CSU FIRE II CIRRUS FIELD EXPERIMENT: DESCRIPTION OF FIELD DEPLOYMENT PHASE

By: S. Cox, G. Beck, C. Cornwall, J. Davis, P. Hein, C. Lappen, R. Song, J. Wothrow, and D. Wood
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

J. Alvarez
NASA/Langley Research Center
Hampton, VA 23665

P. Anikin
Russian Academy of Science
Institute of Atmospheric Physics
Moscow

FIRE Series No. 8

Funding Agencies: **National Aeronautics & Space Administration**
Office of Naval Research

Colorado State University

Department of Atmospheric Science

Paper No. 506

CSU FIRE II CIRRUS FIELD EXPERIMENT:

DESCRIPTION OF FIELD DEPLOYMENT PHASE

S. Cox, G. Beck, C. Cornwall, J. Davis, P. Hein,
C. Lappen, R. Song, J. Withrow, and D. Wood

Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

and

J. Alvarez

NASA/Langley Research Center
Hampton, VA 23665

and

P. Anikin

Russian Academy of Science
Institute of Atmospheric Physics
Moscow

August, 1992

FIRE Series No. 8

Atmospheric Science Paper No. 506

TABLE OF CONTENTS

LIST OF FIGURES

1.0 Experiment Site and Schedule

The Colorado State University surface observing systems described in this document were deployed at the Parsons' Kansas site during the FIRE II Cirrus Special Observing Period (SOP) from 13 November to 07 December 1991. The specific location of most of the CSU instrumentation was at a recreational area maintained by Kansas Gas and Electric Co.; this site was approximately eight miles east and two miles south of the town of Parsons. The geographical coordinates of this site are 37° 18 min. N. latitude and 95° 07 min. W. longitude; site elevation was 269 meters. In addition one surface meteorological and broadband flux observing site was maintained at the Tri City Airport which is approximately eighteen miles due west of Parsons (37° 20 min. N. latitude, 95° 30 min. 30 sec. W. longitude. Figure 1 presents a map of the locations of the CSU deployment sites.

At the main Parsons' site the instrumentation was located directly adjacent to and north of a recreational lake. Under most cirrus observing conditions, when the wind had a significant southerly component, the lake was upwind of the observing site.

Table 1 lists the measurements and observations collected during the experiment. These measurements may be grouped into five categories: Surface meteorology; infrared spectral and broadband measurements; solar spectral and broadband measurements; upper air measurements; and cloud measurements.

Table 2 presents a summary of observations collected at the Parsons site during the SOP. One should be aware that the wind profiler, the laser ceilometer, surface meteorology and surface broadband radiation instrumentation were operated on a continuous basis. All other systems were operated on an "on demand" basis when cloud conditions merited the collection of data.

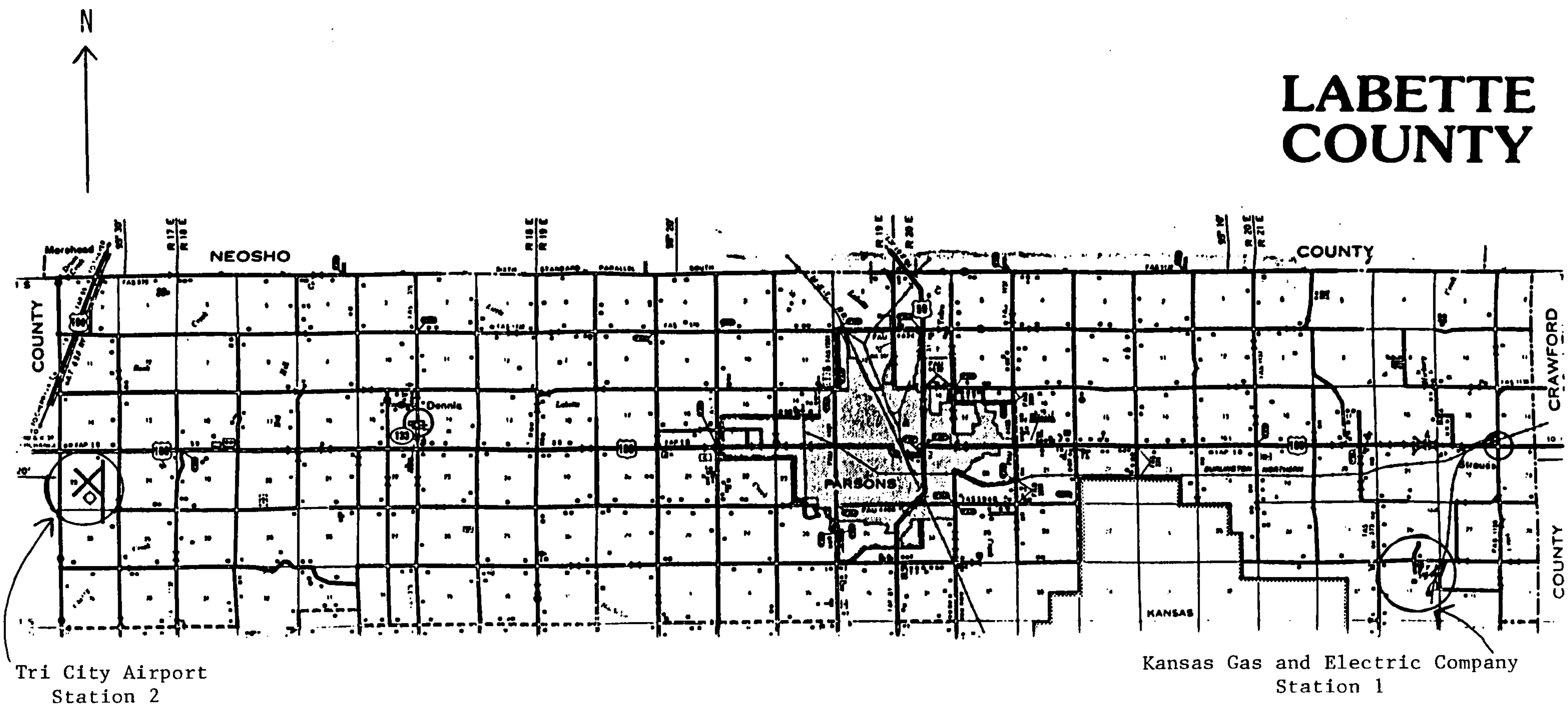


Figure 1: Map of the locations of CSU deployment sites.

Table 1 Instrumentation deployed at FIRE II Cirrus Parsons site.

Category	Instrumentation	Observed Variable
Surface Meteorology	Campbell Surface Station	T, T_d, u, v
Infrared Radiation	Pyrgeometer PRT-6 Interferometer	3-50 μm flux 11 μm radiance 5-15μm radiance
Solar Radiation	Pyranometer Pyrheliometer MFOV Sun Photometer	.3-2.8 μm flux .3-2.8 μm direct component .53 μm long pass filter .695 μm long pass filter 1.0 μm long pass filter .4-1.0 μm;5,10,20,28° FOV .38,.412,.5,.675,.862 μm
Upper Air	Radiotheodolite 403 MHz Wind Profiler RASS	P, T(p), T_d(p), u(p), v(p) u(z), v(z), w(z) T(z)
Cloud Measurements	Laser Ceilometer Video All Sky Camera Cloud lidar (Operated by Joe Alvarez, NASA Langley)	Cloud base height (z<7.58km) Cloud cover, cloud type Cloud base, thickness, Backscatter coefficient

Table 2

Summary of CSU FIRE II Data

CSU FIRE II - CIRRUS IFO 11 NOVEMBER 1991 - 8 DECEMBER 1991
Colorado State University, Parson's Site
Cirrus IFO II No.

Data Set	Nov																			Dec							
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8
Station 1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Station 2			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Station 3											x			x	x	x		x					x	x	x	x		
Wind Profiler/RASS		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Ceilo-meter	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Sky Camera					x		x	x		x	x	x	x			x	x	x	x					x	x	x	x	
Rawinsonde			2				1	4	2	3	4	4		2	4	3		1	1				1	3	4	4		
Other:																												
Interfero-meter			2				16	32		20	50	13	15	24		36		18					11	14	40	17		
PRT-6			x				x	x		x	x	x	x	x		x		x					x	x	x	x		

Table 2, Continued

Station 1 - (Power Plant in Parsons, Kansas)
- Air temperature
- Relative humidity
- Wind speed
- Wind direction
- Downwelling solar irradiance
- Downwelling near-infrared irradiance
- Downwelling infrared irradiance
- Direct solar radiance
- Direct filtered solar radiance

Station 2 - (Parsons - Tri City Airport)
- Air temperature
- Relative humidity
- Wind speed
- Wind direction
- Downwelling solar irradiance
- Downwelling near-infrared irradiance
- Downwelling infrared irradiance

Station 3 - (Power Plant in Parsons, Kansas)
- Sunphotometer
- Multiple field of view photometer

2.0 Surface Meteorology

2.1 Campbell Surface Station

The radiation and meteorological data collections employed data loggers from Campbell Scientific Inc. Each remote station was slightly different from the others in order to make use of the systems on hand.

Station 1 was located on a dyke approximately 120 feet South of the wind profiler location at the Parson's site. This system consisted of a Campbell CR10 data logger with an AM32 thirty-two-channel multiplexer to increase the number of effective input channels. The meteorological instruments consisted of an R.M. Young model 05103 wind monitor and a Campbell model 207 air temperature/relative humidity sensor. The radiation sensors included Eppley PSP pyranometers for hemispheric solar and near IR readings, an Eppley PIR pyrgeometer for hemispheric IR data, and two Eppley NIP pyrheliometers--one filtered, one unfiltered--for direct solar measurements. The hemispheric instruments were mounted looking upward from the h-frame support structure. The pyrheliometers were mounted on Licor solar trackers.

Station 2 was located at the Parsons Tri-City Airport, approximately 25 miles West of the profiler site. A Campbell CR21X data logger powered this system. The meteorological and hemispheric radiation sensors were the same as on Station 1. Measurements of the direct solar component were not made at this site.

Station 3 was used to collect sun photometer data. Another Campbell CR21X data logger received data from CSU's Multiple Field of View (MFOV) photometer, and from a Mainz Sunphotometer (model MZ II 585). Both photometers were also mounted on Licor solar trackers.

All stations collected instantaneous data at two-minute intervals. Station 3's data rate was occasionally increased for calibration and comparison purposes.

Data were downloaded from stations 1 and 3 each morning, and from station 2 every two days. The data were initially stored on 740 kbyte floppy disks in a comma-delineated ascii format. This data was archived to Exabyte tape from a 386 PC using the Novaback backup utility, and is also archived under the FIRE data account on the HP9000-730 workstation.

2.2 Temperature and Relative Humidity

Figure 2: Surface Instrument:
Lower left: Filtered and unfiltered pyrheliometer; Center: Model #207 temperature and relative humidity unit; Upper right: Wind speed and direction sensor.

The Campbell Model 207 unit measures temperature and relative humidity using two sensors combined into one probe. Separate CR7 input/output instructions are used to read each one. The probe was mounted on an H frame with a radiation shield.

The probe contains a Phys-Chemical Research PCRCII RH sensor and a Fenwal electronics UUT50J1 themistor configured for use with CSI's CR7 data logger.

The instruction used to read the temperature sensor provides a 4V AC excitation, makes a single ended measurement, and linearizes the result with a 5th order polynomial to output temperatures in °C.

The instruction used to read RH sensor provides a 3V AC excitation, makes a single ended measurements and linearizes the result with a fifth order polynomial to % RH. It performs the required temperature compensation before outputing the result.

The following are the linearization errors:

thermistor	
-40 to 56°C	≤ 1°C
-36 to 53°C	≤.5°C
-33 to 48°C	≤.1°C
RH sensor	
12 to 100%	≤3%
25 to 94%	≤1%

The temperature compensation for the relative humidity is given by:

$$RH = RH + .36(25-T)$$

where T - temperature of the air in deg C.

The accuracy of the measurements for the temperature sensor depend on a combination of Fenwal's interchangeability specification, precision of bridge resistors and linearization errors. The overall accuracy is ±.2°C.

The accuracy of the RH sensor is a combination of the RH chip, precision resistors, and linearization error. The overall accuracy is quoted as better than 5% in the range 12% to 100%.

For additional information on the data gathering system, data storage or data location, see section 2.1.

2.3 Wind Direction and Speed

Wind Speed Measurements:

Range	-	0 to 60 m/s (80 m/s gust survival)
Sensor	-	18 cm 4 blade helicoid propeller
Pitch	-	29.4 cm
Distance constant	-	2.7 m for 63% recovery
Threshold sensitivity	-	.9 m/s
Transducer output	-	100 mV p-p at 60 rpm 20 V p-p at 1200 rpm

Wind Direction Measurements:

Range	-	360° mechanical, 355° electrical
Sensor	-	Balanced vane 38 cm turning radius
Damping ratio	-	.25
Delay distance	-	1.3 m for 50% recovery
Threshold sensitivity	-	1 m/s at 10° displacement 1.5 m/s at 5° displacement
Transducer	-	.25% linearity-rated 1 watt at 40°C, 0 watts at 125°C

Wind speed and direction were monitored using a propeller anemometer manufactured by R. M. Young. The main housing, nose cone, propeller, tail, and internal parts are injection-molded, uv-stabilized plastic. The propeller rotation produces an AC sine wave signal with frequency proportional to wind speed. Three complete sine wave cycles are produced for each propeller revolution.

Vane position is transmitted by a 10K ohm precision conductive plastic potentiometer. The output signal is an analog voltage directly proportional to azimuth angle.

The monitor was mounted on an H frame stand and is calibrated before shipment. It requires no adjustments.

References:

Campbell Scientific, 1983: Model 207 Temperature and Relative Humidity Probe Instruction Manual.

21X Micrologger Instrumentation Manual. Revision: 21X.1M. Copyright, 1984. Campbell Scientific, Inc.

CR10 Measurement and Control Module Operations Manual. Revision: 11/88. Copyright 1986, 1988. Campbell Scientific, Inc.

R. M. Young Co., 1988: Wind and Temperature Instruments.

3.0 Infrared Radiation

3.1 Pyrgeometer

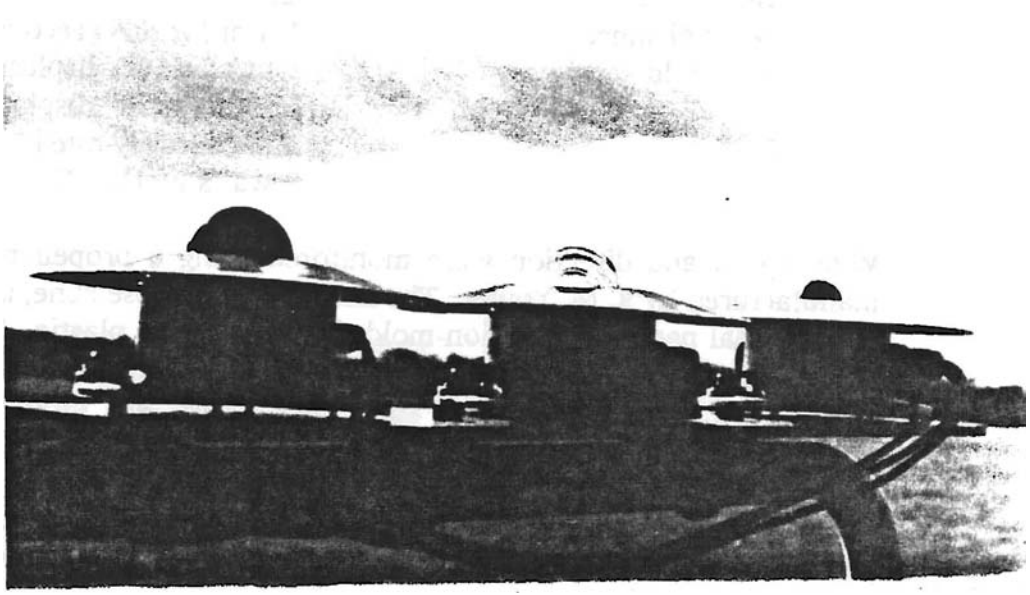


Figure 3: Surface irradiance sensors:
Left: .695-2.8 micrometer pyranometer; Center: .3-2.8 micrometer pyranometer; Far right: 3-50 micrometer pyrgeometer.

3.11 Instrument Description

The Eppley Precision Infrared Pyrgeometer measures irradiance in the 4-100μm spectral region of terrestrial radiation. It uses a blackened multi junction thermopile to create a voltage which ideally is linearly related to the net gain in radiant power. The thermopile is coated with Parsons black lacquer and emits like a black body at a temperature T. A thermistor is used to measure the sink temperature of the thermopile (see figure below).

This pyrgeometer achieves its aim by isolating the desired spectral region with a single dome of silicon used with an interference filter vacuum deposited on the inside of the dome.

