NBP0001 Data Report

Feb 15 – Apr 1 2000

Jacobs/Kellogg

United States Antarctic Program

RVIB Nathaniel B. Palmer

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Introduction

The NBP data acquisition systems continuously log data from several instruments throughout the cruise. This document describes the format of that data and its location on the distribution DAT tapes. It also contains important information which may affect how this data is processed such as instrument failures or other known problems with acquisition.

The data collected during this cruise is distributed on two CD-ROMs written in ISO9660 level-1 format. This data format has very strict requirements on filenames and organization. However, it is readable by virtually every computing platform.

The data is contained in a Unix tar archives. All of the data has been compressed using Unix "gzip" compression. Gzipped files have a ".gz" extension. Tools are available on all platforms for uncompressing and de-archiving these formats. On Macintosh, Stuffit Expander 5.5 will open a tar archive and uncompress gzipped and Unix compressed files. For Windows computers WinZip, a shareware utility included on this CD (remember, it is shareware) will open these files.

IMPORTANT: Read the Acquisition Problems and Events section, for important information that may affect the processing of this data.

Archive Data Extraction

It is often useful to know exactly how an archive was produced when expanding its contents. NBP0001.tar was created on an SGI using the following commands:

```
tar cvLf archive-file files-to-be-archived
```

To create a list of the files in the archive:

```
tar tvf  archive-file  > contents.list
```

To extract the files from the archive:

```
tar xvf  archive-file file(s)-to-extract
```

G-zipped files will have a ".gz" extension on the filename. These files can be decompressed after de-archiving, using:

```
gunzip filename.gz
```

The directories in the archive are structured in the following manner:

CD 1

adcp/pingdata files
    config files
ctd/0001ctd.tar
NBP0001.trk
NBP0001.mgd
NBP0001.gmt
NBP0001.ps
report/ 0001data.doc
    0001data.htm
    0001data.txt
geopdata/0001jgof.tar
    0001min.tar
    0001sec.tar
    0001mgd.tar
rvdas/uw/ 0001bar1.tar
    0001bat1.tar
    0001flr1.tar
    0001met1.tar
    0001mag1.tar
    0001oxyg.tar
    0001pco2.tar
    0001sim1.tar
    0001tsg1.tar
rvdas/other/0001eng.tar
    0001wnc.tar
rvdas/cal/ *Calibration Files*
ocean/ 0001pcoM.tar
    0001tsgfl.tar
    0001xbt.tar
NBP0001/ *other cruise data*
utils/ *Mac & PC file compresion utilities*

CD 2

rvdas/nav/00013df1.tar
    0001adcp.tar
    0001gyr1.tar
    0001ngl1.tar
    0001PCOD.tar

Distribution Contents

ADCP

The ADCP data set is broken up into files representing 24 hours of data collection. The files are named pingdata.xxx (xxx representing a day number). Note that these extensions do NOT represent Julian day numbers. Please refer to the file's creation date.

Some ADCP data is also transmitted to RVDAS. East and North vectors for ship's speed relative to the reference layer and ship's heading are archived in the navigational data section of RVDAS.

CTD

The ctd data and report have been placed in the tar file 9909ctd.tar, which contains the fllowing structure:

ctd.list (list of all ctd stations)
ctdsetup/ (batch files, cfg & con files)
data/ (raw datafiles)
plots/ (up & down trace postscript plots)
seasoft4.234/ (application for processing ctd data)

report/section/ (section plots)
casts/ (plots of individual casts)
text/ (ctd data report)
seacat/ (data strucutre for SeaCat ctd)

Individual CTD casts are represented by a set of four files containing a bottle-firing file (.bl), a configuration file (.con), a data file (.dat) and a header file (.hdr). Casts are numbered according to the cruise id number (0001) followed by the number of the cast. For example; the raw files associated with the third cast on this cruise are: 0001003.bl, 0001003.con, 0001003.dat, 0001003.hdr. The raw and processed data files are in binary format. The 1 db bin averaged up and down traces have been converted to ascii (.asc files).

SeaBird's SeaSoft software used to acquire the data is included in the CTD data distribution in the "Seasoft" directory. SeaSoft is a DOS-based software package, but can be run in a DOS window under the Windows9X operating systems for cast playback and data analysis. The software package used to process this data (version 4.234) is included on this CD in the directory **Seasoft**. The configuration files and processing scripts (written by Suzanne O'Hara for the standard processing of the SBE 9/11*plus*) are also included in the **Seasoft** directory under in the **ctdsetup** directory. The directory **report** contains the CTD data report with folder for all plots produced during the cruise. The directory **seacat** gas a strucutre similar to the ctd directory and conatins the data from the SeaCat CTD unit.

File extension definitions:

EXT	**Description**
ASC	The data portion of a .CNV converted data file written in ASCII by ASCIIOUT, or files written by TERM37.
BL	Created by SEASAVE when a bottle fire confirmation is received. Contains bottle sequence number, position, date, time, beginning and ending scan numbers.
BTL	Created by ROSSUM. This is a summary of the data in a .ROS file.
BSR	Bottle scan range file, used by DATCNV to create a .ROS file.
CFG	Used by SEASOFT modules to store the input filename, input data path, output data path, and other miscellaneous module specific parameters.
CTR	Density contour file generated by CONTOUR.
CNV	'Converted' engineering unit data file. An ASCII header precedes the data.
CON	Contains instrument configuration and calibration coefficients, used by SEACON, SEASAVE, and DATCNV
DAT	Raw binary data, optionally with header information (SBE 9/11, 11X, 9/11*plus*, and data files created with previous versions of SEASOFT).
DSP	Used by SEASAVE to store data acquisition and display parameters.
HDR	R. Header portion of a .CNV converted data file written by ASCIIOUT. 2) Header recorded when acquiring real time data or uploading archived data.
HEX	Raw HEX data with header information (SBE 16, 17, 19, 21, and 25)
MRK	Marker file created by SEASAVE during real time data acquisition.

PLT	Used by SEAPLOT to store display parameters
ROS	Scans marked with the bottle fire confirmation bit, or defined by a .BSR file, written by DATCNV.

*Note: This is a complete list of all file extensions. This data set may not contain ALL of the above extension files.

SEASOFT modules search the current directory for DSP, PLT, and CFG files. SEASOFT modules search the 'input data path' for CON, HEX, DAT, and CNV files. One exception is SEACON which searches the current directory for CON files.

