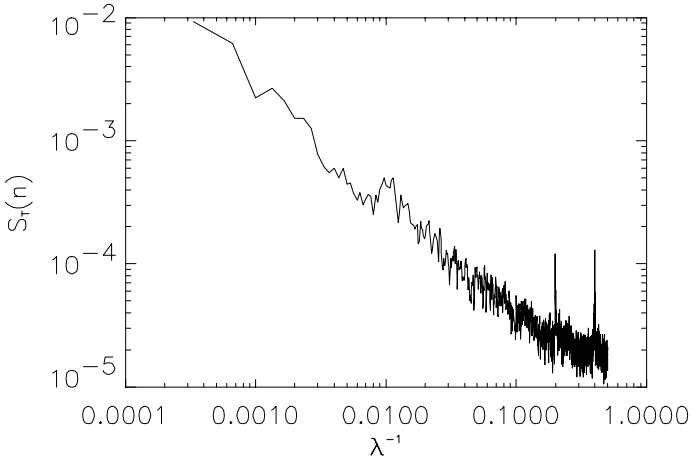

Fig. 2. FUST wavenumber spectra from a 18,000 foot level pass.

weak signal encountered at the 18,000 feet flight altitude. Further tests will be conducted to determine the recovery factor for the probe as well the investigating frequency response under conditions of both stronger and weaker signal (Jeff.French@noaa.gov, Tim Crawford, Shane Beard, Randy Johnson).

Extreme Turbulence (ET) Probe

The 16 inch diameter prototype fiber glass ET Probe sphere is complete (see Fig. 3) with the necessary physical and electronics mounting hardware. The previously completed and tested electronic transducer board and data acquisition system are mounted inside with the pneumatic connections to the pressure transducers on the electronics board. A ribbon cable connects the transducer board to the Data Translation data acquisition module. Two way data flow and power to the data acquisition module are provided via a small USB cable from a notebook computer. A small diaphragm pump in conjunction with a miniature flow splitter provide back-flow air of a few cubic centimeters per minute through each of the 30 pressure ports on the sphere. The back flow air will keep each of the ports clear of water and small debris that would affect pressure port measurements (Tim.Crawford@noaa.gov, Randy Johnson, Eric Egan, Jerry Crescenti).

Fig. 3. Eric Egan displays the prototype ET probe after installation of sensors, data system and pneumatics.

VTMX-CBNP 2000

The field deployment phase of VTMX-CBNP 2000 has come to an end. However, remnants of the study can still be seen around FRD. The analysis of the whole-air bag samplers continued in November, and will be completed in early December. The age of the analysis equipment is evident in the failure of oven controllers to maintain proper column temperature and in the shape of the chromatograph signal. Initial results from the first 4 tests show that whole-air bag sample SF_6 concentrations were below 215,000 ppt. These high concentrations severely challenged the measurement capability of our systems, which are usually used for maximum concentrations 40 times lower. The real-time SF_6 analyzers are also aging. The standing current of the electron capture detector is about one-half its original strength. The detectors have been removed and returned to the manufacturer for reconditioning.

Kirk Clawson attended the quarterly meeting of CBNP participants and directors held at Lawrence Livermore National Laboratory. His presentation included a brief overview of FRD's field deployment efforts, initial results from the whole-air bags samples, and results from the analysis of the radar profiler, sodar, and meteorological tower data. (Kirk.Clawson@noaa.gov and staff)

A 10-m meteorological tower, phased-array Doppler sodar, and a 915-MHz radar wind profiler acquired more than 3-weeks of surface and upper-air meteorological data during the VTMX-CBNP 2000 field study from October 4 to October 27. These sensors were deployed in a open parking lot on the grounds of the Raging Waters entertainment complex (40 43.92' N, 111 55.65' W, elevation 1291 m). This site, about 5 km southwest of downtown Salt Lake City, was secured for the VTMX-CBNP 2000 field study.