3.12 Specifications

Sensitivity	-	5 μV/Watt/m^2
Impedence	-	700 ohms

Temperature Dependence	-	± 2% (-20° C to 40° C)
Linearity	-	± 1% (0 to 700 watts/m^2
Response Time	-	2 seconds
Cosine Response	-	< 5% from normalization (Insignificant for a diffuse source)

The orientation of the instrument has no effect on performance, but the accuracy of the instrument is very dependent on calibration which requires special care due to the dome-sink temperature differences.

3.13 Data Reduction

Using the reduction equations from Albrecht and Cox, 1976, the incident radiance, L, upon the pyrgeometer is given by the following equation.

$$L = K_1 E + \sigma \epsilon_o T_s^4 - K_2 \sigma (T_d^4 - T_s^4)$$

T_s	-	sink temperature
T_d	-	dome temperature
L	-	incident radiation
E	-	voltage

The constants K_1 and K_2 for the two stations are given below.

Station 1:	K_1 = -243.309	K_2 = 3.85
Station 2:	K_1 = -234.742	K_2 = 4.1

For any additional information concerning data gathering systems, data storage or data location, see section 2.1.

Data are archived at NCDS.

References:

Albrecht, B. A. and S. K. Cox, 1976: Pyrgeometer data reduction and calibration procedures. Department of Atmospheric Science, CSU, Paper No. 251, 1-16.

The Eppley Laboratory: An instrumentation for the measurement of the components of solar and terrestrial radiation.

3.2 PRT-6 Infrared Radiometer

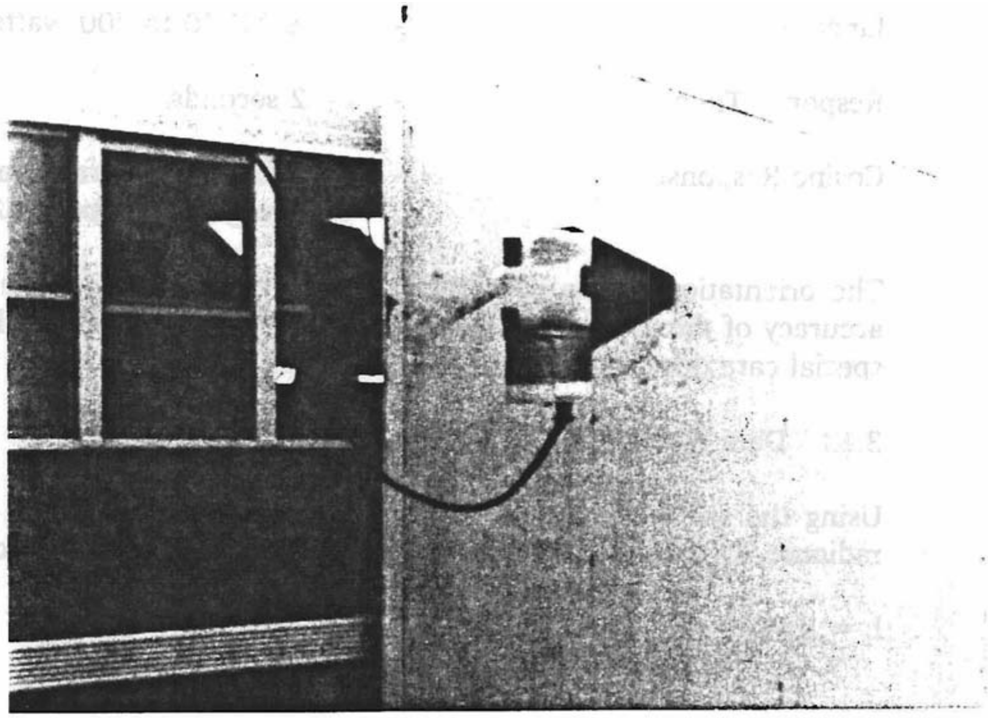


Figure 4: PRT-6 infrared bolometer (11 micrometers).

3.21 The Instrument and Its Purpose

The PRT-6 is an all-purpose chopped bolometer which can passively sense ambient infrared targets within the range of 2 to 20 microns. It can be deployed vertically or at any zenith angle orientation, and at a field of view of either 2 or 20 degrees. The output is a voltage signal, recorded every 5 seconds, which possesses a linear relationship to incident irradiance.

3.22 Capabilities and Specifications

Throughout the entire 1991 FIRE IFO Experiment the instrument was set at a field of view of 2 degrees and made use of a filter whose transmission curve is displayed in Figure 5. This filter effectively narrowed the spectral band to a range of about 885 to 945 inverse centimeters. Most of the measurements were made using a vertical orientation, although zenith angles of 15, 30, 45, 60, and 75 degrees were also utilized.

During the experiment an electrical attenuation component was sometimes added to the instrument to maintain the readings to within

-10 and 10 volts, the range of linearity. The resulting attenuation factor was 1.98 and its use or lack thereof is listed in the data file listing.

3.23 The Data

The data retrieval system used was a Campbell datalogger unit which stored the data in the format displayed in Table 3, where the parameters of each line reveal the date, the Z time in hours and minutes, seconds, and the output voltage reading, respectively.

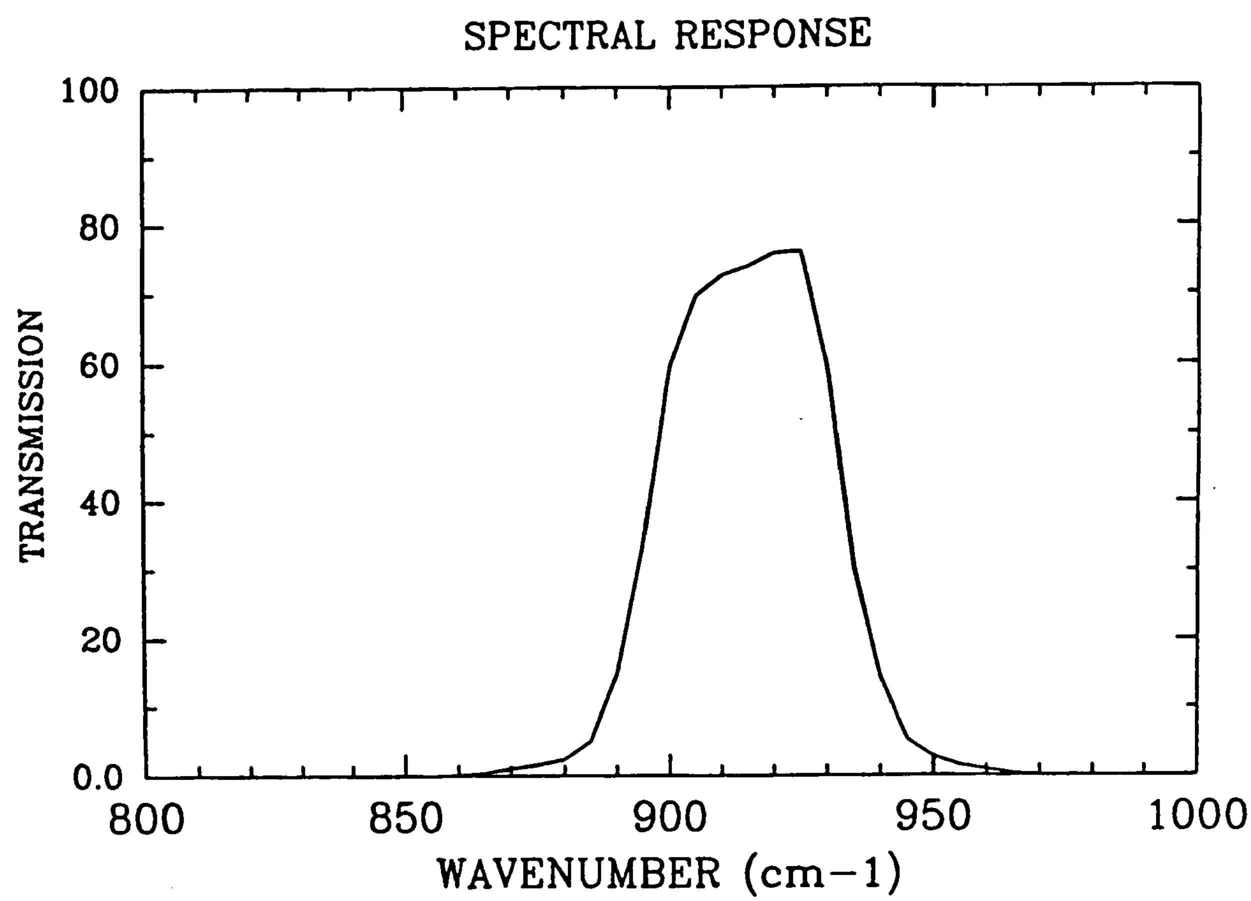


Figure 5: PRT-6 spectral response curve (Parsons deployment)

Table 3: Format of the PRT-6 data recorded in the datalogger. Although the format of the calibrated data is in a different form, both datasets can be accessed by the FORTRAN command "READ(*,*)".

Day No.	GMT Hrs., Mins.	Sec.	Voltage mv
204	2210	52	-1379
204	2210	57	-1383
204	2211	2	-1386
204	2211	7	-1389
204	2211	12	-1391
204	2211	17	-1392
204	2211	22	-1395
204	2211	27	-1397
204	2211	32	-1401
204	2211	37	-1404

The calibration efforts of the PRT-6 output voltages into radiance measurements has been twofold. One method involved the intercomparison of the data with corresponding interferometer data taken at the same time and zenith angle and integrated over the aforementioned spectral transmission curve. The other method involved the acquisition of additional data taken from reference blackbodies. The combined results of both efforts have resulted in the curve of Figure 6.

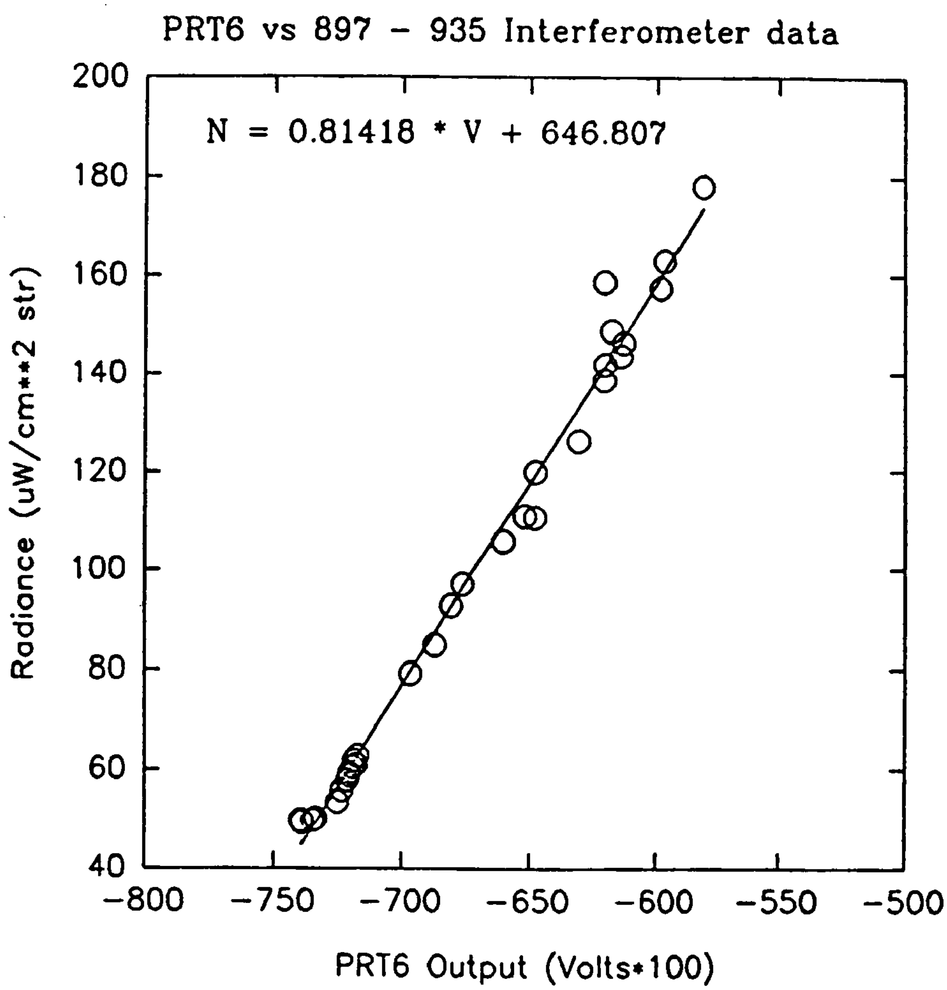


Figure 6: Calibration curve.

Raw voltage values may be reduced to radiance values by applying the following equation:

$$I = \left(\frac{V}{A}\right) \times 0.81418 + 646.80730$$

where I is given in microwatts per square centimeter per steradian, A is the attenuation coefficient of 1.98 (used when applicable), and V is the output voltage signal in volts. With this in mind the following data files are available, shown here with their respective filenames, dates and times, zenith angle orientations, and electrical attenuation usage:

Filenames	Start (UTC)	End (UTC)	Orientation	Att
no17p01.dat no17c01.dat	17 Nov 91 18:01	17 Nov 91 19:27	Vertical	No
no17p02.dat no17c02.dat	17 Nov 91 19:32	17 Nov 91 20:18	Vertical	No
no17p03.dat no17c03.dat	17 Nov 91 20:18	17 Nov 91 21:19	Vertical	No
no18p01.dat no18c01.dat	18 Nov 91 19:23	18 Nov 91 20:04	Vertical	No
no18p02.dat no18c02.dat	18 Nov 91 20:09	18 Nov 91 20:27	Vertical	No
no18p03.dat no18c03.dat	18 Nov 91 20:37	18 Nov 91 21:04	Vertical	No
no18p04.dat no18c04.dat	18 Nov 91 21:08	18 Nov 91 21:33	Vertical	No
no18p05.dat no18c05.dat	18 Nov 91 22:00	18 Nov 91 22:48	Vertical	No
no18p06.dat no18c06.dat	18 Nov 91 23:13	18 Nov 91 23:44	Vertical	No
no20p01.dat no20c01.dat	20 Nov 91 22:10	20 Nov 91 22:20	Vertical	No
no20p02.dat no20c02.dat	20 Nov 91 22:23	20 Nov 91 22:47	Variable	No
no20p03.dat no20c03.dat	20 Nov 91 22:52	20 Nov 91 23:55	Variable	No
no21p01.dat no21c01.dat	21 Nov 91 21:33	22 Nov 91 04:06	Vertical	No
no22p01.dat no22c01.dat	22 Nov 91 14:42	22 Nov 91 19:59	Vertical	No
no23p02.dat no23c02.dat	23 Nov 91 18:12	23 Nov 91 18:43	Vertical	Yes
no23p03.dat no23c03.dat	23 Nov 91 19:00	23 Nov 91 19:29	Vertical	Yes
no24p01.dat no24c01.dat	24 Nov 91 17:25	24 Nov 91 22:44	Variable	Yes
no24p02.dat no24c02.dat	24 Nov 91 22:54	25 Nov 91 02:43	Vertical	Yes
no26p01.dat no26c01.dat	26 Nov 91 14:20	26 Nov 91 19:18	Vertical	Yes
no26p02.dat no26c02.dat	26 Nov 91 19:18	26 Nov 91 23:45	Vertical	Yes
no28p01.dat no28c01.dat	28 Nov 91 15:42	28 Nov 91 22:15	Vertical	Yes
no29p01.dat no29c01.dat	29 Nov 91 14:34	29 Nov 91 17:33	Vertical	Yes
de03p01.dat de03c01.dat	03 Dec 91 19:50	03 Dec 91 20:34	Vertical	Yes
de03p02.dat de03c02.dat	03 Dec 91 21:15	03 Dec 91 22:05	Variable	Yes
de04p01.dat de04c01.dat	04 Dec 91 16:12	04 Dec 91 20:29	Vertical	Yes
de04p02.dat de04c02.dat	04 Dec 91 20:29	05 Dec 91 00:53	Vertical	Yes
de04p03.dat de04c03.dat	05 Dec 91 00:53	05 Dec 91 05:07	Vertical	Yes
de05p01.dat de05c01.dat	05 Dec 91 00:53	05 Dec 91 10:15	Vertical	Yes
de05p02.dat de05c02.dat	05 Dec 91 10:15	05 Dec 91 15:35	Vertical	Yes
de05p03.dat de05c03.dat	05 Dec 91 15:35	05 Dec 91 20:12	Vertical	Yes
de06p01.dat de06c01.dat	05 Dec 91 21:18	06 Dec 91 03:51	Vertical	Yes
de06p02.dat de06c02.dat	06 Dec 91 07:39	06 Dec 91 14:12	Vertical	Yes
de06p03.dat de06c03.dat	06 Dec 91 14:12	06 Dec 91 20:25	Vertical	Yes
de07p01.dat de07c01.dat	07 Dec 91 15:41	07 Dec 91 22:14	Vertical	Yes

where the respective filenames are for the uncalibrated and the calibrated data, and all dates and times are UTC. The variable zenith angle scans recorded on the third of December are unusual in that the respective sequence of zenith angles was 0, 15, 30, 50, 60, and 75 degrees. Data files are archived at Colorado State University.