For more information and updated software visit the web site at www.seabird.com; or contact (206) 643-9866, seabird@seabird.com, Sea-Bird Electronics 1808 – 136th Place NE Bellevue, WA 98005

Cruise Track

A PostScript cruise track file has been produced for this cruise: NBP0001.ps. NBP0001.ps is poster-sized (36" x 40"). A GMT cruise track file (NBP0001.trk) is also included, which contains the longitude and latitude at one-minute intervals extracted from the NBP0001.gmt file.

Satellite Images

TeraScan image satellite data will be distributed on DDS-3 tapes to the S. Jacobs, S. Li and S. Hill.

NBP Data Products: MGD77 & JGOFS

NBP0001.mgd
/geopdata/

JGOFS

The JGOFS data set consists of a single file produced each day named jgDDD.dat.gz where DDD is the Julian day the data was acquired. The ".gz" extension indicates that the individual files are compressed before archiving. The daily file consists of 20 separate columnar fields in text format, which are described below. The JGOFS data set is obtained primarily by applying calibrations to raw data and decimating to whole minute intervals. However, several fields are derived measurements from more than a single raw input. For example, Course Made Good (CMG) and Speed Over Ground (SOG) are calculated from gyro and GPS inputs by the NGL software package. Similarly, the wind direction field is the vector sum of the separate X and Y inputs received from the wind instrument. The JGOFS data set was used to produce the daily data plots during the cruise. *Note: Null, unused, or unknown fields are filled with 9's in the JGOFS data. TSG data is processed by RVDAS.*

Field	Data	Units
01	GMT date	dd/mm/yy
02	GMT time	hh:mm:ss
03	NGL latitude (negative is South)	dd.dddd
04	NGL longitude (negative is West)	ddd.dddd
05	speed over ground	Knots
06	GPS HDOP	-
07	Gyro Heading	Degrees (azimuth)
08	course made good	Degrees (azimuth)
09	mast PAR	μEinsteins/meters^2 sec
10	sea surface temperature	°C
11	sea surface conductivity	siemens/meter
12	sea surface salinity	PSU
13	sea depth (uncorrected, calc. sw sound vel. 1500 m/s)	meters
14	true wind speed (port windbird)	meters/sec
15	true wind direction (port windbird)	degrees (azimuth)
16	ambient air temperature	°C
17	relative humidity	%
18	barometric pressure	mBars
19	sea surface fluorometry	volts (0-5 FSO)

Field	Data	Units
20	not used	-

MGD77

The MGD77 data set is contained in a single file for the entire cruise named NBP0001.mgd, There is also a file named NBP0001.gmt. This file is the output of the mgd77togmt utility using NBP0001.mgd as input. The “gmt” file can be useful for plotting data using the GMT plotting package. The directory /geopdata/PROC contains a file from each day of data acquisition named: Dddd.fnl.gz, where ddd is the Julian day. These files contain all the data used to produce the “mgd” file, but in a space-delimited columnar format that may be more accessible for some purposes. In addition, these files contain data at one-second intervals rather than one minute and are individually “gzipped” to save space. Below is a detailed description of the MGD77 data set format.

All decimal points are implied. Leading zeros and blanks are equivalent. Unknown or unused fields are to be filled with 9’s. All “corrections”, such as time zone, diurnal magnetic, and Eotvos, are understood to be added.

Col	Len	Type	Description
1	1	int	DATA RECORD TYPE Set to “3” for data record.
2-9	8	char	SURVEY IDENTIFIER
10-14	5	int	TIME-ZONE CORRECTION: In hundredths of hours. Corrects time (in characters 13-27) to GMT when added: equals zero when time is GMT.
15-16	2	int	YEAR 2 digit year
17-18	2	int	MONTH (e.g. May is represented as 05)
19-20	2	int	DAY Day of month
21-22	2	int	HOUR
23-27	5	real	MINUTES X 1000
28-35	8	real	LATITUDE X 100000 + = North; - = South. (–9000000 to 9000000)
36-44	9	real	LONGITUDE X 100000 + = East; - = West. (–18000000 to 18000000)
45	1	int	POSITION TYPE CODE: 1=Observed fix; 3=Interpolated; 9=Unspecified
46-51	6	real	BATHYMETRY, 2- WAY TRAVELTIME: In 10,000th of seconds. Corrected for transducer depth and other such corrections
52-57	6	real	BATHYMETRY, CORRECTED DEPTH: In tenths of meters.
58-59	2	int	BATHYMETRIC CORRECTION CODE: This code details the procedure used for determining the sound velocity correction to depth
60	1	int	BATHYMETRIC TYPE CODE: 1 = Observed; 3 = Interpolated (Header Seq. 12); 9 = Unspecified
61-66	6	real	MAGNETICS TOTAL FIELD, 1ST SENSOR: In tenths of nanoteslas (gammas).
67-72	6	real	MAGNETICS TOTAL FIELD, 2ND SENSOR: In tenths of nanoteslas (gammas). For trailing sensor.
73-78	6	real	MAGNETICS RESIDUAL FIELD: In tenths of nanoteslas (gammas). The reference field used is in Header Seq. 13.
79	1	int	SENSOR FOR RESIDUAL FIELD 1 = 1st or leading sensor; 2 = 2nd or trailing sensor; 9 = Unspecified
80-84	5	real	MAGNETICS DIURNAL CORRECTION: In tenths of nanoteslas (gammas). (In nanoteslas) if 9-filled (i.e., set to “+9999”), total and residual fields are assumed to be uncorrected; if used, total and residuals are assumed to have been already corrected.
85-90	6	F6.0	DEPTH OR ALTITUDE OF MAGNETICS SENSOR: In meters. + = Below sea level 3 = Above sea level
91-9	7	real	OBSERVED GRAVITY: In 10th of mgals. Corrected for Eotvos, drift, tares.
98-10	6	real	EOTVOS CORRECTION: In tenths of mgals. E = 7.5 V cos phi sin alpha + 0.0042 V*V
104-108	5	real	FREE-AIR ANOMALY In tenths of milligals

Col	Len	Type	Description
			Free-air Anomaly = G(observed) – G(theoretical)
109-113	5	char	SEISMIC LINE NUMBER: Used for cross-referencing with seismic data.
114-119	6	char	SEISMIC SHOT-POINT NUMBER
120	1	int	QUALITY CODE FOR NAVIGATION: 5=Suspected, by the originating institution;6=Suspected, by the data center, 9=No identifiable problem found

RVDAS

rvdas/uw
rvdas/nav

RVDAS (Research Vessel Data Acquisition System) was developed at Lamont-Doherty Earth Observatory of Columbia University and has been used on the R/V Maurice Ewing for several years. It was adapted for use on the Nathaniel B. Palmer and her sister ship, the R/V Laurence M. Gould.