A 10-m tower was installed for the measurement of wind speed, wind direction, air temperature, and relative humidity. All of these instruments worked exceptionally well during VTMX-CBNP 2000. The wind rose depicted in Figure 4 shows a predominately southeasterly wind flow at 10 m. A maxima is from the northwest which suggests a lake breeze flow that is typically found in the late afternoon. For the most part, wind speeds were generally less than 5 m s^{-1} during the study with very light winds (< 2 m s^{-1}) observed during the evening and early morning hours.

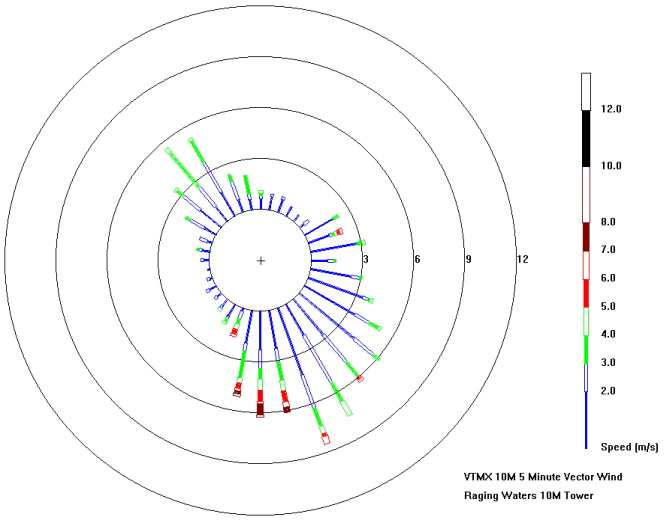

Fig. 4. Wind rose for Raging Waters tower.

The Doppler sodar was configured to acquire 15-min wind profiles from 40 to 300 m with a 10-m resolution. Contours of vector average wind speed are shown in a time/height plot in Fig. 5. Over the three-week period, a fairly persistent southeasterly wind of 3 to 4 m s^{-1} is observed by the sodar from the surface up to 300 m in the early morning hours prior to sunrise. A couple of hours after sunrise, the mean wind speed decreases to about 1 to 2 m s^{-1} and veer with time to a southerly flow by late morning to a southwesterly flow by early afternoon. As the day progresses, the winds continue to veer. A shallow northwesterly flow exists in the late afternoon to a height of about 80 to 90 m. These data suggest that this flow may be a weak lake breeze. Above 100 m in the late afternoon, the winds tend to be more westerly and less persistent. Winds tend to be very light and variable through 300 m for a couple of hours after sunset. However, the wind speeds quickly strengthen and become more organized out of the southeast after 2100 MDT. In fact, the data suggest the formation of a 5 m s^{-1} southeasterly jet between 250 and 300 m between 2200 MDT and midnight.