trueno.atmos.colostate.edu
(129.82.107.109)

and the following directory:

/users/johnw/prt6

3.3 Infrared Interferometer

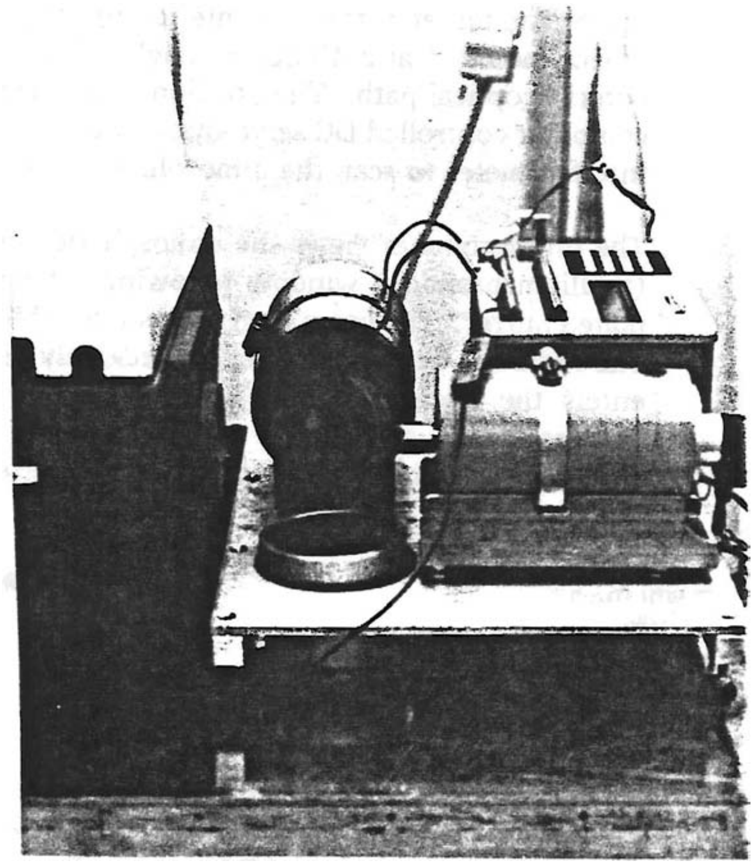


Figure 7: Infrared interferometer and calibration system.

3.31 Instrument Description

The instrument used in this experiment was a dual port emission interferometer manufactured by Bomem, Inc. It has an adjustable resolution ranging from 1 cm^{-1} to 128 cm^{-1}. FIRE data were taken with the interferometer at the 1 cm^{-1} resolution setting. The detector is liquid nitrogen cooled. The useful range of the detector is from 500 to 2000 cm^{-1}.

One port views a reference blackbody and is protected by a desiccant container. This reference blackbody is attached directly outside the second interferometer port and it consists of a thermoelectrically-heated copper element which is grooved and coated to improve the emissivity. The reference blackbody temperature is monitored by a small thermocouple which is located within ten thousandths of an inch beneath the surface of the coated side. A simple toggling and monitoring control loop on the thermoelectric element maintain the temperature of the reference blackbody to within 0.1 C.

Facing the target port of the interferometer is a rotatable gold-plated mirror mounted at a 45 degree angle with respect to the axis of the entering optical path. The position of this mirror is maintained by a computer controlled DC servo motor and control circuit, enabling the interferometer to scan the atmosphere at various zenith angles.

The interferometer views the atmospheric emission through a KRS5 (thallium bromide) window following reflection by rotatable gold-plated mirror. The beam then enters into a Michelson interferometer. The radiation from the reference blackbody in the reference port also enters the Michelson interferometer. This beam however is 180 degrees out of phase with the atmospheric emission beam which results in the generation of a difference interferogram at the detector module.

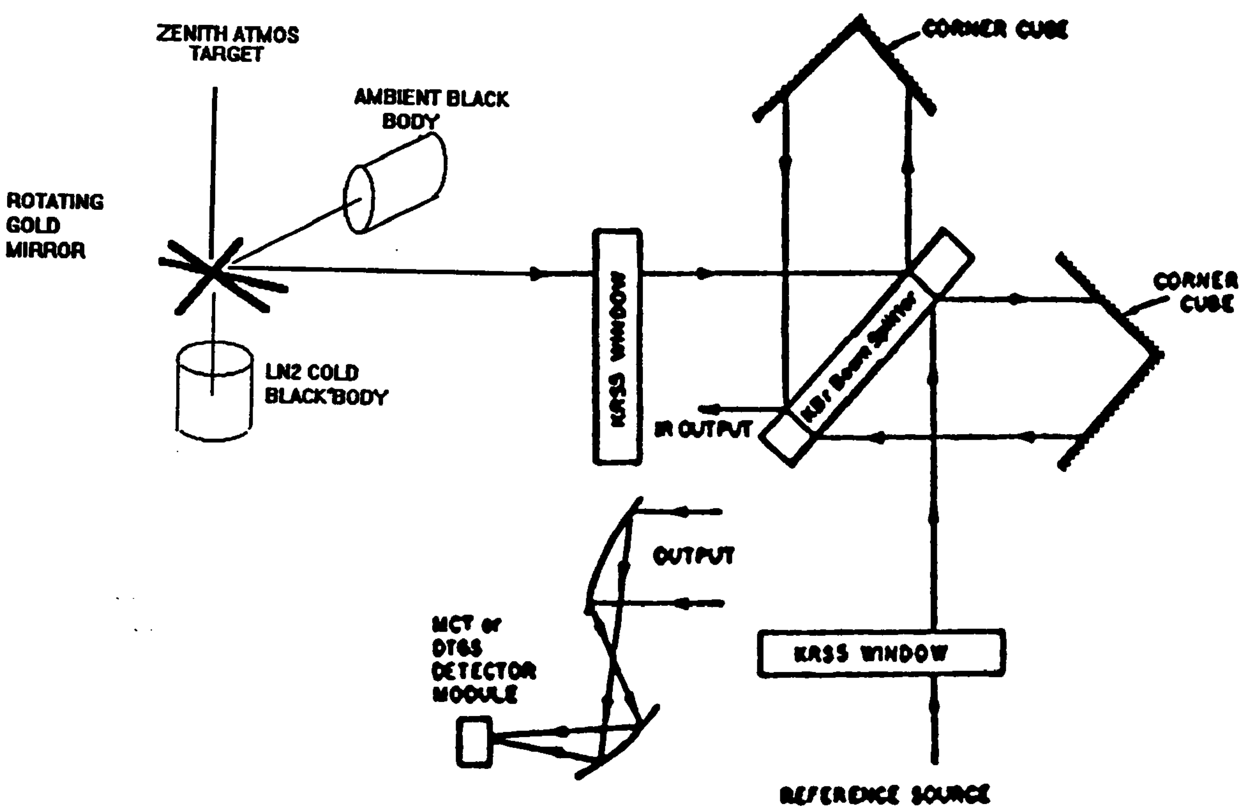


Figure 8. Schematic of the optical path of the dual port interferometer system.

3.32 Calibration and Measurement

3.321 Blackbody sources

Two blackbody sources are used to calibrate the interferometer. A cold blackbody source is a dewar of liquid nitrogen which is known to be at 77 K. The other blackbody used in the calibration is a warm blackbody source that is made out of copper. Its cavity is grooved and coated to insure a high surface emissivity. The copper blackbody is at the ambient air temperature; two small thermocouples located near the inner walls of the copper blackbody monitor the temperature. For the calibration of the instrument, it is necessary to record the emission at each wavenumber from each of the two blackbody sources. It is practical to use the liquid nitrogen since it is preferable that the two sources bracket the emission temperature of the atmospheric beam.

The mirror is controlled by PC software such that the interferometer views the liquid nitrogen followed by the copper blackbody and then the atmosphere in sequence.

3.322 Data Storage

One data collection cycle includes viewing the two blackbody sources and the atmosphere. In the FIRE experiment each cycle consisted of 20 interferometric scans for each mirror position which are co-added to reduce the noise of the measurement. This yields three interferograms. The temperatures of the reference blackbody, the warm and cold blackbody sources, and the ambient air are measured every 0.2 seconds. Every 100 temperature measurements are averaged and are then recorded at 20 second intervals on a CR21X Campbell datalogger. The temperature data are then downloaded to the PC which operates the interferometer. Each cycle takes slightly less than two minutes to complete, resulting in five temperature readings per object.

3.323 Brief Outline of Calibration Procedure

The data which are taken during each set of 20 scans by the interferometer is an interferogram. This may be written as:

$$F(x) = \frac{1}{2}\int_{-\infty}^{\infty} C_\nu \exp[i\phi(\nu)] \exp[i2\pi\nu x]\, d\nu \qquad (1)$$

This interferogram can be processed by Fourier transform to a difference spectrum. The uncalibrated spectrum in terms of radiances may be written as:

$$C_\nu = |\tilde{F}| = r_\nu (L_\nu + L_\nu^o) \qquad (2)$$

where:

x is the optical path delay
ν is the wavenumber in cm^{-1}
$\phi(\nu)$ is the phase response of the instrument
r_ν is the responsivity of the instrument
L_ν is the spectral emission
L^o_ν is the offset emission of the instrument

$\tilde{F}$ is the complex Fourier transform

Equation (2) shows the linear relationship between the uncalibrated spectrum and the spectral emission. The response of the detector and the offset are two unknowns to be derived from the calibration. These unknowns can be found from observing the cold and hot blackbody sources.

The responsivity of the interferometer may be written as:

$$r_\nu = (C_{h\nu}-C_{c\nu})/[B_\nu(T_h)-B_\nu(T_c)] \qquad (3)$$

and the offset required may be written as:

$$L_\nu^o = \frac{C_{h\nu}-C_{r\nu}}{r_\nu} - B_\nu(T_h) \qquad (4)$$

where B_ν (T) represents the Planck function, the subscripts h and c refer to the hot and cold blackbodies respectively, and r refers to the reference blackbody. Now, with the known detector response and offset required, the atmospheric emission can be found and may be written as:

$$L_\nu = \frac{C_\nu}{r_\nu} - L_\nu^{\circ} \qquad (5)$$

The interferograms are actually difference interferograms between the desired target and the reference blackbody, and since the reference blackbody temperature can be maintained to 0.1 C, the uncalibrated reference spectra ($C_{r\nu}$) subtracts out of equations (3) and (5). The calibration of the interferometer within the range of interest is within 2%.

Interferogram and calibrated spectra data are archived at Colorado State University in a compressed format on exabyte tape.

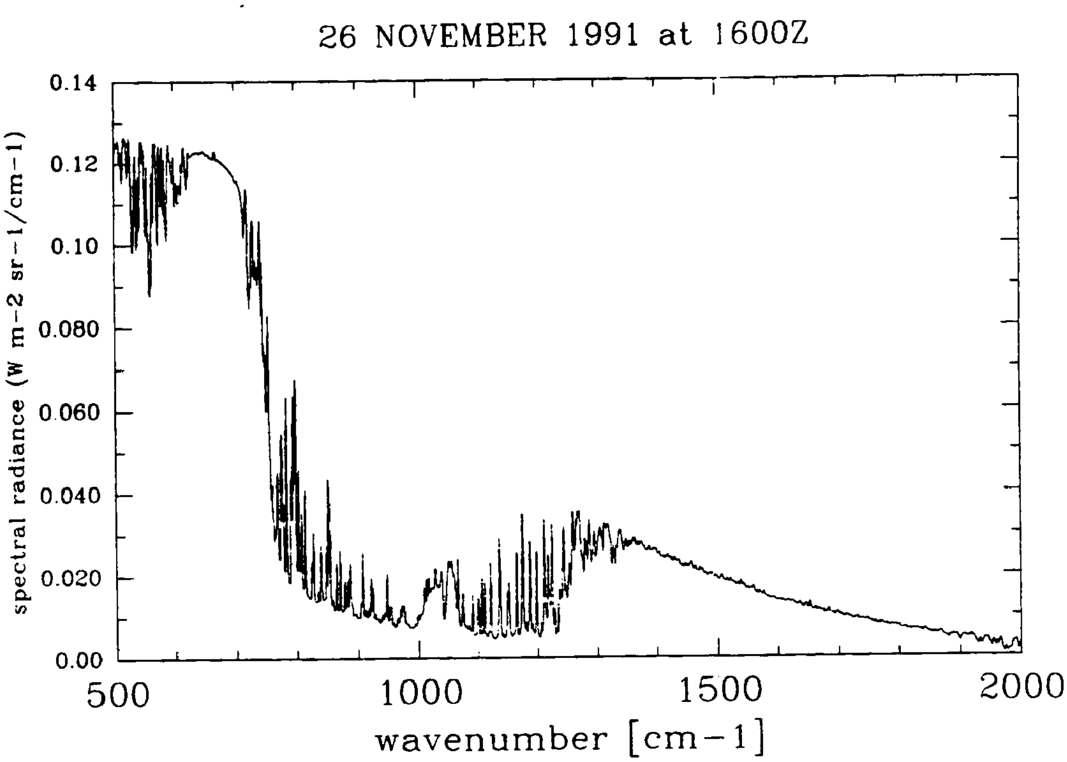


Figure 9a: Example of a clear sky infrared spectrum observed on Nov. 26, 1991.

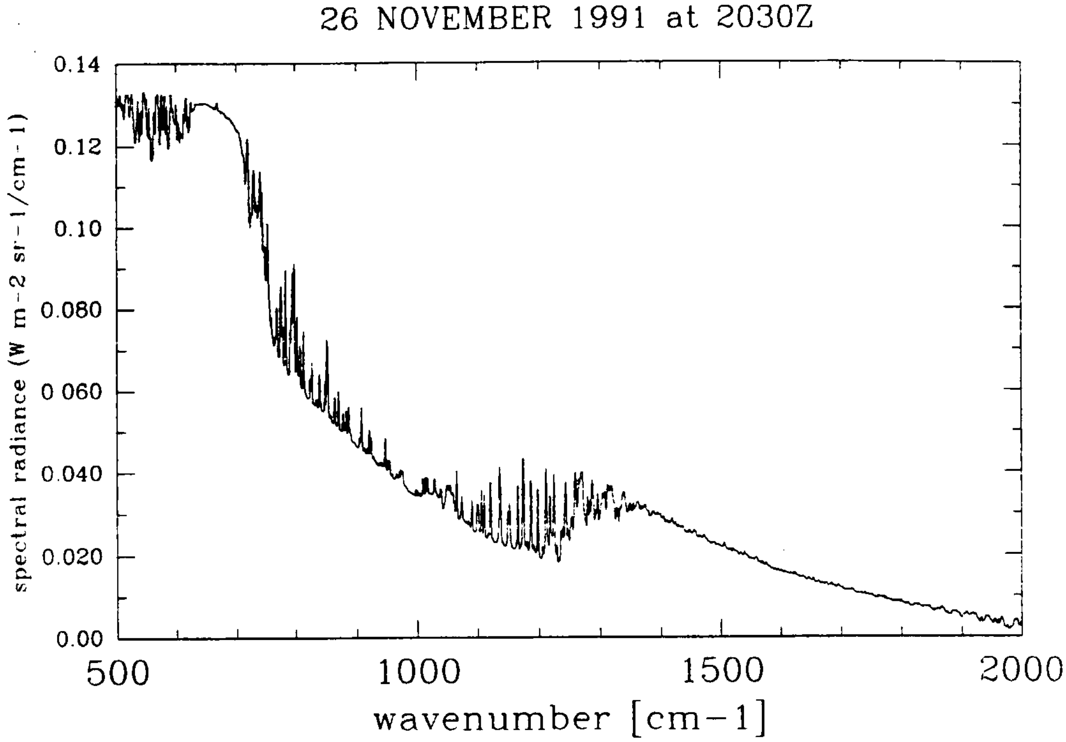


Figure 9b: Example of an infrared spectrum observed in the presence of cirrus clouds on Nov. 26, 1991.

References:

Revercomb, H. E., et al., 1988: Radiometric calibration of IR Fourier transform spectrometers: solution to a problem with the high-resolution interferometer sounder. *Applied Optics,* 15, 3210-3218.

4.0 Solar Radiation

(See Figure 3, section 3.1)

4.1 Pyranometer

4.11 Instrument Description

The Eppley Precision Spectra Pyranometer (PSP) measures shortwave radiation including the direct component of sunlight, the diffuse component, and reflection from natural surfaces.