Daily data processing of the RVDAS data is performed to convert values into uasable units and as a check of the proper operation of the DAS. Both the raw and processed data sets from RVDAS are included in the data distribution. Below you will find detailed information on the data included. Be sure to read the “Significant Acquisition Events” section below for important information about data acquisition during this cruise.

Meteorological and Light Data

Measurement	File ID	Collect. Status	Rate	Instrument
Air Temperature	met1	continuous	0.5 sec	R. M. young 41342C
Relative Humidity	met1	continuous	0.5 sec	Rotonics MP-101A-C4
Wind Speed/Direction	met1	continuous	0.5 sec	Belfort Model 5-122AHD
PIR (LW radiation)	met1	continuous	0.5 sec	Eppley PIR
PSP (SW radiation)	met1	continuous	0.5 sec	Eppley PSP
PhotoActive Radiation	met1	continuous	0.5 sec	BSI QSR-240
Barometer	bar1	continuous	9 sec	AIR-DB-3A

Navigational Data

Measurement	File ID	Collect. Status	Rate	Instrument
Attitude GPS	3df1	continuous	1 sec	Ashtec 12
P-Code GPS	PCOD	continuous	1 sec	Trimble 20636-00SM
Gyro	gyr1	continuous	0.2 sec	Yokogawa Gyro
NGL	ngl1	continuous	1 sec	NGL Processed Nav Data

Geophysical Data

Measurement	File ID	Collect. Status	Rate	Instrument
Gravimeter	grv1	not collected	n/a	Lacoste & Romberg Gravity
Magnetometer	mag1	collected JD+84	10 sec	EG&G G-866
Bathymetry	bat1	continuous	varies	ODEC Bathy 2000
Bathymetry	sim1	depth < 2500 m	varies	Simrad EK200 Sonar

Oceanographic Data

Measurement	File ID	Collect. Status	Rate	Instrument
Conductivty	tsg1	continuous	15 sec	SeaBird 21
Salinity	tsgfl	continuous	15 sec	calculated from conductivity
Sea S Temperature	tsg1	continuous	15 sec	SeaBird 3-01/S
Fluorometry	flr1 & tsg1	continuous	15 sec	Turner 10-AU-005
pCO_2	pco2	continuous	70 sec	
ADCP	adcp	continuous	1 sec	RD Instruments

Data File Names and Structures

RVDAS data is divided into two broad categories, ***Underway*** and ***Navigation***. The groups are abbreviated “uw” and “nav”. Thus, these two subdirectories exist under the top-level rvdas directory. The instruments are broken down as shown. Each data file is g-zipped to save space on the distribution. Not all data types are collected everyday or on every cruise.

RVDAS data files are named following the convention: NBP[CruiseID][ChannelID].dDDD.

- The CruiseID is the numeric name of the cruise, for example: NBP0001.
- The FileID (aka Channel ID) is a 4-character code representing the system being logged, for example: met1 (for meteorology)
- DDD is the Julian day of the data collection

Underway Data	Channel ID
Barometer	bar1
Bethy 2000	bat1
Fluorometer	flr1
Gravimeter	grv1
Magnetometer	mag1
Meteorological	met1
Simrad	sim1
Thermosalinograph	tsg1
pCO_2	pco2

Navigation Data	Channel ID
Ashtech GPS	3df1
Trimble GPS (P-Code)	PCOD
Gyro Compass	gyr1
Furuno GPS	gp02
NGL	ngl1
ADCP course	adcp

Data is received by the RVDAS system via RS-232 serial connections. The data files that comprise the rvdas data set are described below. A time tag is added to each line of data received and the data is written to disk.

```
YY+DDD:HH:MM:SS.SSS [data stream from instrument]
```

Where, YY: two-digit year, DDD: Julian Day, HH: 2 digit hours, MM: 2 digit minutes SS.SSS: seconds. All times are UTC.

The delimters used to separate fields in the raw data files are usually spaces and commas, but other delimiters are used (::, =, @) and occasionaly there is no delimiter. Care should be taken when reprocessing the data that the fields separations are clearly understood. An example data

bar1

```
00+019:23:59:57.441  963.25
```

Field	Data	Units
1	Time Tag	
2	Pressure	mBar

bat1

```
00+019:23:59:53.901 ;I04485.3ME-23.0,I00000.0,-99.9, 0000@01/11/00,23:59:52.08 PW2 PF1 SF1 PL3
MO4 SB3 PO0 TX1 TR: GM5 1500 06.7 -72.1
```

Field	Data	Units
1	RVDAS Time Tag	
2	Flagged Low Freq. Chn. Depth w/ units ;FDDDDD.DUN F= V valid, I invalid	meters
3	Low Freq. Echo Strength EEE.EE	dB
4	Flagged High Freq. Chn. Depth – unused	
5	High Freq. Echo Strength – unused	
6	Signed Heave Data SHHHH	cm
7	Date	mm/dd/yy
8	Time	hh:mm:ss
9	transmit pulse window type: PW1 Rectangular, PW2 Hamming, PW3 Cosine, PW4	