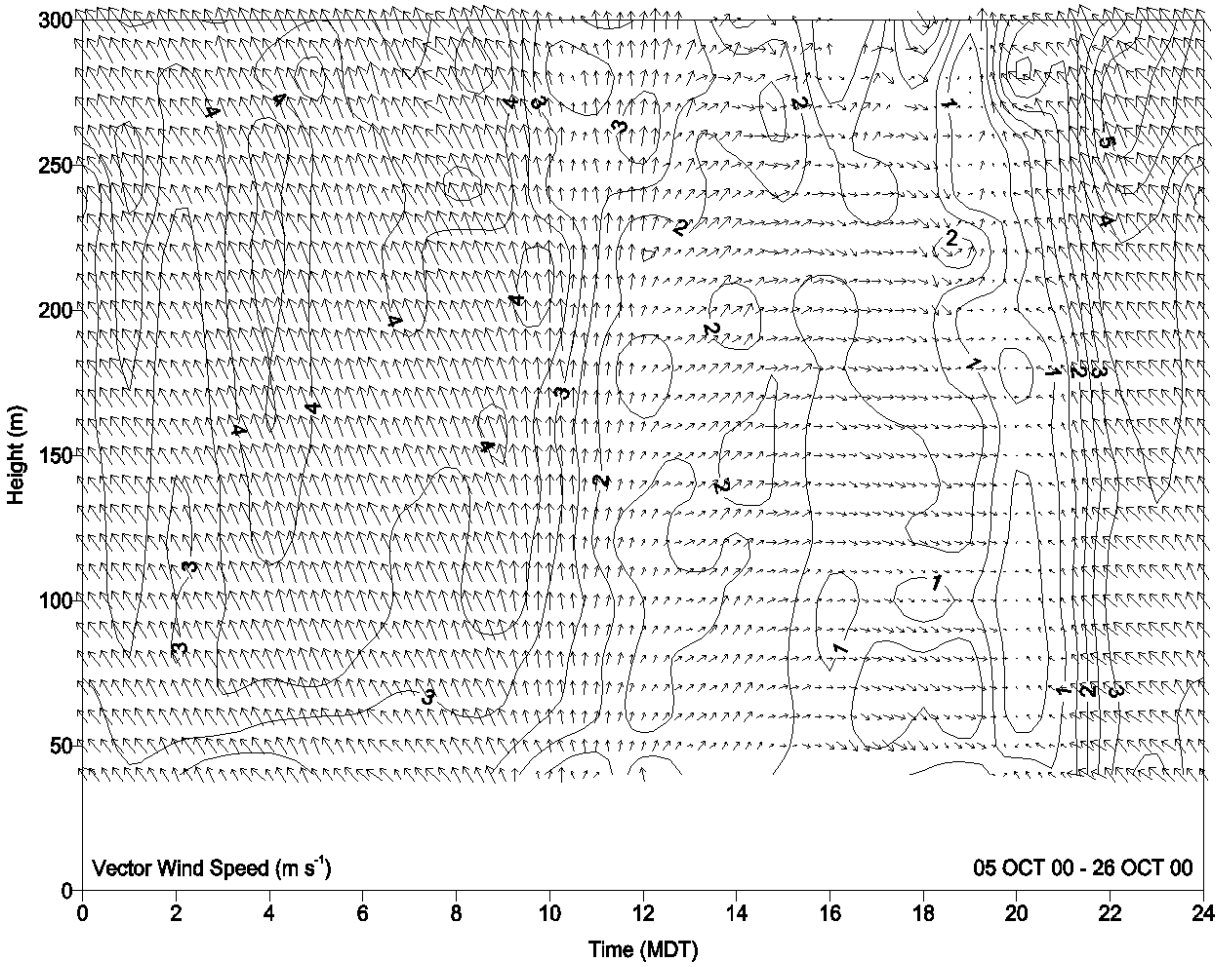

Fig. 5. Contour and vector time/height plot of averaged winds acquired by the sodar.

The radar was configured to acquire one-hour wind profiles in a dual mode. The first mode acquires high resolution data from 124 to 2158 m with a resolution of about 55 m. The second sampling mode acquires wind profile data from 172 to 3732 m with a resolution of about 96 m. Contours of vector average wind speed are shown in a time/height plot in Fig. 6 based on the high resolution (55 m) radar data. The radar data from 150 m to 300 m agree quite well with those acquired by the sodar. However, the radar data does not depict the 250 to 300 m jet observed by the sodar just prior to midnight. The radar data suggests that the lake breeze is approximately 400 m deep and is observed at Raging Waters for no more than a couple of hours. From 500 to 1000 m, the mean flow is predominately from the south for the entire day. The flow becomes more southwesterly and westerly above 1200 m. Missing data are found at the higher range gates because of the lack of sufficient turbulence to scatter the transmitted signal back to the radar.