It uses a multi junction thermopile blackened with Parsons black lacquer which is temperature compensated to give a response independent of ambient temperature.

The pyranometers used had a pair of concentric hemispheres of Schott optical glass precision ground and polished. The inner hemisphere on both pyranometers was WG7 clear glass transparent from .28 to 2.8 μm. On one pyranometer the outer dome was also WG7; the other used RG695 dark red glass transparent from .695 to 2.8 μm.

The accuracy of the PSP is typically 1%. It should be noted, calibrations could have a diurnal and annual cycle and may change with temperature.

4.12 Specifications

Sensitivity	~	9 μV/watt/m^2
Impedence	~	650 ohms
Temperature Dependence	~	± 1% over ambient temperature (20°C to 40°C)
Linearity	~	± .5% (0 to 2800 watt/m^2)
Response Time	~	1 second
Cosine Response	~	± 1% from normalization (0 to 70° zenith)

4.13 Data Reduction

The instruments used in these experiments were compared with secondary standards to establish calibration coefficients relating the voltage output of the instruments to the irradiance. The following calibration coefficients were obtained and compared with pyranometer calibrations at NOAA CMDL:

$H(w/m^2) = aV + b$	Slope $a(w\ m^{-2}\ mv^{-1})$	Y intercept $b(w\ m^{-2})$
Station 1 - WG7	117.246	-1.599
Station 1 - RG695	102.1832	-1.726
Station 2 - WG7	100.9247	-1.810
Station 2 - RG695	117.4345	-1.659

where V is the measured voltage output expressed in mv.

For additional information concerning the data gathering system and data storage see section 3.

Reference:

The Eppley Laboratory: Instrumentation for the Measurement of the Components of Solar and Terrestrial Radiation.

4.2 Pyrheliometer

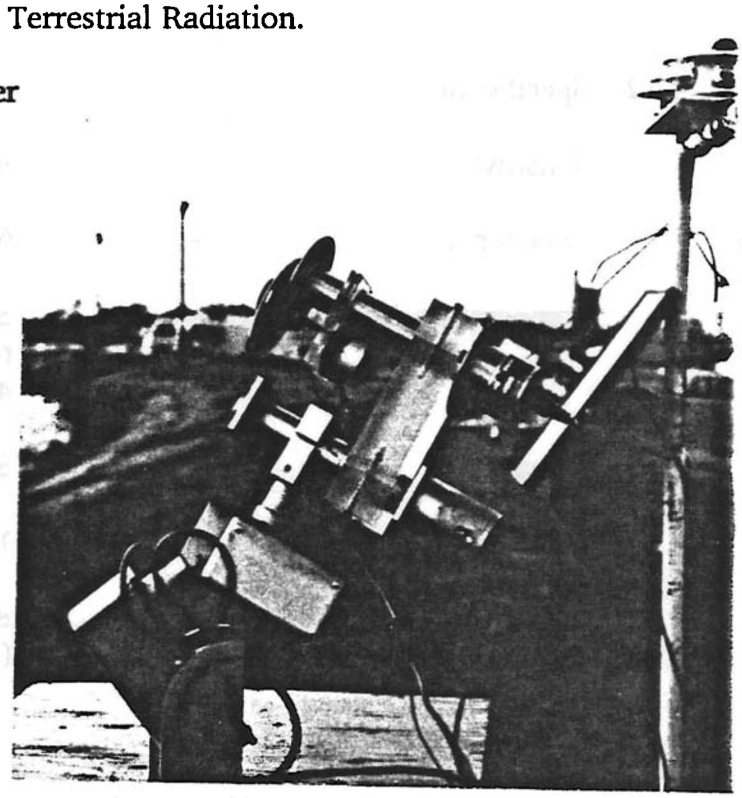


Figure 10: Filtered and unfiltered pyrheliometer (see also figure 2, section 2.2).

4.21 Instrument Description

The Eppley pyrheliometer measures the direct component of solar radiation along a surface perpendicular to solar beam.

The receiver is in the form of a thin 9 mm silver disc coated with Parsons optical black lacquer. Fifteen junctions of fine bismuth silver thermocouples are in thermal contact with, but electrically insulated from the lower surface of the disc. The cold junctions are in thermal contact with the copper tube of the instrument. A rotatable frame for three filters is provided. The receiver rotates allowing timed readings from each filter. The following filters were used:

Channel 1	Schott filter	.53 - 2.8 μm.
Channel 2	Schott filter	.695 - 2.8 μm.
Channel 3	Schott filter	1.0 - 2.8 μm.
Channel 4	Schott filter	.3 - 2.8 μm.

4.22 Specifications

Temperature Range	-	-20 to 40° C (1% accuracy is achieved by a special temperature compensation circuit.
Response Time	-	98% of maximum output is achieved in 20 seconds
Output	-	3.0-3.5 μv/cal/cm^2/min.
Internal Resistance	-	400 ohms at 25° C
Emf	-	8.8 2 x 10^{-6} volts/watt/m^2 (after comparisons with Eppley group reference standards under radiation intensities from 700 to 888 watt/m^2
Linearity	-	within .5% of the above intensity
Field of view	-	5° 43'

4.23 Data Reduction

Two pyrheliometers tracked the sun using a LICOR 2020 solar tracker. Pyrheliometer data were reduced using a linear relationship between voltage output and radiance. This reduction equation is of the form $N(w/m^2) = a * V(volts)$ where the constant a is 8.82E-06 w/m^{-2} $Volt^{-1}$ and 6.905E-06 w/m^{-2} $Volt^{-1}$ for pyrheliometers 1 and 2 respectively. The three filters were installed in pyrheliometer 1; the second pyrheliometer made observations in the channel 4 spectral bandpass only.

Data are archived at NCDS.

References:

The Eppley Laboratory: Instructions for the Installation of the Solar Tracker and Normal Incidence Pyrheliometer.

The Eppley Laboratory: Standardization of Eppley Pyrheliometer (Normal Incidence).

4.3 Multi Field of View Radiometer (MFOV)

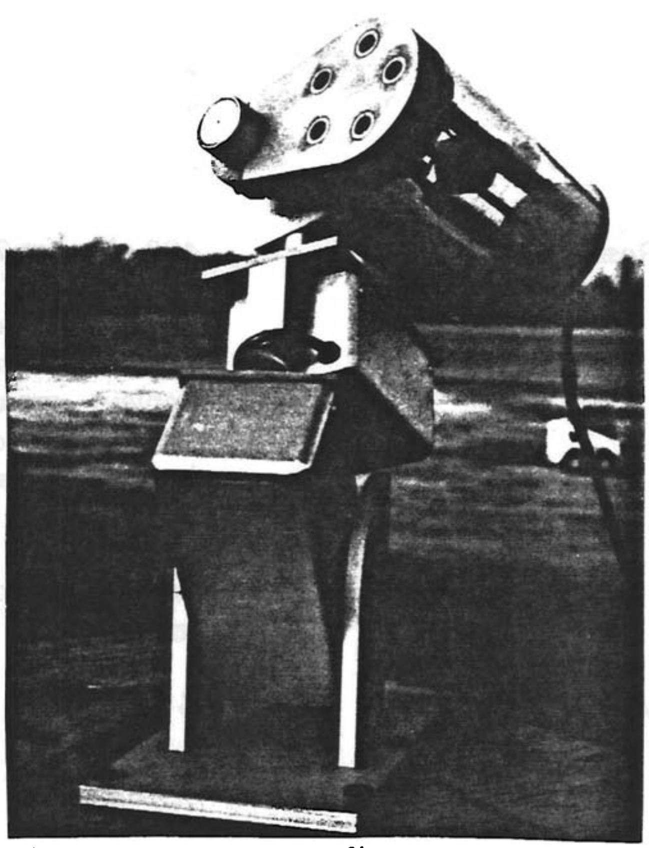


Figure 11: MFOV Radiometer

4.31 Instrument Description

From the MFOV measurements, one may infer the optical depth of clouds and gain some insight into the equivalent MIE size characteristics of the scattering medium. This is achieved by measuring the solar irradiance in five different fields of view centered on the solar disk.

The MFOV utilizes five silicon photodiodes (PV100A series) aligned along a common optical axis each collimated a different length to achieve five different full angle fields of view with a spectral bandpass .35 to 1.15 μm.

Field of View (degrees)	Length (mm)	Aperature Diameter (mm)
2°	144.8	2.5
5°	57.2	2.5
10°	29.2	2.5
20°	14.0	2.5
28°	10.2	2.5

4.32 Photodiode Specifications

The interior of the collimator is flat black to reduce scattering. The following are the characteristics of the PV100A photodiodes:

Active area	-	5.1 mm^2
Window thickness	-	1.3 mm
Window diameter	-	6.1 mm
Diode length (minus leads)	-	4.2 mm
Diode length (plus leads)	-	$<$ 24.2 mm

The MFOV tracks the sun with a LICOR microprocessor based solar tracker.

The accuracy of the measurements are dependent on instrument calibration. Calibrations were performed at CSU on October 23, 1991 for clear sky cases. Data during the experiments are used to confirm this calibration data.

For any additional information concerning the data gathering system, data storage, or data location.

Data are archieved at CSU on exabyte tape.

Reference:

Raschke, R. A. and S. K. Cox, 1982: The determination of cloud optical depth from multiple field of view pyrheliometric measurements. Department of Atmospheric Science, CSU, Paper No. 361, 1-14.

4.4 Sun Photometer

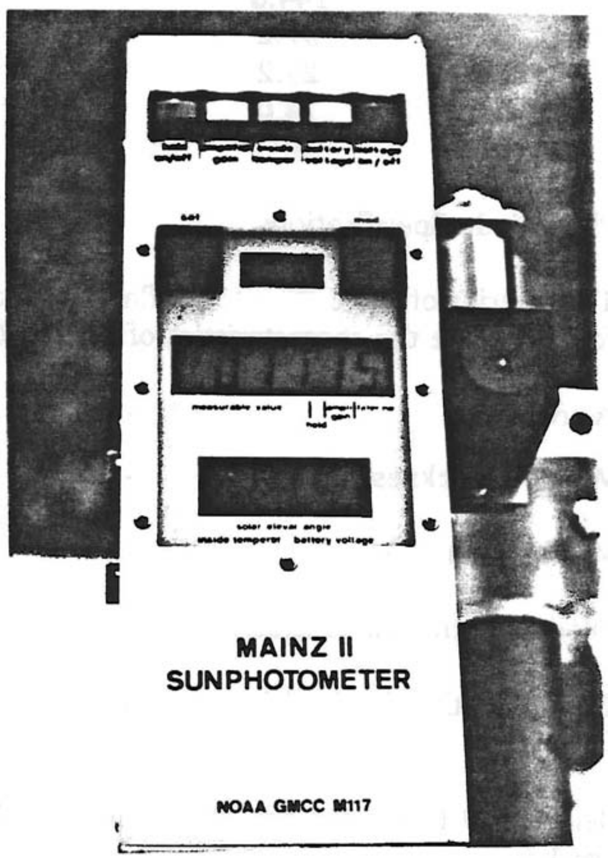


Figure 12: Tracking Sun Photometer

A MAINZ sunphotometer was deployed at the Parsons site in order to infer the optical thickness of cirrus clouds in the mid-visible portion of the solar spectrum. These data will also be used to provide calibration of the NASA lidar system. The photometer is not a completely weather proof instrument and was deployed only during times of interest (see table 2) and only when precipitation posed no threat to instrument integrity.

4.41 Instrument Description

The MAINZ sunphotometer, model MZ II, is a precision electro-optical device which was originally designed to estimate aerosol optical depth. It was designed to be hand held or tripod mounted, and its output signal can be read from an LCD display on the top panel of the instrument. Several features of the instrument pertain to a "stand alone" type of measurement. In its deployment at Parsons the output of the instrument was obtained from a 0.0 - 2.0 volt output jack on the instrument, and several of the features (such as a selectable signal amplification, elevation angle measurements and peak signal holding feature) were not pertinent to its operation and will not be discussed here.

The detector employed in the sunphotometer is an EG&G UV 100 BQ, which is a UV enhanced photodiode linear to within 1% for a range of incident irradiances spanning 7 decades. The dark current of the photodiode is 3 nA.

A diopter with a plano convex lens and a surface mirror images the sun on an opaque screen in order to assure proper alignment of the instrument.

A filter wheel allows the selection of 5 interference filters, although only the 0.500 μm filter was used for this deployment. Table 4 summarizes the instrument capabilities.

Table 4. Technical specifications of the MAINZ MZ II - 85 sunphotometer

Model	MAINZ MZ II - 85
Number of channels	5
Peak wavelength in μm	0.38, 0.412, 0.50, 0.675,0.862
Wavelength accuracy	± 0.001 μm
Bandwidth	0.002 - 0.005 μm
Transmission	15 - 50 %
Full field of view	2.2°
Slope angle	0.8°
Filter diameter	10 mm
Effective filter diameter	6 mm
Type of detector	EG&G, UV 100 BQ
Relative signal accuracy	0.5 %

4.42 Instrument Deployment

The sunphotometer was deployed on a LICOR model 2020 solar tracker. Actually, the instrument was originally deployed in tandem with the MFOV (Multiple Field Of View) photometer on 18 Nov 1991 at 1900 UTC. Due to problems in keeping both instruments aligned, the instruments were placed on separate tracker units on 21 Nov at 1400 UTC. The sun tracker was mounted approximately 1 meter above the ground and 10 m to the west of the H-Frame station along a berm which bordered the south shore of the power plant lake.

As mentioned above, the sunphotometer is not designed for deployment in all types of weather and particularly not during precipitation events. When conditions warranted the instrument was enclosed in a plastic bag containing a large supply of desiccant. The instrument was also covered in this manner during the night to protect it from moisture. Care was taken to keep the instrument aligned and viewing the solar disk; however, because of the photometer's small field of view and imperfect alignment of the solar tracker the user of the data should beware of possible inaccuracies introduced by slight misalignment. Table 5 indicates the periods of data collection.

4.43 Data Collection and Archiving

The data were collected by accessing a 0 - 2 Volt output jack on the side of the photometer. The data were recorded once every 2 minutes, except as noted in Table 5. Data were recorded using a Campbell CR21X data logger. The data were downloaded to a DOS disk and converted to ASCII format. The data are archived in this original format and also in ASCII format on a UNIX workstation. Table 5 details the times of data collection as determined from an initial inspection of the archived data. All times are UTC.

Table 5. Dates and times (UTC) of data collected by the Mainz Sun photometer.

Date	Start Time	End Time	Period
21 Nov 91	14:00	15:35	2.0 min
25 Nov 91	20:25	22:00	30 sec
26 Nov 91	14:00	21:00	30 sec
03 Dec 91	16:18	16:48	30 sec
04 Dec 91	15:16	16:12	30 sec
04 Dec 91	20:48	22:48	30 sec
05 Dec 91	20:24	21:54	30 sec
06 Dec 91	18:24	21:18	30 sec

4.44 Calibration

The data from the sunphotometer are in units of volts. No calibration exists at the current time for converting the signal to irradiance or to optical depth. Some information is contained in the data for clear sky conditions; however, further processing of these data is required to obtain calibration constants. A laboratory calibration will be performed on the sunphotometer using an irradiance standard lamp during spring of 1992.

5.0 Upper Air

5.1 Radiotheodolite

5.11 Instrument Description

At the Parsons site, rawinsondes were launched primarily in support of surface radiation measurements. The sondes were Intellesondes, made by A.I.R. (Atmospheric Instrumentation Research, Inc.). The sondes transmit at 1680 MHz, and contain a capacitance aeroid barometer, a 2mm diameter rod thermistor, and a carbon hygristor. The barometer has a range from 1050 to 5 mb with a sensor precision of 1 mb. The range of the thermistor is from 50° C to -90° C with a precision of 0.5° C. The carbon hygristor has a range from 5% to 100% RH with a precision of 3% RH. (Note that a humidity of 20% is often observed as a minimum value, especially at low pressures and cold temperatures.)

The sonde radio signal was tracked by an A.I.R. automatic radiotheodolite (model AIR-3A-RT). The antenna consists of an eight element phased array. From the antenna azimuth and elevation angles the winds can be calculated. The antenna has a static tracking accuracy of 0.5 degrees. (Due to hardware problems, the tracking accuracy varied and was generally less reliable than the specifications.)

5.12 Data Format/Ascent Schedule

The rawinsonde data consist of julian day, hour (UTC), minute, second, height (km), pressure (mb), temperature (K), relative humidity (%), azimuth angle, and elevation angle, and is stored with the format (3I3,F6.2,6F10.3). An example of the data is seen in Table 6. Table 7 shows the sonde flight times and brief comments on the data quality. The data are available from NCDS (NASA Climate Data System).