Field	Data	Units
	Blackman	
10	Primary transmit frequency PF1 3.5 kHz, PF2 12.0 kHz	
11	Parametric mode secondary freq. SF1 3.5 kHz, SF2 12.0 kHz	
12	pulse length: PL1 200usec, PL2 500usec, PL3 1msec, PL4 2msec, PL5 5msec, PL6 10msec, PL7 25msec. If transmit mode is FM: PL1 25msec, PL2 50msec, PL3 100msec.	
13	Operating Mode: MO1 CW parametric, MO2 CW, MO3 FM parametric, MO4 FM	
14	Frequency sweep bandwidth: SB1 1 kHz, SB2 2 kHz, SB3 5 kHz	
15	power level: PO1 0dB, PO2 -6dB, PO3 -12dB, PO4 -18dB, PO5 -24dB, PO6 -30dB, PO6 -30 dB, PO7 -36dB, PO8 -42dB	
16	Transmit Mode: TX1 single ping active, TX2 pinger listen, TX3 multipinging TR, TX4 multipinging TR, TX5 multipinging TTRR, TX6 mulitpinging TTTTRRRR, TX7 mulitpinging TTTTTRRRRR	
17	Transmit Rate: TR3 4Hz, TR4 2Hz, TR5 1Hz, TR6 .5Hz, TR7 .33Hz, TR8 .25Hz, TR9 .20Hz, TR: = .10Hz, TR; = .05Hz	
18	System Gain Mode: GM0 hydrographic AGC, GM1 to GM9 hydrographic +3db to + 27db manual. GMA to GMD hydrographic + 30db through + 60db manual, GME to GMK sub-bottom 1 through sub-bottom 7	
19	speed of sound	m/sec
20	depth of sonar window below sea-level	meters
21	background noise level in fixed point reference	dB/V

flr1

```
00+019:23:59:58.061 0  0818 ::  1/19/00 17:23:17 = 0.983  (RAW)   1.2 (C)
```

Field	Data	Units
1	RVDAS Time Tag	
2	marker 0 to 8	
3	4-digit index	
4	date	mm/dd/yy
5	time	hh:mm:ss
6	signal	
7	signal units of measurement	
8	cell temperature	
9	temperature units	

grv1

```
99+099:00:18:19.775 your_line#1999 99 01818 9735.4
```

Field	Data	Units	Conversion
1	RVDAS Time Tag		
2	text string		
3	gravity device date	yyyyjjjhhmmss	
3	gravity count	count	mgal = count x 1.0047 + offset

mag1

```
99+099:00:00:23.203 %  0  98 235928    0?372453
```

Field	Data	Units
1	RVDAS Time Tag	
2	% 0 denotes G-866 magnetometer	
3	Julian Day	
4	Time	
5	0? denotes high noise condition	
6	Magnetic Data (last digit is 10th's place)	nT

met1

```
00+019:23:59:59.761 $MET:  0.84, 1.12, 0.76, 1.06, 4.98, 0.26, 1.49, 3.93, 8.94, 0.80, 0.01,
0.01, 0.01, 0.22, 0.02, 0.1,40.11,4.96
```

Field	Data	Units	Conversion
1	RVDAS Time Tag		
2	$MET		
3	starboard windbird north rel. speed vector voltage	V	m/s = 7.553 x voltage
4	starboard windbird east rel. speed vector voltage	V	m/s = 7.553 x voltage
5	Port windbird north rel. speed vector voltage	V	m/s = 7.553 x voltage
6	Port windbird east rel. speed vector voltage	V	m/s = 7.553 x voltage
7	Air temperature	V	°C = 10 x voltage - 50
8	PIR Eppley Pyrgeometer	V	W/m^2 = 923.87 x voltage
9	PSP Eppley Pyranometer	V	W/m^2 = 194.53 x voltage
10	Temperature at the Relative Humidity Sensor	V	°C = 10 x voltage – 40
11	Relative Humidity	V	%RH = 10 x voltage
12	PAR Irradiance	V	□Ei/m^{2}s = 1662.24 x voltage
13	spare		
14	high resolution infrared sensor (S. Li's instrument)	V	
15	direct output infrared sensor (S. Li's instrument)		
16	spare		
17	spare channels		
18	AC line voltage	V	VAC = 150 x voltage
19	uMac Temperature	C	
20	uMac DC Supply	V	

pCO_2

```
00+021:23:59:43.190 2000021.9992 2382.4 984.2 30.73 50.8 345.9 334.1 -1.70 -68.046 -144.446 Equil
```

Field	Data	Units
1	RVDAS Time Tag	
2	pCO_2 Time Tag (decimal is time of day)	yyyjdd.fod
3	raw voltage	mV
4	barometer	mBar
5	cell temperature	°C
6	flow rate	cm^3/min
7	concentration	ppm
8	pCO_2 pressure	microAtm
9	Equilibrated temperature	°C
10	Latititude	degrees
11	Longitude	degrees
12	Flow Source (Equil = pCO_2 measurement)	

sim1

```
00+005:00:00:52.388 D1,23583509,1479.6, 17,  1,  0
```

Field	Data	Units
1	RVDAS Time Tag	
2	Header	
3	Time Tag	hhmmss.sss
4	depth	m
5	bottom surface backscattering strength	dBar
6	transducer number (1 = 38 kHz)	
7		

tsg1

```
00+019:23:59:46.976 15A16CFC163F8C2C100
```

Field	Data	Units
1	RVDAS Time Tag	
2	Seabird Hex string (see notes on converting to real units)	

3df1

PBEN: Measurement Data

```
00+019:23:59:57.054 $PASHR,PBN,345609.00,-1695527.0,-1569301.4,-5925126.0,-068:49.6968,-
137:12.8448,00047.7,-000.69,000.67,-000.51,08,????,02,01,02,01*32
```

Field	Data	Units
1	RVDAS Time Tag $PASHR	
2	PBN	
3	GPS Time sec. of the week	seconds
4	Station Postion: ECEF X	meters
5	Station Postion: ECEF Y	meters
6	Station Postion: ECEF Z	meters
7	Latitude (- = South)	deg:min
8	Longitude (- = West)	deg:min
9	altitude	meters
10	velocity in ECEF X	m/sec
11	velocity in ECEF Y	m/sec
12	velofity in ECEF Z	m/sec
13	number of satellites used	
14	site name	
15	PDOP	
16	HDOP	
17	VDOP	
18	TDOP	

ATTD: Attitude Data

```
00+019:23:59:57.854 $PASHR,ATT,345610.0,252.82,+000.52,+001.95,0.0011,0.0068,0
```

Field	Data	Units
1	RVDAS Time Tag $PASHR	
2	ATT	
3	GPS Time sec. of the week	seconds
4	heading (rel. to true North)	degrees
5	pitch	degrees
6	roll	degrees
7	Measuremnet RMS error	meters
8	Baseline RMS error	meters
9	attitude reset flag	

GGA: GPS Position Fix – Geoid/Ellipsoid

```
00+019:23:59:57.134 $GPGGA,235956.00,6849.6968,S,13712.8448,W,1,08,01.0,+00048,M,,M,,
```