Winds from 1800 to 3000 m (not shown) also are predominately from the southwest throughout much of the day. (Jerry.Crescenti@noaa.gov, Neil Hukari)

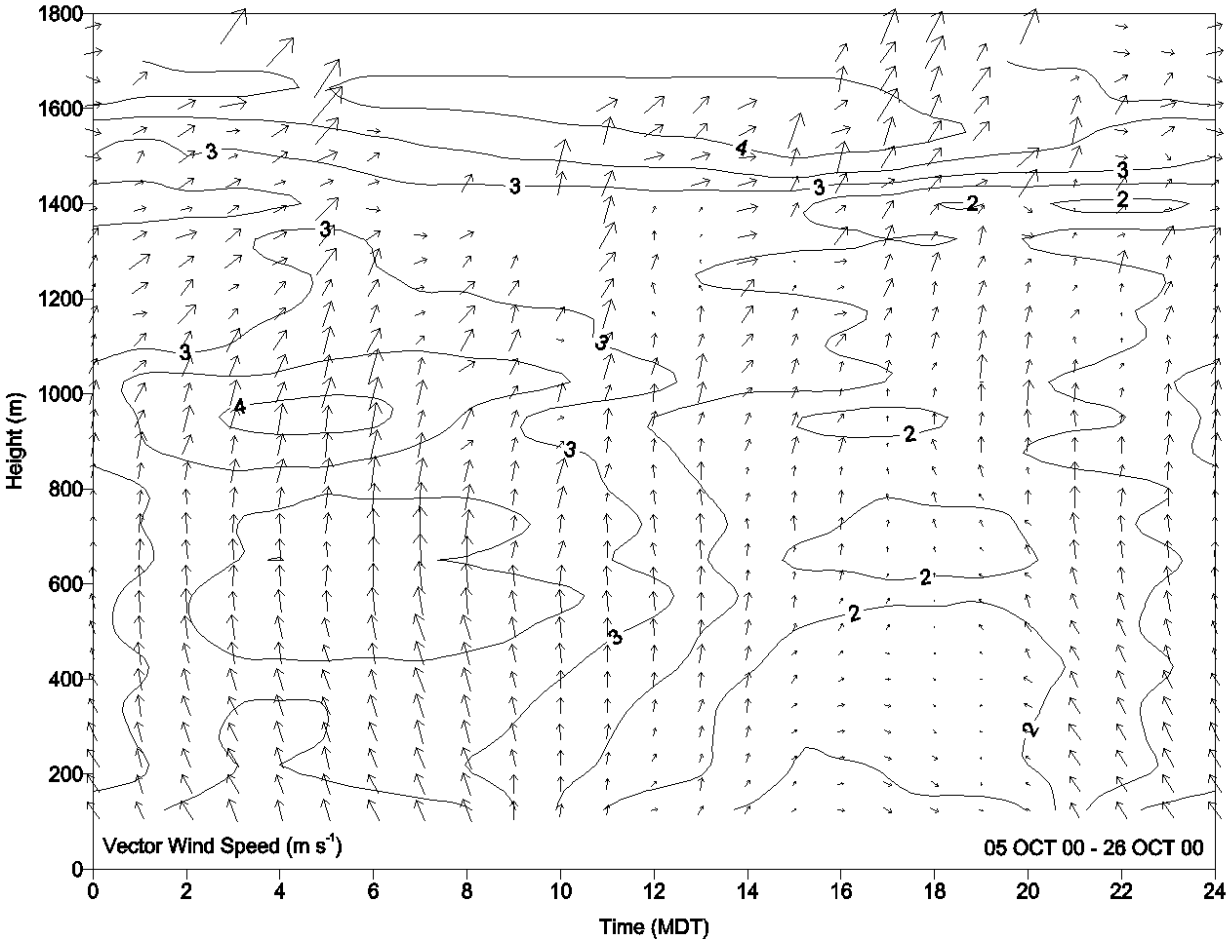

Fig. 6. Contour and vector time/height plot of average winds acquired by the radar.