Table 6. Sample of a rawinsonde data file.

JD	HR	MIN	SEC	HT (KM)	PRES(mb)	TEMP(°A)	Relative Humidity %	Azimuth deg.	Elev. deg.
330	14	58	20.08	0.269	988.320	278.620	67.090	337.830	-0.730
330	14	58	22.23	0.269	988.330	278.620	68.140	338.580	-0.730
330	14	58	26.46	0.269	988.300	278.600	67.340	337.920	-0.520
330	14	58	28.60	0.269	988.340	278.580	67.070	337.730	-0.930
330	14	58	30.68	0.269	988.330	278.580	67.410	338.000	-0.680
330	14	58	32.83	0.269	988.330	278.580	67.090	338.270	-0.680
330	14	58	34.91	0.269	988.270	278.610	67.210	338.350	-0.700
330	14	58	37.06	0.269	988.310	278.630	66.940	338.520	-0.550
330	14	58	39.14	0.269	988.340	278.640	66.690	338.550	-0.730
330	14	58	51.83	0.340	979.720	278.050	64.260	341.850	-1.020
330	14	58	53.97	0.356	977.870	277.910	64.460	334.770	2.400
330	14	58	56.06	0.371	976.060	277.770	64.690	325.380	10.520
330	14	59	0.29	0.402	972.350	277.620	65.200	324.700	15.900
330	14	59	2.38	0.416	970.630	277.560	65.310	325.000	21.300
330	14	59	4.52	0.432	968.680	277.430	65.450	330.500	21.330
330	14	59	6.61	0.446	966.990	277.310	65.670	339.520	21.330
330	14	59	8.75	0.465	964.720	277.260	66.680	341.300	21.330
330	14	59	17.21	0.524	957.820	277.320	68.260	348.950	31.150
330	14	59	19.35	0.536	956.390	277.230	68.430	349.380	30.420
330	14	59	21.49	0.552	954.520	277.200	69.090	350.580	29.850

Table 7. Rawinsonde Launches

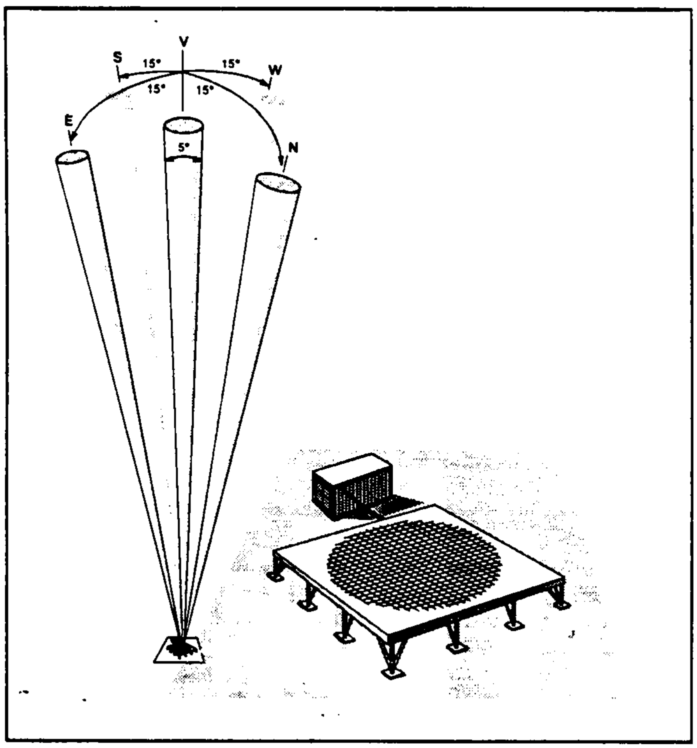
Date	Time (UTC)	Lowest Pressure	Comments
911113	18:28	250 mb	No wind, data missing between 871 and 783 mb
911113	21:20	207	No wind
911117	18:48	26	
911118	15:45	25	
911118	18:58	28	Data missing 915 - 184 mb (data collection problem)
911118	21:40	125	Data missing between 407 and 163 mb
911118	22:41	205	
911119	15:09	963	Data collection problem
911119	17:33	193	No wind, data missing 325 -273, 263 - 193 mb
911120	19:03	83	No wind
911120	21:46	131	No wind
911120	23:01	46	No wind
911121	16:38	407	No wind, data missing 621 - 587, 587 - 429 mb
911121	18:16	30	
911121	21:06	190	No wind
911121	22:52	222	No wind
911122	02:00	61	No wind
911122	13:40	109	No wind
911122	15:48	80	No wind
911122	18:11	276	No wind
911124	18:15	39	
911124	21:55	44	
911125	00:09	734	
911125	00:45	46	
911125	15:12	66	
911125	20:08	78	
911126	14:58	124	
911126	17:43	94	
911126	19:36	63	
911128	19:29	82	
911129	16:22	39	
911203	21:06	341	
911204	16:54	516	
911204	20:41	597	
911204	22:15	155	
911205	03:55	384	

Table 7, Continued

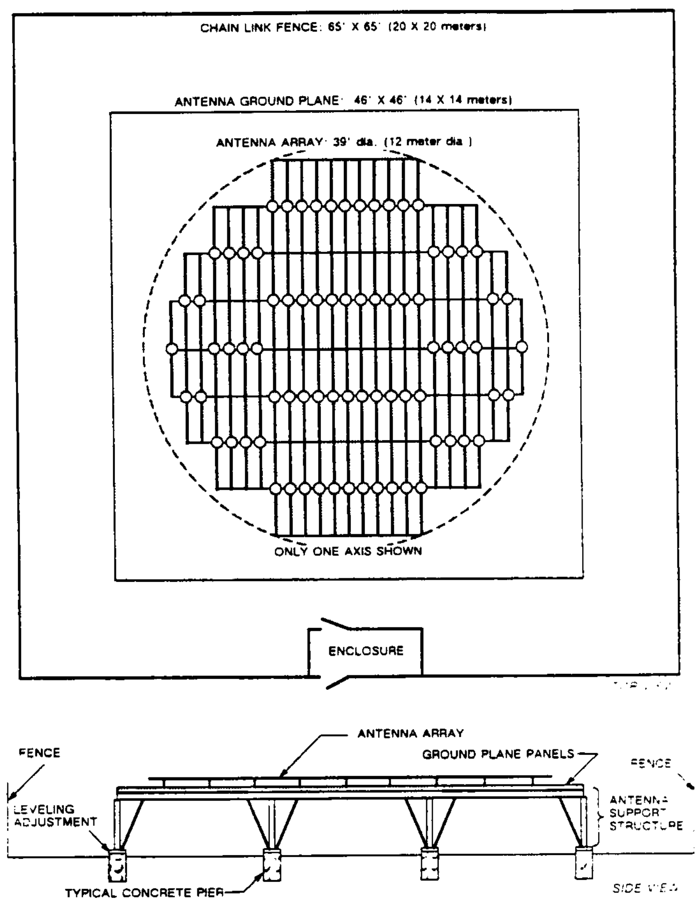
Date	Time (UTC)	Lowest Pressure	Comments
911205	14:25	197	
911205	16:17	49	
911205	18:23	29	
911205	21:07	141	
911206	01:39	46	
911206	05:29	615	
911206	06:45	52	
911206	12:30	38	No wind, data missing between 212 and 174 mb
911206	17:04	25	No wind

Note: Many times immediately after launch the theodolite initially had trouble tracking causing some low level erroneous winds.

5.2 Model 400 Wind Profiler



Typical beam configuration in wind profiling consists of three beams: one vertical, and two tilted 15° from the zenith (to the east and north, for example). Under some circumstances, two additional beams are needed (such as to the south and west).



Typical Model 400 wind profiler site.

Figure 13: Wind Profiler System

5.21 System Introduction

The model 400 wind profiler provides measurements of wind (horizontal and vertical components) above the radar site up to 15km. The whole system mainly consists of two parts: the radar system and the computer work station for system control and data processing. The data are provided continuously every 6 or 10 minutes (set by operators). Data can be used on-site, saved on magnetic media and transferred to some central system. The accessed data processing system provides the following format data:

5.211 Spectrum every 6 or 10 minutes (Figure 14).

5.212 Processed data including signal power, velocity, and signal spectral bandwidth every 6 or 10 minutes (Figure 15).

5.213 Hourly and 6-minute or 10-minute horizontal wind profile (Figures 15 and 16).

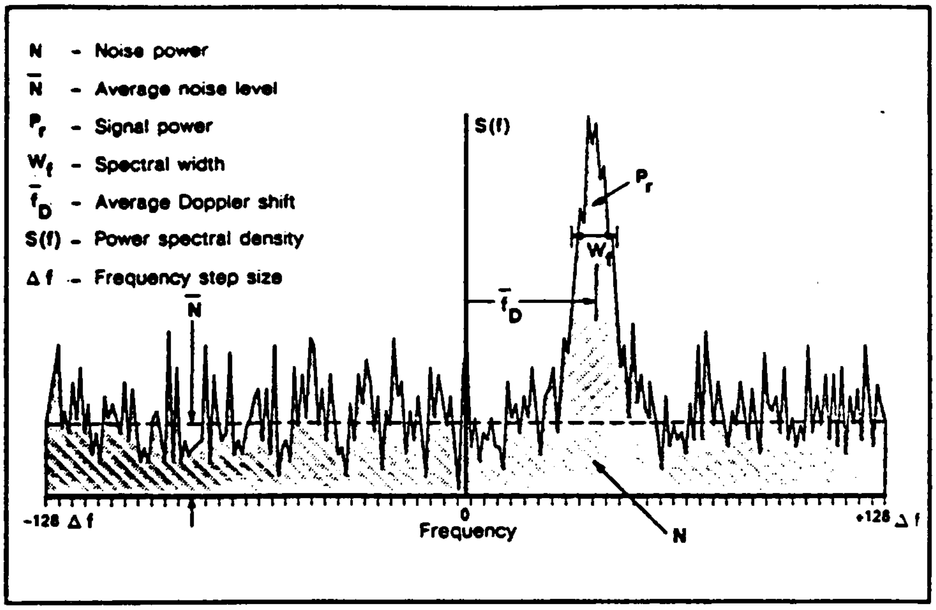
5.22 System Principal

The wind profiler is a Doppler radar which depends upon the scattering of electromagnetic energy by small irregularities in the refractive index. The spatial variation in this refractive index encountered by propagating microwave energy causes a small amount of the energy to be scattered (or dispersed) in all direction of which the backscattering is received by the radar. The irregularities, which have the size comparable to one-half the radar wavelength, are the most effective sources of scattering. Most of the energy propagates through the refractive irregularities without being scattered.

The transmitted microwave energy is at a frequency of 404.37MHz. The motion of the air toward or away from radar will cause a frequency shift of the received signal. This frequency shift is proportional to the speed of the air motion, and can be used to calculate the wind speed. Following is the Tycho algorithm used to calculate horizontal wind speed:

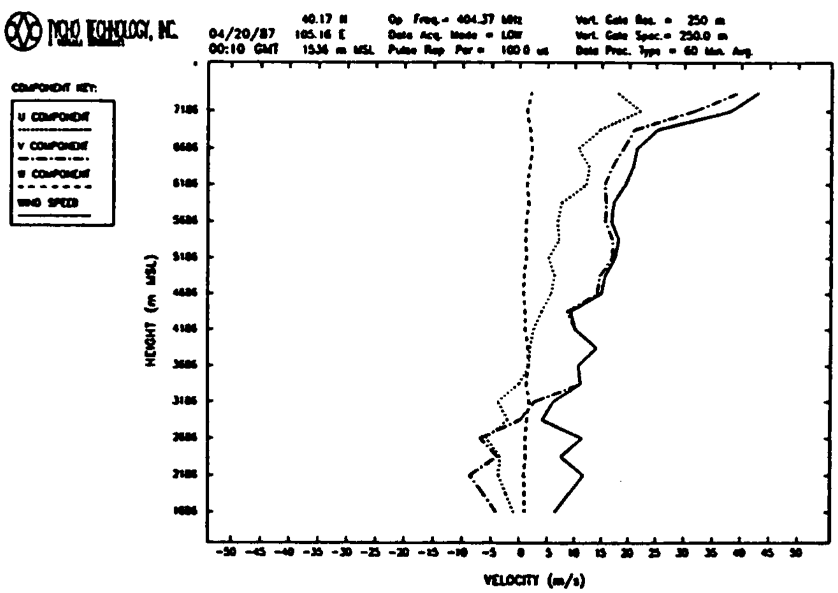
$$V_{re} = U \sin 75^\circ + w \cos 75^\circ$$
$$V_{rn} = V \sin 75^\circ + w \cos 75^\circ$$
$$V_{rz} = w$$

Where, V_{re}, V_{rn}, and V_{rz} are radial velocities measured in the east, north, and zenith directions, respectively. U, V are east-west, north-south components of horizontal wind, respectively; W is the vertical velocity.



Typical power spectrum showing measurement parameters.

Figure 14: Spectrum



An example of wind data for one six-minute integration. Profiles of the three components (u, v, w) are shown separately. Also shown is the horizontal wind speed, which is calculated from the east-west (u) and north-south (v) components.

Figure 15: Ten minute wind profile

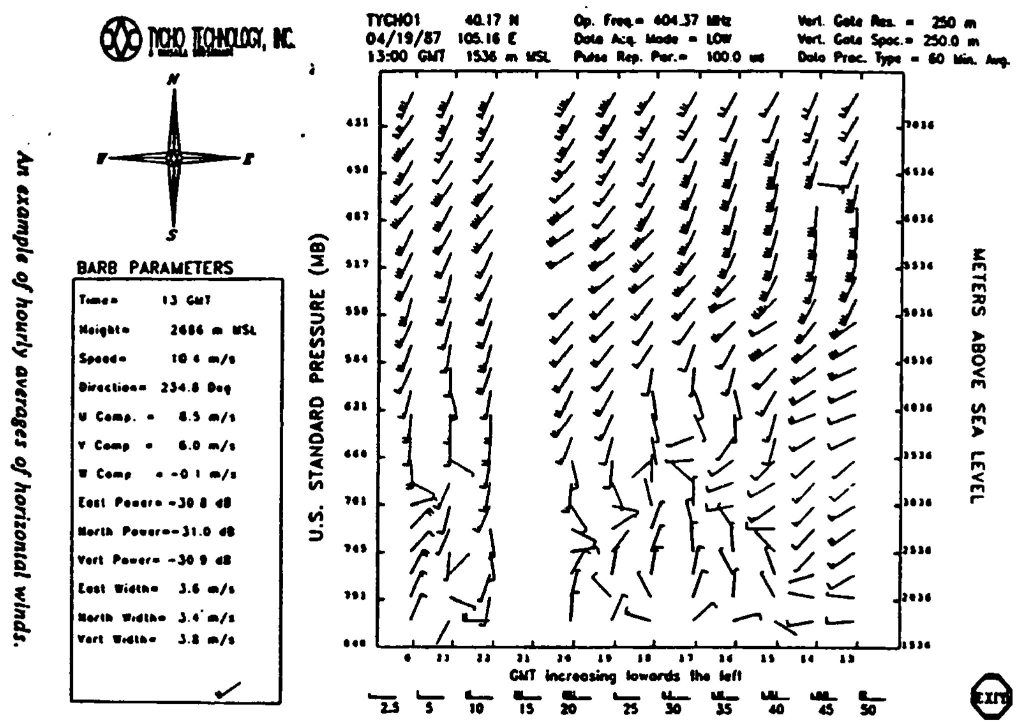


Figure 16: Hourly averaged wind profile

5.23 Specifications

5.231 Wind Profiler Site Location:

Parson, Kansas: Elevation: 269m Latitude:37°18' Longitude:95°07'

5.232 The Wind Profiler Parameters:

Table 8 lists the operator selected parameters which determine the operating characteristics of the wind profiler. Values assigned to these parameters are given in the Appendix. Here, we should mention that, during the whole FIRE period, we used five beams. So the data time cycle was about 10 minutes plus one minute to transfer the spectrum to an optical disk archive.

5.233 Height Coverage and Resolution:

The wind profiler has high and low modes. The low mode covers the height from 500m above ground level (AGL) to 9.25km AGL with height resolution of 250m. The high mode covers the height from 7.50km AGL to about 16.25km AGL with a height resolution of 1000m.

Table 8. List of the operator selected parameters which determine the operating characteristics of the wind profiler.