Field	Data	Units
1	RVDAS Time Tag $GPGGA	
2	UTC time at position	hhmmss.ss
3	Latitude	ddmm.mmm
4	North (N) or South (S)	
5	Longitude	ddmm.mmm
6	East (E) or West (W)	
7	GPS quality (1=GPS 2=DGPS)	
8	Number of GPS satellites used	
9	HDOP	
10	Antenna Height	meters
11	M for Meters	
12	Geoidal height	meters
13	M for meters	

Field	Data	Units
14	age of diff. GPS data	
15	differential reference station ID	

gyr1

```
00+019:23:59:59.952 $HEHRC25034,-020*73
```

Field	Data	Units
1	RVDAS Time Tag	
2	$HEHRC	
3	Heading XXXXX = ddd.dd	degrees
4	Rate of Change SYYY S = +/-, YYY = r.rr	
5	Checksum	

ngl1

```
00+019:23:59:59.857 -68.82822,-137.21416,1.10,279.27,251.10,0.00,0.00,0,18.2587,1,1146973
```

Field	Data	Units
1	RVDAS Time Tag	
2	Latitude (south is negative)	degrees
3	Longitude (west is negative)	degrees
4	Ship Speed	knots
5	Course made good	degrees
6	Gyro Heading	degrees
7	PDOP	
8	HDOP	
9	quality	
10	GPS up	
11	Fix Number	

PCOD

GGA: GPS Position Fix – Geoid/Ellipsoid

```
00+019:23:59:59.301 $GPGGA,235958.409,6849.6944,S,13712.8472,W,1,06,1.2,092.4,M,047.3,M,,*67
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPGGA	
3	UTC time at position	hhmmss.sss
4	Latitude	ddmm.mmm
5	North (N) or South (S)	
6	Longitude	ddmm.mmm
7	East (E) or West (W)	
8	GPS quality (1=GPS 2=DGPS 3=P-CODE)	
9	Number of GPS satellites used	
10	HDOP	
11	Antenna Height	meters
12	M for Meters	
13	Geoidal height	meters
14	M for meters	
15	age of diff. GPS data	
16	differential reference station ID	
17	checksum	

GLL: GPS Latitude/Longitude

```
00+019:23:59:59.381 $GPGLL,6849.6944,S,13712.8472,W,235958.409,A*35
```

Field	Data	Units
1	RVDAS Time Tag	

Field	Data	Units
2	$GPGLL	
3	Latitude	degrees
4	North or South	
5	Longitude	degrees
6	East or West	
7	UTC of position	hhmmss.sss
8	staus of data (A = valid)	
9	checksum	

VTG: GPS Track and Ground Speed

```
00+019:23:59:59.382 $GPVTG,238.7,T,182.3,M,001.8,N,003.3,K*41
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPVTG	
3	heading	degrees
4	degrees True (T)	
5	heading	degrees
6	degrees magnetic (M)	
7	Ship speed	knots
8	N = knots	
9	speed	km/hr
10	K = km per hour	
11	checksum	

adcp

```
00+019:23:59:59.099 $PUHAW,UVH,-1.48,-0.51,250.6
```

Field	Data	Units
1	RVDAS Time Tag	
2	$PUHAW	
3	UVH (E-W, N-S, Heading)	
4	Ship Speed relative to reference layer, East vector	kn
5	Ship Speed relative to reference layer, North vector	kn
6	Ship heading	degrres

Ocean Data Files

ocean/

tsgfl

```
00+075:00:00:04.467 -01.488 -01.720 02.6783 33.63748 1.002442 0.002442
```

Field	Data	Units
1	RVDAS Time Tag	
2	Internal water temperature	°C
3	Sea Surface Temperature	°C
4	Conductivity	□Siemens
5	Salinity	PSU
6	Fluorometry	V
7	unused	

xbt

During the cruise Expendable Bathythermographs were used to obtain water column temperature profiles. These were used to adjust the sound velocity profile for the SeaBeam system. The data files from these launches are included.

pCO2-merged

Some data files are "processed" into a slightly different form. The pCO_2 data is merged with data from other sources for ease of data analysis.

```
00+019:23:58:15.502 2000019.9983 2445.2 965.0 32.90 52.8 372.3 352.5 -1.27 -68.8285 -137.2080
Equil -68.8280 -137.2079 -1.58 33.60 0.97 9.06 307.23 50.0
```

Field	Data	Units
1	RVDAS Time Tag	
2	pCO_2 Time Tag (decimal is time of day)	yyyjdd.fod
3	raw voltage	mV
4	barometer	mB
5	cell temperature	°C
6	flow rate	cm^3/min
7	concentration	ppm
8	pCO_2 pressure	microAtm
9	Equilibrated temperature	°C
10	Latitude	degrees
11	Longitude	degrees
12	Flow Source (Equil = pCO_2 measurement)	
13	RVDAS latitude	degrees
14	RVDAS longitude	degrees
15	TSG external temperature	°C
16	TSG salinity	PSU
17	TSG fluorometry	V
18	RVDAS true wind speed	m/s
19	RVDAS true wind direction	degrees
20	uncontaminated seawater pump flow rate	l/min

PROCESSING DATA

RAW TSG

Raw TSG data is stored as a hex string 20 bytes long.

Bytes	Data
1-4	Sensor Temperature
5-8	Conductivity
9-14	Remote Temperature
15-17	Fluorometer voltage
18-20	unused voltage

In all of the formulas listed below, the variables can be found in the TSGcal file.