Central California Ozone Study (CCOS)

All of the data acquired during the Central California Ozone Study (CCOS) has been put through quality control screens. This includes data from nine meteorological towers and wind profiles acquired by a 915-MHz radar wind profiler and Doppler sodar. The final data sets will be released to the California Air Resources Board (CARB) within the next few weeks. (Jerry.Crescenti@noaa.gov, Neil Hukari)

Cooperative Research with INEEL

INEEL Wildfire Modeling

Two staff members from FRD accompanied Bruce Hicks on a visit to the U. S. Forest Service Fire Sciences Laboratory in Missoula, Montana, on 2 November. Discussions were held with the Fire Lab staff on their research projects and on the possibility of collaborative research between the Fire Lab and ARL. (Richard.Eckman@noaa.gov, Tim Crawford)

INEEL Mesoscale Modeling

Some preliminary comparisons have been made between the MM5 simulations for Southeast Idaho and the meteorological observations from the INEEL Meosnet. The figure below, for example, shows a boxplot of the bias between the predicted and observed wind speeds for the first half of November 2000. Nineteen Mesonet towers are included in the comparison. The observed speeds are taken at about 15 m AGL, whereas the predicted speeds are from the lowest sigma level in the MM5 simulations, about 36 m AGL. A slight positive bias is observed in the early morning hours, which could be partly be explained by the greater height AGL of the model predictions. During the afternoon hours, the median model wind speeds are about 2 m/s less than the observations. The height difference between the observations and predictions works against the model in this case. The boxplot tends to confirm previous experience that MM5 tends to underestimate afternoon wind speeds in the Snake River Plain. Larger samples will of course be required before more statistically conclusive results can be obtained. (Richard.Eckman@noaa.gov)

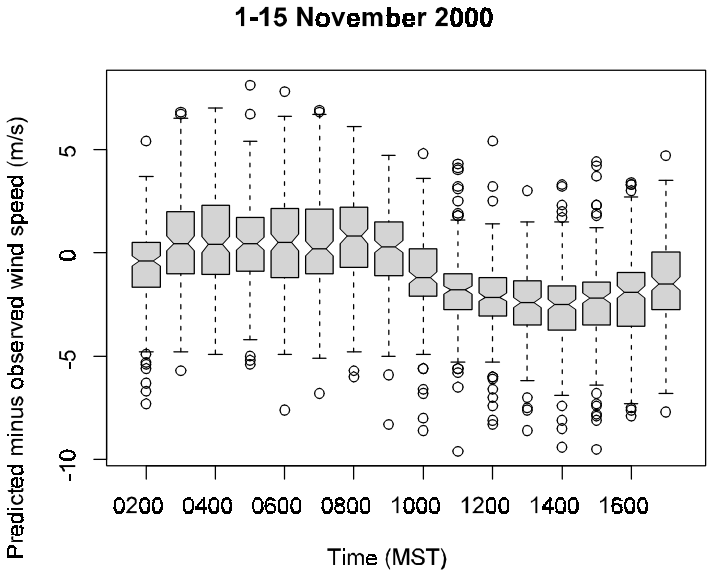

Fig. 7. Bias between predicted and observed wind speeds.

Other Activities

ARL Booth

Efforts are underway for the development of an ARL booth which will be in the exhibit hall during the 81st Annual Meeting of the American Meteorological Society (AMS) to be held from January 14-19, 2001 in Albuquerque, New Mexico. ARL technology will be the central theme to the booth. Exhibit props will include the Extreme Turbulence (ET) probe being jointly developed by FRD and ATDD, the LongEZ with an emphasis on the small environmental research aircraft (SERA) concept, and demonstrations of the READY model by HQ staff and Models-3 by ASMD. Barbara Shiflett has been asked to be the lead coordinator for this effort with input from the various ARL divisions. So far, these participants include Bruce Hicks, Kimberly Hill, Jerry Crescenti, Tim Crawford, Dennis Atkinson, Evelyn Poole-Kober. (Jerry.Crescenti@noaa.gov, Tim Crawford).

AMS Short Course on Instrumentation and Observations Techniques

Lecture notes have been finalized and submitted to the American Meteorological Society (AMS) for the upcoming one-day short course on the introduction to meteorological instruments and observations that will be held on January 14, 2001, in Albuquerque, New Mexico during the 81st Annual Meeting of the AMS. These slides and notes can be found on-line at http://measure.noaa.inel.gov/agenda.htm. The short course instructors include 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). In addition to these notes, several key EPA guidance documents are also being used in this short course. Several vendors have generously agreed to lend meteorological instrumentation to the short course for a "hands-on" experience. (Jerry.Crescenti@noaa.gov)

AMS Nomination for the Walter Orr Roberts Lecturer in Interdisciplinary Sciences

The AMS Measurements Committee, chaired by Jerry Crescenti, has submitted a nomination of Dr. Robert A. Weller (Woods Hole Oceanographic Institution) for the Walter Orr Roberts Lecturer in Interdisciplinary Sciences. The Walter Orr Roberts Lecturer in Interdisciplinary Sciences is selected in recognition of significant contributions to the understanding of atmospheric processes derived from multi-disciplinary research activities. The purpose of the lectureship is to foster interchange of knowledge between atmospheric scientists and persons in other disciplines. The lecture is presented at the AMS Annual Meeting or an appropriate specialized conference. The lecture is published in the *Bulletin of the AMS*. Previous lecturers include Richard C. J. Somerville (1999), Bruce B. Hicks (1998), Syukuro Manabe (1997), Duncan C. Blanchard (1996), Robert E. Dickinson (1995), and John E. Kutzbach (1991). (Jerry.Crescenti@noaa.gov)

AMS Nominations for the Measurements Committee

The AMS Measurements Committee, chaired by Jerry Crescenti, has submitted nominations for new members to join the group. They include John A. Augustine (NOAA / Air Resource Laboratory), Kevin R. Durkee (South Coast Air Quality Management District), Paul M. Fransioli (Science Applications International Corporation), Kenneth G. Wastrack (Tennessee Valley Authority), and Tammy M. Weckworth (NCAR). These nominations were forwarded to AMS STAC Commissioner Rick Rosen for approval. These five highly-qualified individuals will serve a three-year term on the Measurements Committee from January 31, 2001 to January 30, 2004. (Jerry.Crescenti@noaa.gov)

Proposals

Investigation of the Atmospheric Response to Cold land Processes Using Observations and Numerical Modeling by Jielun Sun, Gennaro H. Crescenti, Larry Mahrt, and Fei Chen, submitted to NASA Research Announcement NRA-00-OES-07, Global Water and Energy Cycle Research & Analysis Program.

Papers

Crescenti, G. H., N. F. Hukari, R. C. Johnson, T. W. Strong, and S. A. Beard, 2000: Data report: surface and upper-air meteorological data acquired during the Central California Ozone Study (CCOS). NOAA Data Report, OAR ARL, Silver Spring, MD, in preparation.

Travel

Tim Crawford, Rick Eckman, and Bruce Hicks visited the Fire Sciences Laboratory in Missoula, Montana on November 2, 2000.

Kirk Clawson visited Lawrence Livermore National Laboratory on November 13-15, 2000, to present a post-field deployment progress report to the directors of the Chemical and Biological Nonproliferation Program.

Jeff French and Tim Crawford attended ONR CBLAST-Hurricane planning meeting hosted by Peter Black (AOML/HRD) in Miami, FL Nov 28-29. During this meeting, plans were discussed to install an MFP system on a NOAA P3 to determine heat, moisture, and momentum fluxes in hurricanes.

Visitors

Bruce B. Hicks, Air Resources Laboratory Director, visited FRD November 1-2, 2000.