PARAMETERS	SHORT DESCRIPTION
ANT_DIR	Antenna direction
ARA	Anti-range aliasing for each mode
CCP_GAIN	Digital gain of the real and quadrature channels with the A/D converter
CODE	Complementary coding for each mode
CON_DELTAV	Consensus velocity half-width (m/s)
DELAY	Delay from fall of TX pulse to first range gate (1/6 μs)
DODC	Enables DC removal
DOPOWCOR	Corrects signal power values due to the range dependent attenuation of the T/R switch
FILTER	Receiver filter for each mode
GCNUM	Number of points around zero used in ground clutter removal (same for all modes)
POW_FACTOR	Power scaling factor
PRP	Pulse Repetition Period (0.1 μs)
PW_BAUD	Pulse width for each mode (1/6 μs)
RX_DELAY	Receiver delay (0.01 μs)
RX_GAIN	Receiver gain
SAMPLE_MIN	Minimum number of agreeing samples for consensus
SPACE	Time between range gates for each mode (1/6 μs)
SPAN	Number of spectral points around zero that are searched for peak power
SPECTRA	Number of spectra averaged for each data-taking mode
SSTDODC	Enables SST DC-removal
TDA	Number of samples per time domain average for each mode
WINDOW	Enables a HANN windowing function for the FFT

5.234 Horizontal Spatial Resolution:

To use Tycho wind calculation algorithms, it is assumed the flow to be horizontally homogeneous between beams. Therefore one can only calculate the wind field which has spatial scale at least bigger than the distance between north (south) and east(west) beam volumes. This distance can be refereed as the horizontal spatial resolution when we neglect the air motion. At 10km AGL, this distance is about 3.8km.

5.235 Direction Deviation:

When we use above Tycho algorithms, we assume the wind profiler is aligned along the N-S direction, actually, there was a 4.5° deviation east to north. Therefore the true wind component U' and V' are given by:

$$U' = U \sin 4.5^\circ - V \cos 4.5^\circ$$
$$V' = U \cos 4.5^\circ + V \sin 4.5^\circ$$

5.236 Wind Profiler Operation Times:

The system operated from 12:00 UTC on Nov. 13, 1991 to Dec. 7, 1991; at times within this period, mode 6 was used to measure temperature by RASS once each hour so that the wind profile data of this mode was lost. Also, there were scheduled-off times when satellites passed over the site.

5.24 Data Description

5.241 Archiving of the Data:

The data were archived and the associated format and media used are given below.

5.2411 Raw spectral data:

Raw spectral data were archived on optical disks (following time domain average, FFT and spectral domain average, but before other signal processing) for each gate and each cycle. The file names are in the format: yymmdd_hhmmss.***. Here, yy, mm, dd, hh, mm and ss mean year, month, day, hour, minute and second, respectively. The data format in each file is:

Title:
mode__1_26_Nov_1991_12:32:44_Gate_24_Height_xxxxx/

Byte1--4: 'mode'
Byte6--7:mode number 1--10
Byte9,10:day
Byte12-14:month
Byte16-19:year
Byte21-28:time
Byte30-33:'Gate'
Byte35-36:gate number 1--36
Byte38-43:'Height'
Byte45-49:height in digital format
Byte50:return

After above title, a 256x4 byte binary array is saved. This array is the spectrum for the mode and gate specified by the title. In each file, we have 360 arrays.

5.2412 Processed data

The processed data are derived from the Tycho processing program. It includes all of the moments data: signal power, radial velocity and speed variance. The data have been saved in the TK50 tapes with the following file format:

yymmdd_hhmmss.new (covers the every cycle data in one hour)
yymmdd_hhmmss.pro (covers the data which has been hourly averaged)

and,
yymmddhh.ard (cycle data after quality control)
yymmddhh.arc (hourly-averaged data after quality control)

5.242 Accessing of the Data

As mentioned above, spectra data are archived at CSU on optical disk and moment data on TK 50 and exabyte tapes.

References:

Peterson, V. L., 1988: Wind Profiling -- The History, Principles, and Applications of Clear-air Doppler Radar. Tycho Technology, Inc.

Tycho Technology, Inc., 1989: Model 400s Wind Profiler Software User's Manual.

van de Kamp, D. W., 1988: Wind Profiler Training Manual #1--Principles of Wind Profiler Operation. NOAA Documents Developed for the National Weather Service Office of Meteorology.

5.3 Radio Acoustic Sounding System

5.31 Instrument Description

The Radio Acoustic Sounding System (RASS) is used to acquire temperature profiles of the boundary layer. There are several methods available to use RASS all of which involve introducing an audio signal into the atmosphere and tracking the speed of the acoustic wavefronts using a sensitive Doppler RADAR. By adjusting the audio frequency such that the acoustic wavelength is half that of the transmitted radio frequency (i.e. satisfies the Bragg condition) and by using a wind profile RADAR (or wind profiler), the temperature at a given height can be obtained from the equation (Nalbandyan, O. G., 1977)

$$C_a = 20.047\sqrt{T_v} + v_w \quad (m/s)$$

where C_a is the speed of sound, T_v is virtual temperature in degrees Kelvin and v_w is the wind velocity component parallel to acoustic wave propagation.

The RASS method used presently at CSU is the Receiver Offset Method. After a user-determined number of profiler cycles, the intermediate frequency in the wind profiler's receiver is offset via a single-sideband up-converter, (Strauch, R. G., 1988). The offset causes the baseband of the receiver's discrete-time filter to be shifted to the audio frequency used by RASS.

Shortly after the offset is applied and before the RASS mode begins, a separate oscillator sweeps through a narrow band of audio frequencies selected according to expected air temperatures. This signal is then amplified and broadcast over four loudspeakers which are placed approximately 10 meters away from and encircling the RADAR antenna. When the Bragg condition is satisfied, the strongest signals at the receiver for each range gate will be those of acoustic wavefronts traveling at the velocities corresponding to the temperatures at those altitudes. The Receiver Offset Method was the RASS procedure employed during the FIRE II experiment in Parsons, KS.

5.32 Specifications

5.321 Electromagnetic

Radar	Tycho DORA 400S Wind Profiler
Transmit Frequency	404.37 MHz
Radiated Power	40 kW (peak)
Beamwidth	5 degrees
Antenna Type	Phased Array Coaxial Collinear Dipoles
Antenna Diameter	12 meters

5.322 Acoustic

Transducer Type	Folded Horn with Compression Driver
Transducer Sensitivity	105 dB SPL (1W/1m)
Radiated Power	75 Watts (average)
Beamwidth	110 degrees horizontal 130 degrees vertical

5.323 Data Summary

All data collected by the wind profiler are stored in two formats - as processed spectral moment data and as raw spectra. Temperature profiles are determined from the spectra (see Figure 17) by the equation

$$T_v - \left(\frac{v_{app} - v_{offs}}{20.047}\right)^2 \quad (K)$$

where T_v is virtual temperature and v_{app} is the apparent velocity reported by the profiler. The offset velocity, v_{offs}, results from the offset frequency, f_{offs}, and is calculated from

$$v_{offs} = \frac{\lambda_{em}}{2} f_{offs} \ (m/s)$$

where λ_{em} is the wavelength of the electromagnetic radiation.

During the FIRE II experiment, RASS data were collected every sixth profiler cycle during normal daylight operating periods. During intensive data collection intervals or during maintenance, RASS may have been activated more or less often.

References:

Nalbandyan, O. G., 1977. The Theory of Radioacoustic Sensing of the Atmosphere. *Izvestiya, Atmospheric and Ocean Physics,* **13**, No. 3.

Strauch, R. G., K. P. Moran, P. T. May, A. J. Bedard, W. L. Ecklund, 1988. RASS Temperature Sounding Techniques. NOAA Technical Memorandum ERL WPL-158.

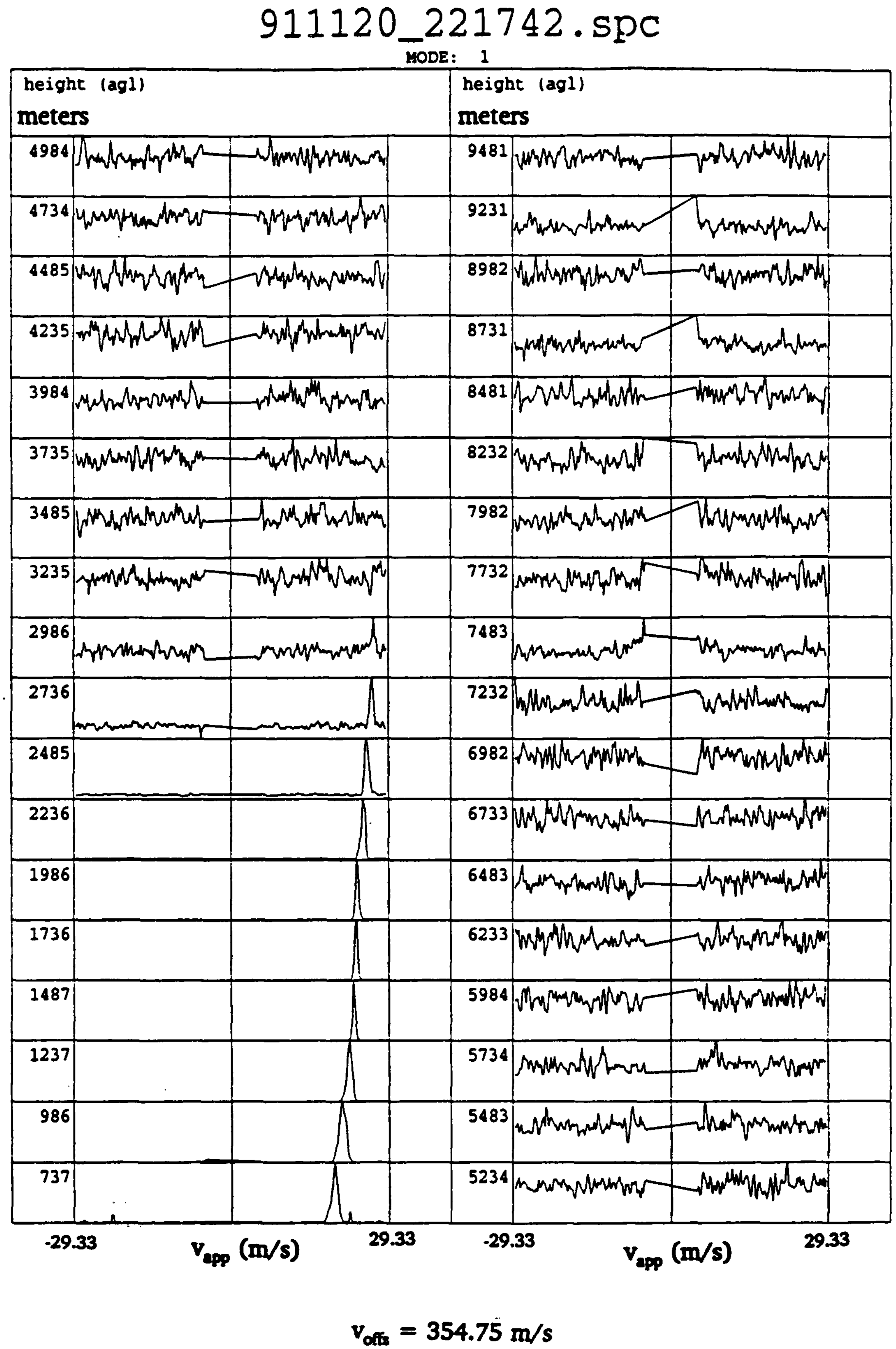


Figure 17: Sample RASS spectra (colder temperatures to the right).

6.0 Cloud Measurements

6.1 Laser Ceilometer

6.11 Instrument Description

The ceilometer utilized at the Parsons site of the 1991 FIRE IFO experiment is an active LIDAR system which employs a vertically oriented Gallium-Arsenide laser to detect cloud base height. Relating specifically to the FIRE experiment, it was utilized to provide a record of when low-level cloudiness was present over the Parsons area.

Within the time frame of the experiment it was not unusual for the atmosphere to present a situation in which a desired cirrus layer study was largely obscured by low-level cloudiness. It is in such situations that, often to the frustration of the observers, radiometric cirrus studies become obscured by such clouds even in situations of partial coverage. The ceilometer was deployed to give a continuous database describing when such low-level cloudiness was present. It is also hypothesized that the ceilometer may have also occasionally detected an actual cirrus cloud near the top of the instrument's vertical range.

6.12 Specifications

The ceilometer utilizes a 20 watt near-infrared Gallium-Arsenide laser operating at a wavelength of .91 microns. It employs the use of 1024 range gates which give it a vertical resolution of 25 feet up to a maximum range of 25,600 feet, the approximate lower edge of the vertical range of cirrus cloud ocurrences. The fields of view of the transmitter and receiver have been estimated to be of the order of 1 degree.

The temporal resolution can be set at one of several settings between 30 seconds and 12 minutes, as the instrument runs through a cycle of of data collection, interpretation, and transmission. This begins with a collection mode where the ceilometer, taking a reading from all of the range gates 1000 times per second, first performs a noise level analysis by taking three such readings in which the laser does not fire. All these measurements are then condensed into one noise level reading. The ceilometer then takes 5120 of the same sets of readings from each range gate, this time with the laser pulsing. During this operation a histogram of the received signal is created in the following manner:

The signal from each range gate is compared with the previous noise level reading, and depending on whether the received signal is above, below, or at the given noise level a value of 1, -1, or zero is, respectively, added to the output histogram value for that specific range gate. This is performed for each of the 5120 pulsed readings, giving a final output in the form of a simple array of integers.

After performing a peak-location algorithm which determines the height of the cloud base (if one exists), the data are then transmitted to a 286 desk top computer where it is stored and displayed in real time. The ceilometer then goes into a wait mode until sufficient time has elapsed for another reading to be done according to the set value for the temporal resolution.

6.13 The Data

The data can be stored in either binary or ASCII, and at present all of the data are available in either form. In its ASCII form the data takes the following format:

```
-7
-7
-7
0
14
36
0
6
7
12
1991
86
-400
-1
-1
-1
178
217
211
13
```

Each file contains a series of output histograms, each containing 1050 integers. The first 1018 entries are the histogram values for each height gate (25 feet) (meaning that only information up to 25,450 feet is actually recorded), and the final 32 integers display the following information:

Position	Function	Example
1019-1023	*	
1024	(Always zero	0
1025	Hour	7
1026	Minute	32
1027	Second	0
1028	Day of Week	4
1029	Date	30
1030	Month	5
1031	Year	1991
1032	Waveform Mode	86
1033	Cloudbase	-1
1034-1036	*	
1037	Laser Temperature	180
1038	Receiver Temperature	260
1039	Ambient Temperature	250
1040-1045	*	
1046	RMS Noise	408
1047-1050	*	

where a cloudbase value of -1 indicates clear sky, the temperatures are given in tenths of a degree Celsius, and an asterisk indicates dummy parameters.

Due to inclement ambient temperatures within the ceilometer circuitry caused by a malfunctioning heater, there were apparent electronic problems within the unit resulting in abrupt "spikes" in the histogram data. A simple program was created which filtered out these unrealistic values, replacing them with data linearly interpolated from adjacent values. Also, since these data "spikes" have before been previously interpreted by the ceilometer as a false cloud base, whenever such filtering has occurred within a given histogram, the cloudbase parameter (1033) was changed to a value of -400 (-10,000 ft). A record was also created of all such changes made for each file.

The following data files are available:

Filename	Start (UTC)	End (UTC)	Resolution
10nov91.dat	10 Nov 91 20:48	11 Nov 91 13:48	12m
11nov91.dat	11 Nov 91 15:36	12 Nov 91 14:00	12m
12nov91.dat	12 Nov 91 14:12	13 Nov 91 13:48	12m
13nov91.dat	13 Nov 91 14:12	14 Nov 91 14:48	12m
14nov91.dat	14 Nov 91 15:00	15 Nov 91 14:36	12m
15nov91.dat	15 Nov 91 14:48	16 Nov 91 16:00	12m
16nov91.dat	16 Nov 91 16:12	17 Nov 91 16:00	12m
17nov91.dat	17 Nov 91 16:12	18 Nov 91 14:00	12m
18nov91.dat	18 Nov 91 14:12	19 Nov 91 13:48	12m
19nov91.dat	19 Nov 91 14:48	20 Nov 91 15:48	12m
20nov91.dat	20 Nov 91 16:12	21 Nov 91 13:48	12m
21nov91.dat	21 Nov 91 15:00	22 Nov 91 13:00	12m
22nov91.dat	22 Nov 91 13:12	23 Nov 91 17:00	12m
23nov91.dat	23 Nov 91 17:36	24 Nov 91 15:24	12m
24nov91.dat	24 Nov 91 17:12	24 Nov 91 17:24	12m
24nov291.dat	25 Nov 91 01:12	25 Nov 91 14:40	1m
25nov191.dat	25 Nov 91 16:39	25 Nov 91 23:07	1m
25nov291.dat	25 Nov 91 23:09	26 Nov 91 00:02	1m
25nov391.dat	26 Nov 91 00:08	26 Nov 91 04:08	4m
26nov191.dat	26 Nov 91 15:16	26 Nov 91 17:08	4m
26nov291.dat	26 Nov 91 17:21	26 Nov 91 21:13	1m
26nov391.dat	26 Nov 91 21:36	26 Nov 91 22:31	1m
26nov491.dat	26 Nov 91 22:36	27 Nov 91 15:48	4m
27nov191.dat	27 Nov 91 19:00	28 Nov 91 15:00	12m
28nov191.dat	28 Nov 91 18:00	28 Nov 91 19:00	12m
28nov291.dat	28 Nov 91 19:10	28 Nov 91 22:08	1m
28nov391.dat	28 Nov 91 22:12	29 Nov 91 14:24	12m
29nov191.dat	29 Nov 91 14:48	30 Nov 91 14:36	12m
30nov191.dat	30 Nov 91 14:48	01 Dec 91 16:48	12m
01dec191.dat	01 Dec 91 17:00	02 Dec 91 16:12	12m
02dec191.dat	02 Dec 91 16:24	03 Dec 91 17:00	12m
03dec191.dat	03 Dec 91 17:12	04 Dec 91 16:12	12m
04dec191.dat	04 Dec 91 16:24	05 Dec 91 14:48	12m
05dec191.dat	05 Dec 91 15:12	06 Dec 91 14:36	12m
06dec191.dat	06 Dec 91 14:48	07 Dec 91 14:12	12m
07dec191.dat	07 Dec 91 14:36	08 Dec 91 16:12	12m

The files are available in the following directory:
/users/johnw/ceil

and appear with a first letter which is either "u", "f", or "s", revealing files which respectively contain either unfiltered data, filtered data, or a summary of the filtering process.