Calculating Temperature

T = decimal equivalent of bytes 1-4
Temperature Frequency: f = T/19 +2100
q = ln(fo/f)
Temperature = 1/{a + b * q + c * q2 + d * q3} -273.15 (degrees C)

Calculating Conductivity

C = decimal equivalent of bytes 5-8
Conductivity Frequency f = sqrt(C*2100+6250000)
Conductivity = (afm +bf2 +c +dt)/[10(1+ep)] (siemens/meter)
note e = epsilon in the TSGcal file

Claculating Fluorometry Voltage

f = decimal equivalent of bytes 15-17
Fluorometry Voltage = f/819

PAR

raw data = V
calibration scale = 9.99 x 10^{-18} V/(quanta/cm ^{2}sec)
offset (V_{dark}) = 0.3 mV
(((V - V_{dark})/scale)/6.022 x 10^{23})x10^{4} cm^{2}/m^{2} x 10^{6} = μEinstiens/m^{2}sec
or
(V - V_{dark}) x 1662.24 = μEinstiens/m^{2}sec

PSP

raw data = V
calibration scale = 8.31 x 10^{-6} V/(W/m^{2})
signal conditioner1 = 309.3
signal conditioner2 = 2
V / (scale x conditioner1 x conditioner2) = W/m^{2}
or

V x 194.53 (W/m^{2})/V = W/m^{2}

PIR

raw data = V
calibration scale = 3.52 x 10^{-6} V/(W/m^{2})
signal conditioner1 = 307.5
signal conditioner2 = 1
V / (scale x conditioner1 x conditioner2) = W/m^{2}
or
V x 923.87 (W/m^{2})/V = W/m^{2}

NBP0001 Sensors

Shipboard Sensors

Sensor	Description	Serial #	Cal. Date	Status
Port Anemometer	Belfort 5-122AHD	7957	4/1/99	collect
Stbd Anemometer	Belfort 5-122AHD	92-2133	6/23/98	collect
Barometer	Atmospheric Instr. AIR-DB-3A	7G3095	5/17/99	collect
Mast PRR	BSI PRR-610	9696	3/18/99	not collect
UW PRR	BSI PRR-600	9695	3/18/99	not collect
Rel. Hum./Air Temp	Rotronics MP-101A-C4	R45618	5/12/99	collect
Mast PAR	BSI QSR-240	6357	7/29/99	collect
P-Code GPS	Trimble 20636-00 (SM)			PCD/CIV
Attitude GPS	Ashtech 12	700273F2114 FW 7B13-D1-C21		collect
Pyranometer	Eppley PSP	28933F3	7/23/98	collect
Pyrgeometer	Eppley PIR	28903F3	7/23/98	collect
Dry Air Temp	R. M. Young 41342C	2267	10/1/99	collect
TSG	SeaBird SBE21	218091-1390	11/20/99	collect
TSG Remote Temp	SeaBird 3-01/S	031267	8/24/99	collect
Fluorometer	Turner 10-AU-005 Lamp: daylight 10-045, reference filter: 10-052, emission filter: 10-051, excitation filter: 10-050.	5651 FRTD		collect
Magnetometer	EG&G G-866			collect
Gravimeter	Lacoste & Romberg Gravity Meter			not collect
Bathymetry	Simrad EK200	3001	11/1/95	collect
Bathymetry	Bathy 2000			collect

0001 CTD Sensors

See CTD data report.

Acquisition Problems and Events

This section lists all known problems with acquisition during this cruise including instrument failures, data acquisition system failures and any other factor affecting this data set. The format is jjj:hh:mm (jjj is julian day, hh is hour, and mm is minute). All times are in GMT.

Start	End	Description
045:03:00		Start data collection
045:06:30	045:07:00	Restarted Challenger
054:23:56	055:00:19	rv_nav stopped sending navigation to SeaBeam. Restarted rv_nav.
066:20:22	067:01:30	Uncontaminated seawater supply line broken. Switched to large pump bypassing external seawater temperature sensor. Repaired and small pump back on line.
070:03:20	070:04:30	Seawater supply line filled with slush. Backflowed to clear.
076:18:00	076:18:10	Met system shut down temporarily to install new signal conditioning module in spare A/D channel for use with temporary IR light sensor installed on bridge wing. Sensor run by S. Li.
090:04:30		End Data collection at 200 mi limit

Calibrations

Additional scans of calibration certifications can be found in /rvdas/cal/ on CD1.

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1390
CALIBRATION DATE: 20-Nov-99

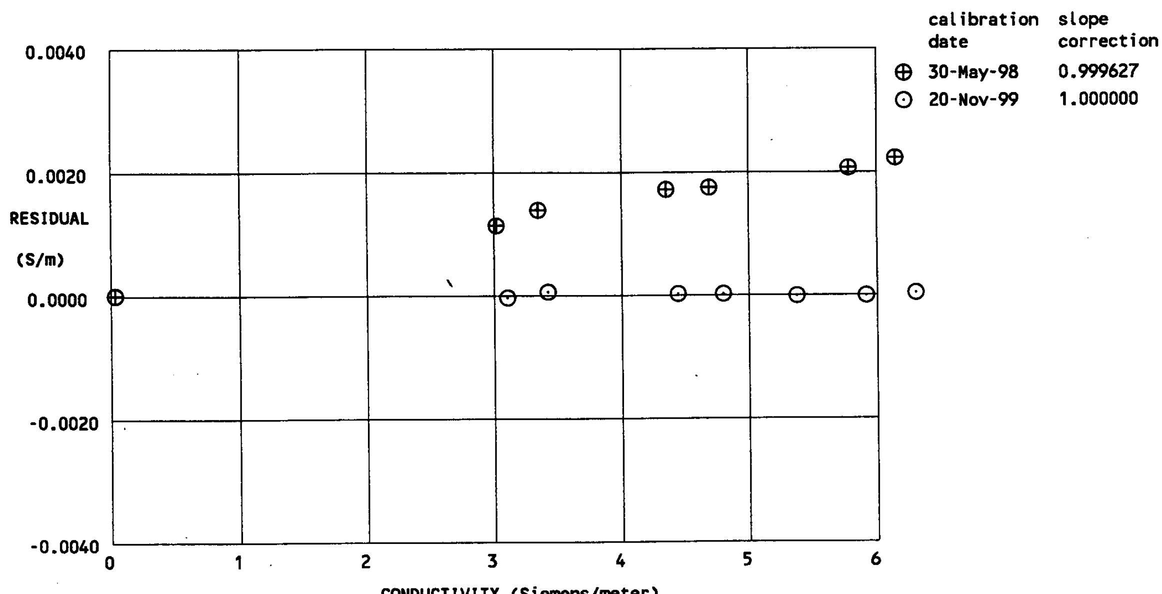
CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

GHIJ COEFFICIENTS
g = -3.93202500e+00
h = 4.70256307e-01
i = 7.32400918e-04
j = -1.40591115e-05
CPcor = -9.57e-08 (nominal)
CTcor = 3.25e-06 (nominal)

ABCDM COEFFICIENTS
a = 1.47556503e-02
b = 4.52645265e-01
c = -3.91849365e+00
d = -9.05554567e-05
m = 2.2
CPcor = -9.57e-08 (nominal)