6.2 Video All Sky Camera

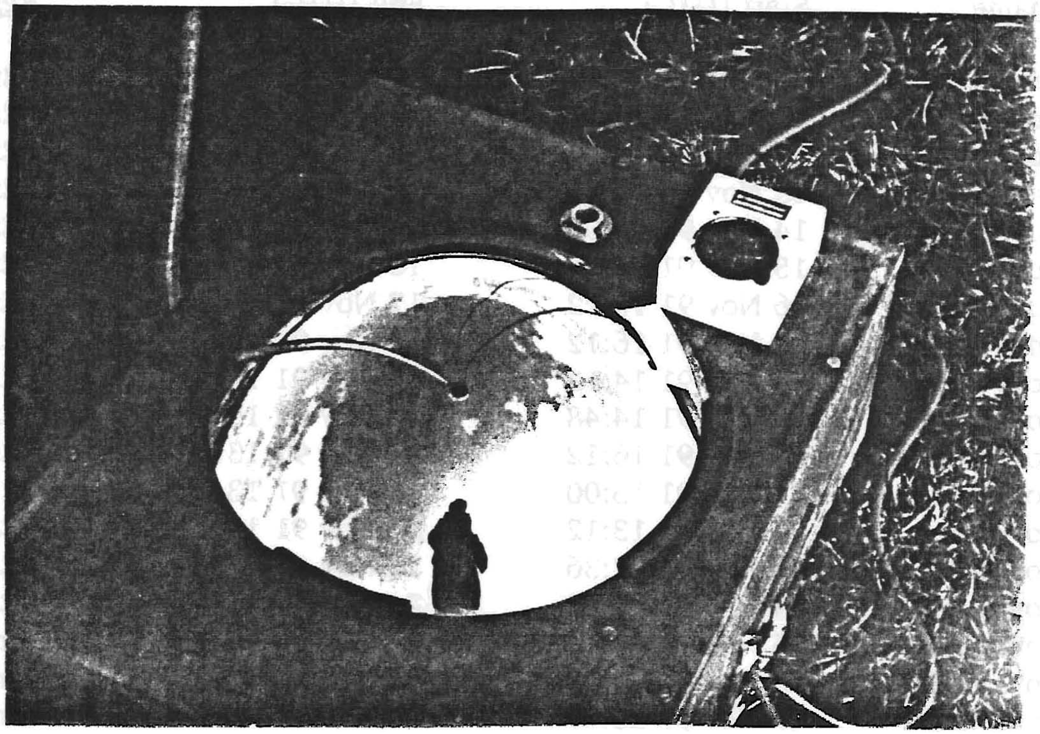


Figure 18: Video all sky camera convex mirror.

In order to archive a visual record of sky conditions, CSU's wind profiler site included a VCR and camera facing an upward looking convex parabolic mirror. The camera was mounted over the upward-facing mirror, thus giving a full-sky view--obscured only by the reflection of the camera.

In all, 25 six-hour VHS video tapes were recorded over the course of the experiment. The camera was only operated during daylight hours when sky conditions were acceptable, i.e. not pouring rain. Each tape covers a six hour period. The video tapes are archived at CSU.

6.3 NASA Langley 8" Cloud Lidar System

(Operated by Joe Alvarez, NASA Langley)

6.31 Instrument Description

The lidar deployed by Langley Research Center (LaRC) at a field site near Parsons, Kansas for the FIRE IFO during November 13 to December 6, 1991 was the LaRC 8" Lidar System housed in a recreational vehicle. This lidar system is comprised of a frequency doubled Nd:YAG laser serving as the lidar transmitter and an 8"

Cassagrain depolarization sensitive receiver system attached to a 386 based data acquisition system.

6.32 Operating Parameters

The table below presents the operating parameters of this lidar system as it was configured and used for the FIRE Kansas IFO.

TRANSMITTER	
Wavelength	532 nm
Pulse Energy	150 mJ
Pulse Rate	10 Hz
Pulse Width	6 ns
Beam Divergence	0.6 mrad
Beam Diameter	6 mm
RECEIVER	
Telescope Diameter	20 cm
Field of View	2 mrad
Filter Bandwidth	1 nm, 50% transmittance centered at 532 nm
Detector, PMT	EMI 9658
Quantum Efficiency	15%
Calibration	Zero order half-wave plate mounted on rotatable assembly used for depolarization calibration

DATA ACQUISITION AND ANALYSIS SYSTEM	
Computer	386 system, 20 Mz
A/D Resolution	10 bits
Altitude Points	4096
Altitude Limits	0 to 60 km, 2 to 15 km normal data range
Altitude Resolution	30 m(amplifier bandwidth usually 5 MHz)
Storage Media	Optical Disk, 400 Mb per disk
Data Analysis	486 system, 33 Mz
Graphics Plotter	286 system, 12 Mz and inkjet printer
Lidar Record	Elementary unit of recorded data consists of hardware average of 150 lidar pulse responses (15 second average)

Data acquisition commenced at 6:00 am on Wednesday, November 13, 1991 and continued intermittently until 11:29 am Friday, December 6, 1991. Approximately 700 Mb of raw data were collected at the field site during a cumulative 143 hours of operation. As mentioned above, the basic unit of data collection were 150 lidar pulse responses averaged over 15 second intervals.

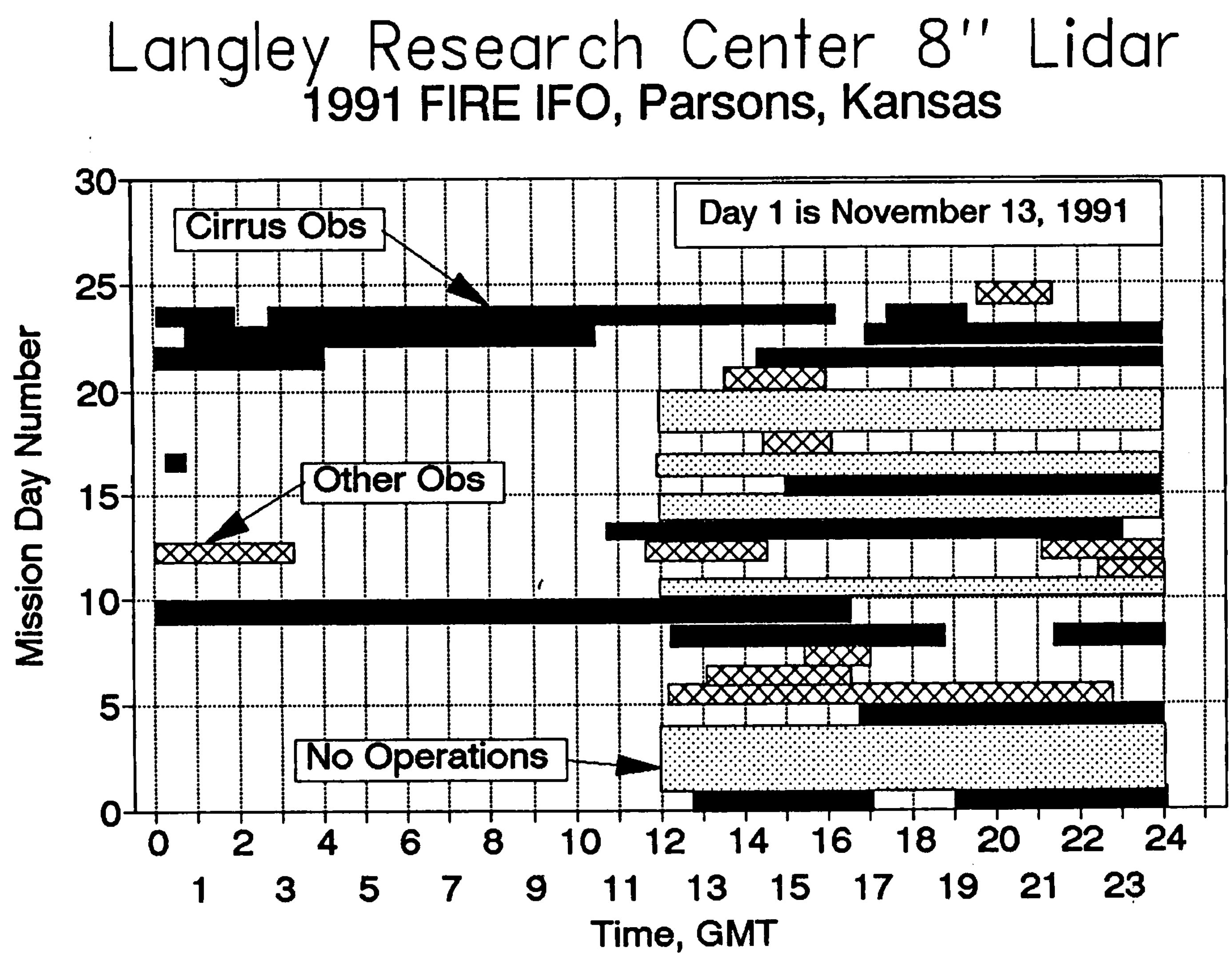


Figure 19: Presents operating times of the LaRC 8" Lidar System while deployed at Parsons. The "other obs" refers to lidar operation occurring during times where no cirrus were detected. During these times either the sky was clear or the detected low level clouds were obscuring overlying cirrus.

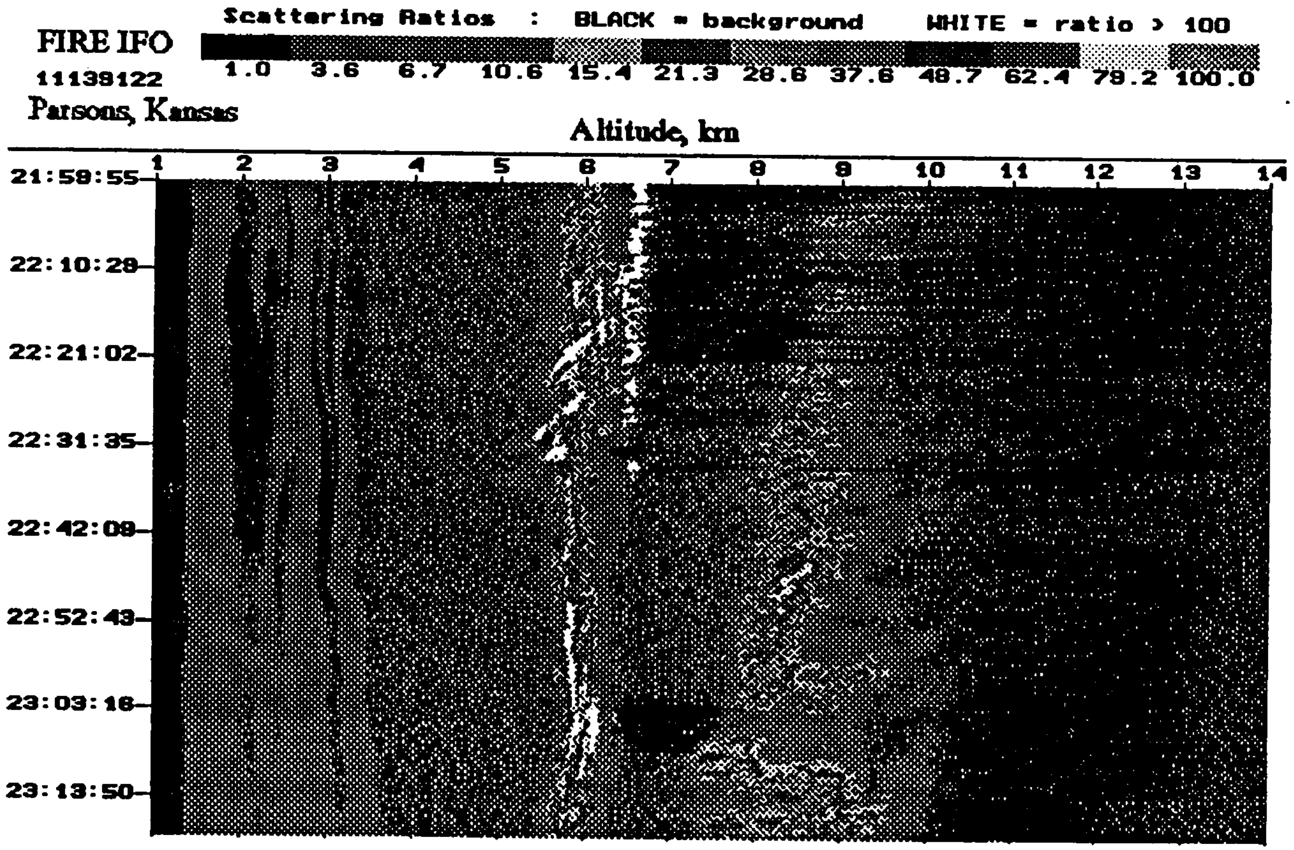


Figure 20: Presents the scattering ratio as a function of altitude and time (GMT) for about one hour on November 13, 1991 starting at approximately 2200 GMT. This figure is a grey-scale transform of the standard color catalog figure depicting this lidar data. It is included only to qualitatively illustrate the type of data which will shortly become available at the NCDSS.

7.0 Acknowledgements

The authors wish to express their sincere appreciation to Ms. Melissa Tucker for her many contributions to the success of our work. Ms. Tucker supports our preparations for the field by arranging travel and accommodations, ordering equipment and monitoring budgets; she support us while in the field by making our offices only a phone call away and acting on our behalf. Following the field experiment, her efforts are critical to reporting the scientific results derived from the whole effort. Her most direct contribution to this document is giving continuity and order to a multi authored collection of miscellaneous facts that will serve scientists studying cirrus cloud systems in the coming decade.

The Kansas Gas and Electric Company provided an excellent site for the CSU/NASA FIRE II installation at their executive recreation site at the Neosho KG&E facility. Special thanks go to Lonnie Bradfield and Bob McMillan and their associates at the Neosho facility and to Gale Chastain at the KG&E in Pittsburg, Kansas. We also wish to express our appreciation to Mr. Randy Trout of Parsons Aviation, Inc. for allowing us to install one of our remote stations at the Tri City Airport near Cherryvale, Kansas.

This research has been supported by the National Aeronautics and Space Administration under Grant NAG 1-1146 and by The Office of Naval Research under Contract No. N00014-91-J-1422, P00002.