BATH TEMP (ITS-90 °C)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88550	0.00000	0.00000
1.0000	36.0948	3.07458	8.53995	3.07454	-0.00004
4.5000	36.0923	3.39296	8.92178	3.39301	0.00005
15.0000	36.0872	4.41063	10.04412	4.41064	0.00001
18.4999	36.0860	4.76818	10.40948	4.76819	0.00001
23.9999	36.0835	5.34578	10.97375	5.34576	-0.00002
29.0000	36.0788	5.88528	11.47555	5.88526	-0.00002
32.5000	36.0722	6.26964	11.81996	6.26966	0.00002

Conductivity = $(g + hf^2 + if^3 + jf^4) / [10(1 + \delta t + \epsilon p)]$ Siemens/meter
Conductivity = $(af^m + bf^2 + c + dt) / [10(1 + \epsilon p)]$ Siemens/meter
t = temperaure [deg C]; p = pressure [decibars]; δ = CTcor; ϵ = CPcor;
Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1267
CALIBRATION DATE: 24-Aug-99s

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.76589627e-03
h = 6.64017768e-04
i = 2.81990688e-05
j = 2.59225365e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.68147123e-03
b = 5.89535209e-04
c = 1.46836969e-05
d = 2.59371452e-06
f_0 = 5704.680

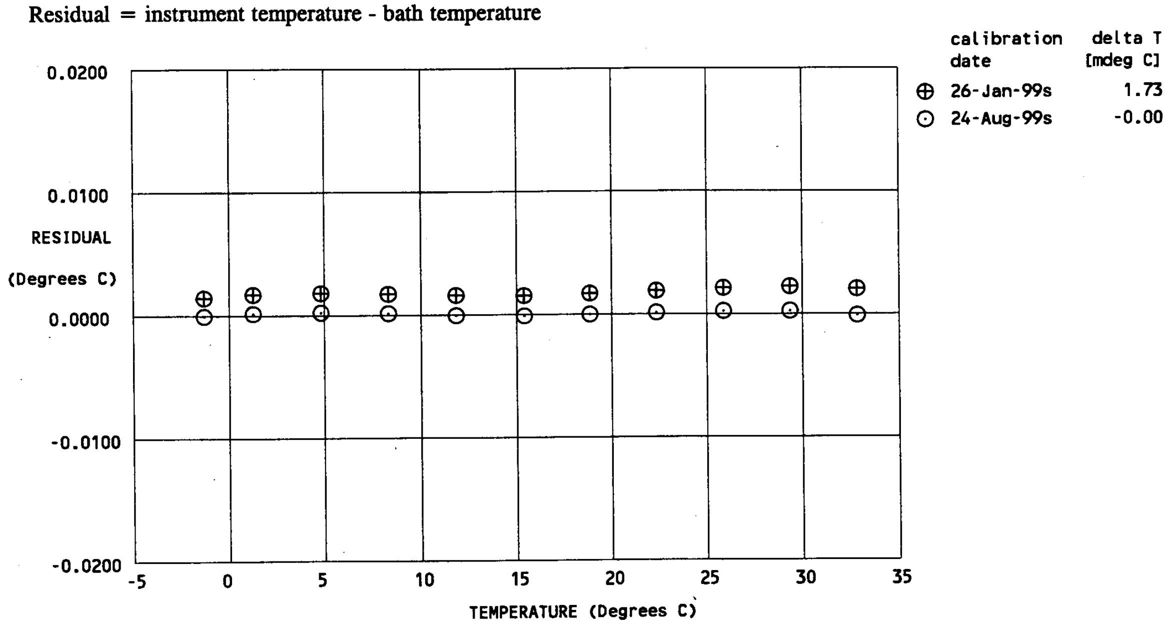
BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
-1.5190	5704.680	-1.5191	-0.00012
1.0420	6047.926	1.0421	0.00008
4.6165	6551.731	4.6167	0.00017
8.1236	7074.738	8.1236	0.00006
11.6276	7626.485	11.6274	-0.00012
15.1881	8217.832	15.1879	-0.00019
18.6521	8823.592	18.6521	-0.00008
22.1530	9466.943	22.1531	0.00005
25.6807	10147.563	25.6809	0.00016
29.1521	10849.626	29.1522	0.00016
32.6273	11585.097	32.6271	-0.00018

Temperature ITS-90 $= 1/\{g + h[\ell n(f_0/f)] + i[\ell n^2(f_0/f)] + j[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 $= 1/\{a + b[\ell n(f_0/f)] + c[\ell n^2(f_0/f)] + d[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C).

Residual = instrument temperature - bath temperature



SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1390
CALIBRATION DATE: 20-Nov-99

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.19943404e-03
h = 6.02868891e-04
i = 5.34296192e-06
j = -1.77943713e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.64763555e-03
b = 5.88552771e-04
c = 1.03072229e-05
d = -1.77889932e-06
f_0 = 2522.389

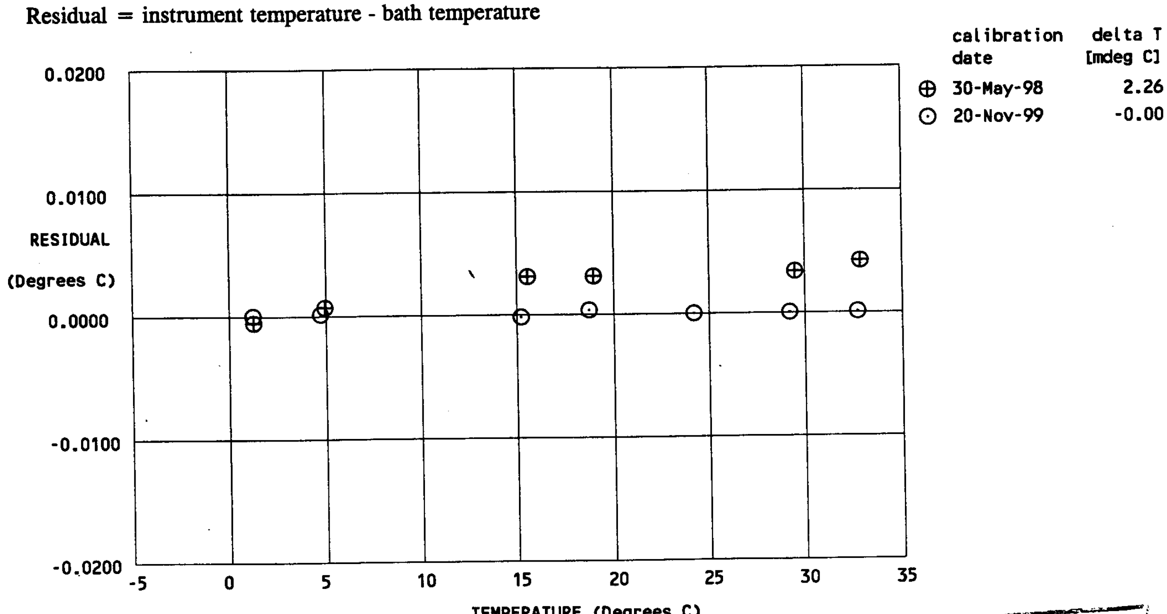
BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
1.0000	2522.389	1.0000	-0.00004
4.5000	2727.711	4.5001	0.00009
15.0000	3414.661	14.9997	-0.00026
18.4999	3668.526	18.5002	0.00027
23.9999	4093.784	23.9998	-0.00005
29.0000	4509.404	29.0000	-0.00002
32.5000	4817.316	32.5000	0.00001