APPENDIX

RADAR PARAMETERS

CONTACT: [illegible] DATE OF CHANGE: 12/5/91 DAY 339 1514 GMT 914 CST

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/I	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 µs	300		32		300		32		300		32	36
DODC	0/I	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 µs	2400		1000		2400		1000		2400		1000	1045
PW_BAUD	1/6 µs	40		10		40		10		40		10	
RX_DELAY	.01 µs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 µs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/I	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/I	1		1		1		1		1		1	
DOPOWCOR	0/I	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 µs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 µs	10	
TX_BLANK	1/6 µs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 µs	8	

NOTES:

fofs = 956.9

~~Vofs = 354.75~~

PARAMETER	UNIT	MODE 7 NORM	MODE 7 NEW	MODE 8 NORM	MODE 8 NEW	MODE 9 NORM	MODE 9 NEW	MODE 10 NORM	MODE 10 NEW	MODE 11 NORM	MODE 11 NEW	MODE 12 NORM	MODE 12 NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	1/6 µs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4					
PRP	0.1 µs	2400		1000		2400		1000					
PW_BAUD	1/6 µs	40		10		40		10					
RX_DELAY	.01 µs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 µs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

CONTACT: [signature] DATE OF CHANGE: 12/3/91 JDAY 337 1941 GM 1341 CS

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/1	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 μs	300		32		300		32		300		32	36
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 μs	2400		1000		2400		1000		2400		1000	1070
PW_BAUD	1/6 μs	40		10		40		10		40		10	
RX_DELAY	.01 μs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 μs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 μs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 μs	10	
TX_BLANK	1/6 μs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 μs	8	

NOTES:

fofs = 934.6

Dofs = 346.46

PARAMETER	UNIT	MODE 7		MODE 8		MODE 9		MODE 10		MODE 11		MODE 12	
		NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	1/6 µs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4					
PRP	0.1 µs	2400		1000		2400		1000					
PW_BAUD	1/6 µs	40		10		40		10					
RX_DELAY	.01 µs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 µs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

11/30/91 1537 GMT

CONTACT: Dew DATE OF CHANGE: UDAY 334 937 CST

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/1	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 μs	300		32		300		32		300		32	[illegible]
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 μs	2400		1000		2400		1000		2400		1000	1070
PW_BAUD	1/6 μs	40		10		40		10		40		10	
RX_DELAY	.01 μs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 μs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 μs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 μs	10	
TX_BLANK	1/6 μs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 μs	8	

NOTES:

$f_{ofs} = 934.6$

~~$\Delta f_{ofs} = 346.46$~~

$$T = \left[\frac{v_{ofs} - v_{app} - v_{uwind}}{20.047}\right]^2$$

PARAMETER	UNIT	MODE 7 NORM	MODE 7 NEW	MODE 8 NORM	MODE 8 NEW	MODE 9 NORM	MODE 9 NEW	MODE 10 NORM	MODE 10 NEW	MODE 11 NORM	MODE 11 NEW	MODE 12 NORM	MODE 12 NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	1/6 μs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4					
PRP	0.1 μs	2400		1000		2400		1000					
PW_BAUD	1/6 μs	40		10		40		10					
RX_DELAY	.01 μs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 μs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

11/27/91 12 h GMT

CONTACT: DRW DATE OF CHANGE: DAY 331 1811 GMT

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	O/I	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 μs	300		32		300		32		300		32	
DODC	O/I	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 μs	2400		1000		2400		1000		2400		1000	1045
PW_BAUD	1/6 μs	40		10		40		10		40		10	
RX_DELAY	.01 μs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 μs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	O/I	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	O/I	1		1		1		1		1		1	
DOPOWCOR	O/I	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 μs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 μs	10	
TX_BLANK	1/6 μs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 μs	8	

NOTES:

$f_{ofs} = 956.9$

$v_{ofs} = 354.75$

$$T = \left[\frac{v_{ofs} - v_{app} - v_{a\,wind}}{20.047} \right]^2$$

		MODE 7		MODE 8		MODE 9		MODE 10		MODE 11		MODE 12	
PARAMETER	UNIT	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	1/6 µs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e4		4.67e4		4.67e4		4.67e4					
PRP	0.1 µs	2400		1000		2400		1000					
PW_BAUD	1/6 µs	40		10		40		10					
RX_DELAY	.01 µs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 µs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

11/26/91 1059 CST

CONTACT: [illegible] DATE OF CHANGE: JDAY 330 1659 GMT

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/1	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 µs	300		32		300		32		300		32	
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 µs	2400		1000		2400		1000		2400		1000	1070
PW_BAUD	1/6 µs	40		10		40		10		40		10	
RX_DELAY	.01 µs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 µs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 µs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 µs	10	
TX_BLANK	1/6 µs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 µs	8	

NOTES:

$f_{ofs} = 934.6$

$v_{ofs} = 346.4$

$$T = \left[\frac{v_{ofs} - v_{app} - v_{\parallel wind}}{20.047}\right]^2$$

PARAMETER	UNIT	MODE 7		MODE 8		MODE 9		MODE 10		MODE 11		MODE 12	
		NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	1/6 μs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e4		4.67e4		4.67e4		4.67e4					
PRP	0.1 μs	2400		1000		2400		1000					
PW_BAUD	1/6 μs	40		10		40		10					
RX_DELAY	.01 μs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 μs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

11/24/91 8 40 CST

CONTACT: DRW DATE OF CHANGE: UDAY 328 1440 GMT

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/1	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	1
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 μs	300		32		300		32		300		32	
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	.1 μs	2400		1000		2400		1000		2400		1000	1070
PW_BAUD	1/6 μs	40		10		40		10		40		10	
RX_DELAY	.01 μs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 μs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 μs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 μs	10	
TX_BLANK	1/6 μs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 μs	8	

NOTES:

$f_{ofs} = 934.6$

$V_{ofs} = 346.46$

$$T = \left[\frac{V_{ofs} - V_{app} - V_{\parallel wind}}{20.047} \right]^2 K$$

		MODE 7		MODE 8		MODE 9		MODE 10		MODE 11		MODE 12	
PARAMETER	UNIT	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	⅙ µs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e4		4.67e4		4.67e4		4.67e4					
PRP	0.1 µs	2400		1000		2400		1000					
PW_BAUD	⅙ µs	40		10		40		10					
RX_DELAY	.01 µs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	⅙ µs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

11/20/91 [illegible]

CONTACT: CRC DATE OF CHANGE: [illegible]

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/1	1		1		1		1		1		1	[illegible]
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	1
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 µs	300		32		300		32		300		32	
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 µs	2400		1000		2400		1000		2400		1000	1045
PW_BAUD	1/6 µs	40		10		40		10		40		10	
RX_DELAY	.01 µs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		25[illegible]	
SAMPLE_MIN	N	4		4		4		4		4			
SPACE	1/6 µs	10		10		10		10		10		1[illegible]	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 µs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 µs	10	
TX_BLANK	1/6 µs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 µs	8	

NOTES:

$f_{c+s} = 956.9$

$\nu_s = 354.75$

$$T = \left[\frac{(v_{\cdot\,is} - v_{app} - v_{\cdot\,w.d})}{[illegible]}\right]^2 \quad [illegible]\,k$$

PARAMETER	UNIT	MODE 7 NORM	MODE 7 NEW	MODE 8 NORM	MODE 8 NEW	MODE 9 NORM	MODE 9 NEW	MODE 10 NORM	MODE 10 NEW	MODE 11 NORM	MODE 11 NEW	MODE 12 NORM	MODE 12 NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	1/6 μs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e4		4.67e4		4.67e4		4.67e4					
PRP	0.1 μs	2400		1000		2400		1000					
PW_BAUD	1/6 μs	40		10		40		10					
RX_DELAY	.01 μs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 μs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

CONTACT: CRC DATE OF CHANGE: 11/20/91 3:50 PM CST

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0	2	0	2	1	2	1	2	2	2	3	2
ARA	0/1	1	0	1	0	1	0	1	0	1	0	1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0	1	0	1	0	1	0	1	0	1	0	1
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 µs	300	32	32		300	32	32		300	32	32	
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1	0	0		1	0	0		1	0	0	
GCNUM	N	3	21	2	21	3	21	2	21	3	21	2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 µs	2400	1045	1000	1045	2400	1045	1000	1045	2400	1045	1000	1045
PW_BAUD	1/6 µs	40	10	10	10	40	10	10	10	40	10	10	10
RX_DELAY	.01 µs	397	208	208		397	208	208		397	208	208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 µs	10		10		10		10		10		10	
SPAN	N	63	127	63	127	63	127	63	127	63	127	63	127
SPECTRA	N	46	35	35	35	46	35	35	35	26	35	28	35
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24	60	64	60	24	60	64	60	24	60	80	60
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 µs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 µs	10	
TX_BLANK	1/6 µs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 µs	8	

NOTES:

f_{efs} = 752.9

v_{efs} = 354.75

PARAMETER	UNIT	MODE 7 NORM	MODE 7 NEW	MODE 8 NORM	MODE 8 NEW	MODE 9 NORM	MODE 9 NEW	MODE 10 NORM	MODE 10 NEW	MODE 11 NORM	MODE 11 NEW	MODE 12 NORM	MODE 12 NEW
ANT_DIR	CODE	4	2	4	2	5	2	5	2				
ARA	0/1	1	0	1	0	1	0	1	0				
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0	1	0	1	0	1	0	1				
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	1/6 µs	300	32	32		300	32	32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1	0	0		1	0	0					
GCNUM	N	3	21	2	21	3	21	2	21				
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4					
PRP	0.1 µs	2400	1045	1000	1045	2400	1045	1000	1045				
PW_BAUD	1/6 µs	40	10	10	10	40	10	10	10				
RX_DELAY	.01 µs	397	208	208		397	208	208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 µs	10		10		10		10					
SPAN	N	63	127	63	127	63	127	63	127				
SPECTRA	N	46	35	35	35	46	35	35	35				
SSTDODC	0/1	1		1		1		1					
TDA	N	24	60	64	60	24	60	64	60				
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

CONTACT: CRC DATE OF CHANGE: 11-15-91 17:30GMT

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/1	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	1
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 µs	300		32		300		32		300		32	
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 µs	2400		1000		2400		1000		2400		1000	1045
PW_BAUD	1/6 µs	40		10		40		10		40		10	
RX_DELAY	.01 µs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 µs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 µs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 µs	10	
TX_BLANK	1/6 µs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 µs	8	

NOTES:

$f_{ofs} = 956.9$

$v_{ofs} = 354.75$

$$T = \left[\frac{(v_{ofs} - v_{app} - v_{11\omega})}{20.047} \right]^2 \quad (K)$$

		MODE 7		MODE 8		MODE 9		MODE 10		MODE 11		MODE 12	
PARAMETER	UNIT	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	M/S	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	⅙ µs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4					
PRP	0.1 µs	2400		1000		2400		1000					
PW_BAUD	⅙ µs	40		10		40		10					
RX_DELAY	.01 µs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	⅙ µs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

PARAMETER	UNIT	MODE 7		MODE 8		MODE 9		MODE 10		MODE 11		MODE 12	
		NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/I	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0					
DELAY	1/6 µs	300		32		300		32					
DODC	0/I	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e-4		4.67e4		4.67e4		4.67e-4					
PRP	0.1 µs	2400		1000		2400		1000					
PW_BAUD	1/6 µs	40		10		40		10					
RX_DELAY	.01 µs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 µs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/I	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/I	1		1		1		1					
DOPOWCOR	0/I	0		0		0		0					

RADAR PARAMETERS

CONTACT: P. WOOD / C. CORNWALL DATE OF CHANGE: 11/11/91

		MODE 1		MODE 2		MODE 3		MODE 4		MODE 5		MODE 6	
PARAMETER	UNIT	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/1	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	1
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 μs	300		32		300		32		300		32	
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 μs	2400		1000		2400		1000		2400		1000	1045
PW_BAUD	1/6 μs	40		10		40		10		40		10	
RX_DELAY	.01 μs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 μs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 μs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 μs	10	
TX_BLANK	1/6 μs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 μs	8	

NOTES: SITE CHANGES. $f_{ofs} = 956.9$ Hz.

$v_{ofs} = 354.75$ m/s

elevation: 269

latitude: 3730

longitude: 9550

Modem: 0

$$T = \left[\frac{(v_{ofs} - v_{app} - v_{110})}{20.047}\right]^2 \; K$$

PARAMETER	UNIT	MODE 7 NORM	MODE 7 NEW	MODE 8 NORM	MODE 8 NEW	MODE 9 NORM	MODE 9 NEW	MODE 10 NORM	MODE 10 NEW	MODE 11 NORM	MODE 11 NEW	MODE 12 NORM	MODE 12 NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00d0		2.00d0		2.00d0		2.00d0					
DELAY	1/6 µs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e4		4.67e4		4.67e4		4.67e4					
PRP	0.1 µs	2400		1000		2400		1000					
PW_BAUD	1/6 µs	40		10		40		10					
RX_DELAY	.01 µs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 µs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

RADAR PARAMETERS

CONTACT: Chris Cornwall / Paul Hein DATE OF CHANGE: 14 Nov 1991 14:19Gm

		MODE 1		MODE 2		MODE 3		MODE 4		MODE 5		MODE 6	
PARAMETER	UNIT	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	0		0		1		1		2		3	
ARA	0/1	1		1		1		1		1		1	
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 µs	300		32		300		32		300		32	
DODC	0/1	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 µs	2400		1000		2400		1000		2400		1000	
PW_BAUD	1/6 µs	40		10		40		10		40		10	
RX_DELAY	.01 µs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 µs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	
SPECTRA	N	46		35		46		35		26		28	
SSTDODC	0/1	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	
WINDOW	0/1	1		1		1		1		1		1	
DOPOWCOR	0/1	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 µs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 µs	10	
TX_BLANK	1/6 µs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 µs	8	

NOTES: Set all the above Paramet Back to NORM setting

RADAR PARAMETERS

CONTACT: CRC DATE OF CHANGE: 11/15/91 16:15 GMT 10:15 AM CST

PARAMETER	UNIT	MODE 1 NORM	MODE 1 NEW	MODE 2 NORM	MODE 2 NEW	MODE 3 NORM	MODE 3 NEW	MODE 4 NORM	MODE 4 NEW	MODE 5 NORM	MODE 5 NEW	MODE 6 NORM	MODE 6 NEW
ANT_DIR	CODE	0		0		1		1		2		3	2
ARA	0/I	1		1		1		1		1		1	0
CCP_GAIN	N	6		6		6		6		6		6	
CODE	CODE	0		0		0		0		0		0	1
CON_DELTAV	m/s	2.00e0		2.00e0		2.00e0		2.00e0		2.00e0		2.00e0	
DELAY	1/6 µs	300		32		300		32		300		32	
DODC	0/I	1		1		1		1		1		1	
FILTER	CODE	1		0		1		0		1		0	
GCNUM	N	3		2		3		2		3		2	21
POW_FACTOR	REAL	4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4		4.67e-4	
PRP	0.1 µs	2400		1000		2400		1000		2400		1000	~~[illegible]~~
PW_BAUD	1/6 µs	40		10		40		10		40		10	
RX_DELAY	.01 µs	397		208		397		208		397		208	
RX_GAIN	N	255		255		255		255		255		255	
SAMPLE_MIN	N	4		4		4		4		4		4	
SPACE	1/6 µs	10		10		10		10		10		10	
SPAN	N	63		63		63		63		63		63	127
SPECTRA	N	46		35		46		35		26		28	35
SSTDODC	0/I	1		1		1		1		1		1	
TDA	N	24		64		24		64		24		80	60
WINDOW	0/I	1		1		1		1		1		1	
DOPOWCOR	0/I	0		0		0		0		0		0	

COMMON PARMS	UNIT	NORM	NEW
BLANK_TX	1/2 µs	15	
CONSESUS_SET	N	12	
COOLDOWN	S	0	
FREEDELAY	10 ms	50	
NUMGATES	N	36	
NUMMODES	N	10	
TR_TX	1/2 µs	10	
TX_BLANK	1/6 µs	10	
TX_DUTY	0.1%	50	
TX_TR	1/6 µs	8	

NOTES:

f_{ofs} = ~~925.1 Hz~~ 910.0 Hz

PRP = ~~[illegible]~~ 1099 µs

v_{ofs} = ~~[illegible]~~ 337.34 m/s

8723 ·
893.8 · 910.0

low freq ~~[illegible]~~ high ~~[illegible]~~

PARAMETER	UNIT	MODE 7		MODE 8		MODE 9		MODE 10		MODE 11		MODE 12	
		NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW	NORM	NEW
ANT_DIR	CODE	4		4		5		5					
ARA	0/1	1		1		1		1					
CCP_GAIN	N	6		6		6		6					
CODE	CODE	0		0		0		0					
CON_DELTAV	m/s	2.00d0		2.00d0		2.00d0		2.00d0					
DELAY	1/6 μs	300		32		300		32					
DODC	0/1	1		1		1		1					
FILTER	CODE	1		0		1		0					
GCNUM	N	3		2		3		2					
POW_FACTOR	REAL	4.67e4		4.67e4		4.67e4		4.67e4					
PRP	0.1 μs	2400		1000		2400		1000					
PW_BAUD	1/6 μs	40		10		40		10					
RX_DELAY	.01 μs	397		208		397		208					
RX_GAIN	N	255		255		255		255					
SAMPLE_MIN	N	4		4		4		4					
SPACE	1/6 μs	10		10		10		10					
SPAN	N	63		63		63		63					
SPECTRA	N	46		35		46		35					
SSTDODC	0/1	1		1		1		1					
TDA	N	24		64		24		64					
WINDOW	0/1	1		1		1		1					
DOPOWCOR	0/1	0		0		0		0					

tote = 918.0 Hz T = 1.089 ms

f = 868.9 Hz 1.151 ms