Temperature ITS-90 $= 1/\{g + h[\ell n(f_0/f)] + i[\ell n^2(f_0/f)] + j[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 $= 1/\{a + b[\ell n(f_0/f)] + c[\ell n^2(f_0/f)] + d[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be $1.00024 * T_{90}$ (-2 to 35 °C).

Residual = instrument temperature - bath temperature



POST CRUISE CALIBRATION

Biospherical Instruments Inc.

CALIBRATION CERTIFICATE

Calibration Date	7/29/99
Model Number	QSR-240
Serial Number	6357
Operator	JSR
Standard Lamp	94532(03/13/98)
Probe Excitation Voltage Range:	5 to 18 VDC(+)
Output Polarity:	POSITIVE

Probe Conditions at Calibration(in air):

Calibration Voltage:	6	VDC(+)
Probe Current:	1.2	mA

Probe Output Voltage:

Probe Illuminated	85.9	mV
Probe Dark	0.3	mV
Probe Net Response	85.6	mV

Corrected Lamp Output:

Output In Air (same condition as calibration):

8.57E+15 quanta/cm²sec

Calibration Factor:
(To calculate irradiance, divide the net voltage reading in Volts by this value.)

Dry: 9.99E-18 V/(quanta/cm²sec)

Notes:
1. Annual calibration is recommended.
2. Calibration is performed using a Standard of Spectral Irradiance traceable to the National Institute of Standards and Technology (NIST).
3. The collector should be cleaned frequently with alcohol.
4. Calibration was performed with customer cable, when available.

QSR240R 05/24/95

THE EPPLEY LABORATORY, INC.
12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA
Telephone: 401-847-1020 Fax: 401-847-1031

EPLAB
Scientific Instruments for Precision Measurements Since 1917

STANDARDIZATION OF EPPLEY PRECISION INFRARED RADIOMETER (PYRGEOMETER) Model PIR

Serial Number: 28903F3

Resistance: 683 Ω at 23 °C
Temperature Compensation Range: -20 to 40 °C

This radiometer has been compared with Precision Infrared Radiometer, Serial Number 29326F3 in Eppley's Blackbody Calibration System under radiation intensities of approximately 200 watts meter^{-2} and an average ambient temperature of 25 °C.

As a result of a series of comparisons, it has been found to have a sensitivity of:

3.52 x 10^{-6} volts/watts meter^{-2}

2.45 millivolts/cal cm^{-2} min^{-1}

The calculation of this constant is based on the fact that the relationship between radiation intensity and emf is rectilinear to intensities of 700 watts meter^{-2}. This radiometer is linear to within ± 1.0% up to this intensity.

The calibration of this instrument is traceable to the International Practical Temerature Scale (IPTS) through a precision low-temperature blacbody.

Useful conversion facts: 1 cal cm^{-2} min^{-1} = 697.3 watts meter^{-2}
1 BTU/ft^{2}-hr^{-1} = 3.153 watts meter^{-2}

Shipped to:
Antarctic Support Associates
Port Hueneme, CA

S.O. Number: 57070
Date: July 30, 1998

Date of Test: July 23, 1998

In Charge of Test: Richard H. Hatch

Reviewed by: Thomas D Kirk

Remarks:

THE EPPLEY LABORATORY, INC.
12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA
Telephone: 401-847-1020 Fax: 401-847-1031

EPLAB
Scientific Instruments
for Precision Measurements
Since 1917

STANDARDIZATION
OF
EPPLEY PRECISION SPECTRAL PYRANOMETER
Model PSP

Serial Number: 28933F3

Resistance: 685 Ω at 23 °C
Temperature Compensation Range: -20 to 40 °C

This radiometer has been compared with Standard Precision Spectral Pyranometer, Serial Number 21231F3 in Eppley's Integrating Hemisphere under radiation intensities of approximately 700 watts meter^{-2} (roughly one-half a solar constant). The adopted calibration temperature is 25 °C.

As a result of a series of comparisons, it has been found to have a sensitivity of:

8.31 x 10^{-6} volts/watts meter^{-2}

5.79 millivolts/cal cm^{-2} min^{-1}

The calculation of this constant is based on the fact that the relationship between radiation intensity and emf is rectilinear to intensities of 1400 watts meter^{-2}. This radiometer is linear to within ± 0.5% up to this intensity.

The calibration was made with both hemispheres made of Schott WG295 glass. This value should be *increased* for other Schott hemispheres as follows:

GG395: 0.0%, OG530: 0.5%, RG610: 1.5%, RG695: 2.0%

The calibration of this instrument is traceable to standard self-calibrating cavity pyrheliometers in terms of the Systems Internationale des Unites (SI units), which participated in the Eighth International Pyrheliometric Comparisons (IPC VIII) at Davos, Switzerland in October 1995.

Useful conversion facts: 1 cal cm^{-2} min^{-1} = 697.3 watts meter^{-2}
1 BTU/ft^2-hr^{-1} = 3.153 watts meter^{-2}

Shipped to:
Antarctic Support Associates
Port Hueneme, CA

S.O. Number: 57070
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In Charge of Test: Richard H. Hatch

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Remarks: