LMG09-02

FoodBancs2 Part 3

Cruise Data Report

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Introduction

The LMG data acquisition systems continuously log data from a suite of instrumentation throughout the cruise. This document describes the format of that data and its location on the distribution CDs. It also contains important information that 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 a CD-ROM 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.

All of the data has been archived with the Unix "tar" command and/or compressed using Unix "gzip" compression.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

In some cases to adhere to the ISO9660 format the .tar extension was removed. When we tarred the files then gzip the tar archive the name of the file became *File*.tgz. This name does not follow the 8.3 naming convention of the ISO9660 format. On Windows and Mac Platforms Winzip and Stuffit Expander handles this just fine. When they expand the *File*.gz the expanded file becomes *File*.tar, which both software packages can handle. On Unix platforms gunzip expands *File*.tgz but it does not append the .tar extension. So you may not recognize the file as a tar archive, but OS does recognize it as a tar archive. If you use the file command it will return saying it is a tar file. The below tar command will un-archive the file just fine.

IMPORTANT: Read the last section in this document, Acquisition Problems and Events, 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. Tar files were created using the following commands:

```
tar cvf 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
```

CD Directory Structure

ADCP: ADCP.tar Cal: InstCoef.txt CTD: ctd.tar Imagery: Imag.tar Maps: LMG0901.track LMG0901_map.jgp LMG0901_map.ps Process: JGOF.tar PCO2.tar PROC.tar QC.tar Report: Report.doc RVDAS: lmgnav.tar lmguw.tar	Salts: LMG09-01SB TSG-Salinity Survey.xls LMG09-01SB.pdf Science: B-019 B-020 B-021 B-045 POD LTER Event Log LMG 0901.xls TCO2: TCO2log.pdf Utility: Acrobat Winzip XBT: Xbt.tar XBT_log.xls XCTD: Xctd.tar XCTD_Log.xls	

Distribution Contents

ADCP

/Adcp/

This directory contains a tar file of gentoo's proc directory, which contains a database of the averaged ping data, Matlab m-files used in processing the data, and daily graphs of the currents. For more information contact Teri Chereskin at tchereskin@ucsd.edu. Processed data is usually available shortly after the cruise at http://currents.soest.hawaii.edu

Calibration

/Cal/

The tar files in the Cal directory contain images of calibration sheets for each of the following systems: Sound Velocity Probe (SVP_CALS.TAR), Meteorological System (MET_CALS.TAR), Underway System (UW_CALS.TAR), and CTD_CALS.pdf.

Refer to the InstCoef.txt file along with the specific instrument calibration sheets, both located in this directory, for information on how the RVDAS data was collected and processed.

CTD

CTD/

CTD/Scripts/

This directory contains the control files used for preliminary processing of the data. Processing performed by the vessel technicians is for *quality control purposes* ***only***, as a check that the instruments are performing correctly.

CTD//raw

Contains the raw data from the instrument.

CTD/process

Contains the files generated as a result of the preliminary post processing. For more details, refer to the SBE Data Processing documentation available on the SeaBird website (http://www.seabird.com).

Ice Images

/ICE_IMAGE/

This directory contains .jpg files of Terrascan ice imagery sent to the ship from Palmer station to aid in navigation of the ship and science.

Isobar Charts

/Isobars/

This directory contains GIF image files. These file are an analysis of mean sea level pressure from the National Center for Environmental Prediction's Medium Range Forecast Model. They are updated every 6 hours. Naming the convention is as follows yyjjj.hh.gif where yy is the year, jjj is the day number, and hh is the hour.

Data and Science Report

/Report/

Copies of this report in MS Word, HTML, and text formats.

Sitrep

/Sitrep/

If this directory exists, it contains copies of the vessels Daily Situation Report.

XBT

/XBT/

Expendable Bathythermographic (XBT) “Deep Blue” probes were used to obtain water column temperature profiles. The dataset includes the following files:

dat.zip	The probe drop schedule and other configuration files.
efiles.zip	The edited data files.
log.zip	The log files for drop and GPS positioning.
nav.zip	The navigation files.
sfiles.zip	The raw data files.
*.pdf	Scanned images of the paper log sheets.

XCTD

/XCTD/

Expendable Conductivity, Temperature, and Depth (XCTD) digital probes were used to obtain water column temperature and Salinity profiles. The two files were created for each drop .RDF files contain the raw data, and the .EDF contain the exported ascii data.

TCO2

/TCO2/

This directory contains the log sheet for the TCO2 sample during the Drake Transect Sampling. For further information on this data, contact Tim Newberger at ***tnewberg@ldeo.columbia.edu***

Salts

/SALT/

This directory contains the log sheet for the Salt sample take during the Drake Transect Sampling, also a spreadsheet containing the Salt sample and TSG comparison. These samples were analyzed with the onboard AutoSal by the MST.

Drifters

/DRIFTERS/

This directory contains the log sheet for the drifter buoys released during the Drake Transect.

Science

/Science/

This directory contains data and photos collected by the individual scientists.

Maps

/Maps/

If this directory is present, it contains maps generated by vessel staff or provided by the science party. Maps may be in any number of formats, some of which may be proprietary or vendor specific. Maps generated by the Marine Electronics and Instrument Specialists are typically JPEG images.

WAYPOINTS

/WAYPTS/

If this directory is present, it contains files in CSV format detailing various navigation waypoints.

QC Plots

/QC_PLOTS/

Postscript files of data stored each day on RVDAS for quality control analysis during the cruise. There are 3 types of files, named metXXX.ps, navXXX.ps, and oceanXXX.ps, where XXX is represents the Julian day. Met files are a summary of the data from the meteorological instruments, Nav files are a summary of navigational data, and Ocean files are a summary of the underway seawater and bathymetry data.

JGOFS Data Set

/JGOF/

The JGOFS data set consists of a single file produced each day named jg<julian_day>.dat.gz where <julian_day> is the day the data was acquired. The ".gz" extension indicates that the individual files are compressed before archiving. The daily file consists of 22 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. *Note: Null, unused, or unknown fields are filled with 9's in the JGOFS data.*

Additionally, 3 separate QC plots are generated daily by the ET using the JGOFS data set. These plots include TSG and Bathymetry data, meteorological data, and navigation data. The files are called ocean<julian_day>.ps, met<julian_day>.ps, and nav<julian_day>.ps respectively.

Field	Data	Units
01	GMT date	dd/mm/yy
02	GMT time	hh:mm:ss
03	PCOD latitude (negative is South)	Ddd.dddd
04	PCOD longitude (negative is West)	Ddd.dddd
05	Ships speed	Knots
06	GPS HDOP	-
07	Gyro Heading	Degrees (azimuth)
08	Course over ground	Degrees (azimuth)
09	Mast PAR	μEinsteins/meters^2 sec
10	Sea surface temperature	°C
11	Conductivity	S/m
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	μg/l
20	Transmissometer	Vols (0-5 FSO)
21	PSP	W/m^2
22	PIR	W/m^2

RVDAS

/RVDAS/

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.

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	lmwx	continuous	1 sec	R. M. young 41372VC
Relative Humidity	lmwx	continuous	1 sec	R. M. young 41372VC
Wind Speed/Direction	lmwx	continuous	1 sec	R. M. young 5106
PAR, (Photosynthetically-Available Radiation)	lmwx	continuous	1 sec	BSI QSR-240
Barometer	lmwx	continuous	1 sec	R. M. young 61201
GUV & PUV	lguv	continuous	1 sec	GUV2511 & PUV2510
PIR (LW radiation)	lmwx	continuous	1 sec	Eppley PIR
PSP (SW radiation)	lmwx	continuous	1 sec	Eppley PSP
Port Ultrasonic Wind Speed/Direction	lmwx	continuous	1 sec	Gill Wind Observer II

Navigational Data

Measurement	File ID	Collect. Status	Rate	Instrument
Attitude GPS	lash	continuous	1 sec	Ashtec ADU-2
Trimble GPS	tgps	civilian mode	1 sec	Trimble 20636-00SM
Gyro	lgyr	continuous	0.2 sec	Anschutz Gyro
Garmin GPS	lgar	continuous	1 sec	Garmin 17

Geophysical Data

Measurement	File ID	Collect. Status	Rate	Instrument
Bathymetry	lknu	variable	Varies	Knudsen 320B/R
Net Depth Sensor	lnds	variable	~1/3 sec	Omega PX-605
DUSH 11 Winch	lwn1	variable	varies	Markey DUSH 11
DUSH 5 Winch	lwn1	variable	varies	Markey DUSH 5
DUSH 4 Winch	lwn1	variable	varies	Markey DUSH 4

Oceanographic Data

Measurement	File ID	Collect. Status	Rate	Instrument
Salinity	utsg	continuous	1 sec	SeaBird 45
Sea Surface Temperature	lrtm	continuous	1 sec	SeaBird 38
Fluorometry (digital)	lflr	continuous	1 sec	Turner 10-AU-005
Fluorometry (digital)	ldfl	continuous	1 sec	Wetlab ECO
ADCP, Speed Log	ladc	continuous	1 sec	RD Instruments
Oxygen	loxy	continuous	1 sec	
PCO2	lpco2	continuous	2.5 min	

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 tar files, lmguw.tar and lmgnav.tar 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: LMG[FileID].dDDD.

- The FileID is a 4-character code representing the system being logged, for example: lmet (for meteorology)
- DDD is the Julian day of the data collection

Underway Data	**File ID**
Meteorological - Cambell	lmwx
Knudsen	lknu
microTSG	utsg
Digital Remote Temperature	lrtm
Fluorometer - Turner	lflr
Fluorometer – Wetlab ECO	ldfl
ADCP	ladc
Sound Velocity Probe	lsvp
GUV & PUV	lguv
PCO2 System	lpco
Oxygen	loxy
Wet Wall Flows	lsea
Winches: Dush4,5,&11	lwn1
Net Depth Sensor	lnds

Navigation Data	**File ID**
Gyro Compass	lgyr
P-CODE GPS	tgps
Ashtech ADU2 GPS	lash
Garmin 17 GPS	lgar

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 delimiters used to separate fields in the raw data files are usually spaces and commas, but other delimiters are used (::, =, @) and occasionally there is no delimiter. Care should be taken when reprocessing the data that the field separations are clearly understood. An example data string is provided with each instrument section for your convenience, however it is always best to refer directly to the raw data.

lknu – Knudsen Sonar

```
08+024:07:36:36.245 HF,00.00, 000,0,LF,448.9,-026,1
```

Field	**Data**	**Units**
1	RVDAS Time Tag	
2	HF – high frequency header (12 kHz)	
3	HF - depth to surface	meters
4	HF - Echo Strength	
5	HF – Depth Valid Flag	
6	LF – low frequency header (3.5 kHz)	
7	LF - depth to surface	meters
8	LF - Echo Strength	

Field	Data	Units
9	LF – Depth Valid Flag	

Inds – Net Depth Sensor

```
99+099:00:18:19.775 V01 00199.8
```

Field	Data	Units
1	RVDAS Time Tag	
2	V01 – Sensor 1	label
3	Depth	meters

Iwn1 - Winches

```
08+033:11:27:50.673 RD,DUSH-5,00111.63,00000000,-0000012,1938
```

Field	Data	Units
1	RVDAS Time Tag	
2	Record Identifier, RD=Remote Data	
3	Winch Indentifier, DUSH-X where X is 4, 5, or 11	
4	Tension	lbs
5	Speed	Meters/minute
6	Payout	meters
7	Checksum	

Imwx - Campbell Meteorological DAS

```
08+034:13:52:14.216 SUS,A,356,002.15,M,+332.28,+000.97,60,08
```

Field	Data	Units
1	RVDAS Time Tag	
2	SUS tag – Starboard UltraSonic Anemometer	
3	Unit Identification, A-Z	
4	Port Wind Direction, degrees relative to Bow	deg
5	Port Wind Speed	m/s
6	Units, M=meters per second	
7	Sound Speed	m/s
8	Sonic Temperature	°C
9	Status, 0=ok, 60=Heating Enabled & ok, Other value mean a fault	
10	Check Sum	

```
08+034:13:52:14.216 PUS,A,356,002.15,M,+332.28,+000.97,60,08

-- Derived from RMYoung Anemometer
```

Field	Data	Units
1	RVDAS Time Tag	
2	PUS tag – Port Anemometer	
3	Unit Identification, A-Z	
4	Port Wind Direction, degrees relative to Bow	deg
5	Port Wind Speed	m/s
6	Units, M=meters per second	
7	Sound Speed	meaningless
8	Sonic Temperature	meaningless
9	Status, 0=ok, 60=Heating Enabled & ok, Other value mean a fault	meaningless
10	Check Sum	meaningless

```
08+034:13:52:14.454 MET,12.22322,44.25706,-75,-25,-363.6365,2.332982,-0.08215196,278.6845,
279.2192,854.6198
```

Field	Data	Units
1	RVDAS Time Tag	
2	MET tag	
3	Power Supply Voltage	Volts
4	Enclosure Relative Humidity	%
5	Air Temp	°C
6	Air Relative Humidity	%
7	PAR	mVolts
8	PSP Thermopile	mVolts
9	PIR Thermopile	mVolts
10	PIR Case Temperature	°K
11	PIR Dome Temperature	°K
12	Barometer	mBars

utsg – microTSG, Thermosalinograph

For further information on this data, check on www.seabird.com on SBE 45 MicroTSG Thermosalinograph

```
08+037:13:45:57.596   2.6470,   3.03853,   33.8129, 1459.351
```

Field	Data	Units
1	RVDAS Time Tag	
2	Internal water temperature	°C
3	Conductivity	S/m
4	Salinity	psu
5	Sound Velocity	m/s

lrtm – digital Remote Temperature

For further information on this data, check on www.seabird.com on SBE38 Digital Thermometer

08+037:13:47:17.841 2.2527

Field	Data	Units
1	RVDAS Time Tag	
2	External water temperature	°C

lflr – Fluorometer, Turner

```
04+107:16:48:02.342 0  5450 ::  4/16/04 09:44:17 = 0.632  (RAW)
```

Field	Data	Units
1	RVDAS Time Tag	
2	Zero Field	numeric
3	Sample Number	numeric
4	Fluorometer Date	mm/dd/yy
5	Fluorometer Time	hh:mm:ss
6	Digital output of fluorometer	Volts
7	(RAW)	

ldfl – Fluorometer, Wetlab ECO

```
08+037:13:55:08.434 99/99/99    99:99:99         0.00     2585    73       543
```

Field	Data	Units
1	RVDAS Time Tag	
2	Fluorometer Date	mm/dd/yy
3	Fluorometer Time	hh:mm:ss
4	Chlorophyll Signal	µg/l
5	Reference	λq
6	Counts – Chlorophyll Signal	Count
7	Thermistor	

loxy - Oxygen

For further information on this data, contact Tim Newberger at ***tnewberg@ldeo.columbia.edu***

```
04+117:23:57:23.504 MEASUREMENT        3830     380  Oxygen:           309.95       Saturation:
83.48   Temperature:       -1.35       DPhase:           33.41       BPhase:           32.22
        RPhase:             0.00       BAmp:      262.09       BPot:      163.00       RAmp:
0.00    RawTem.:          694.92
```

Field	Data	Units
1	RVDAS Time Tag	
2-4	Measurement ID, Model Number, Serial Number	alphanumeric
5	Oxygen heading	text
6	Oxygen Reading	Raw numeric
7	Saturation heading	text
8	Saturation Reading	Raw numeric
9	Temperature heading	text
10	Water Temperature	ºC
11	Dphase heading	text
12	Dphase	Raw numeric
13	Bphase heading	text
14	BPhase	Raw numeric
15	Rphase heading	text
16	Rphase	Raw numeric
17	Bamp heading	text
18	Bamp	Raw numeric
19	Bpot heading	text
20	Bpot	Raw numeric
21	Ramp heading	text
22	Ramp	Raw numeric
23	RawTem heading	text
24	RawTemp	Raw numeric

lpco – PCO2 system

For further information on this data, contact Tim Newberger at ***tnewberg@ldeo.columbia.edu***

```
02+319:23:59:13.748 2002319.99851    7154.27     26.49    1033.6     325.79      6.74     329.3
53.76     0   Equil
```

Field	Data	Units
1	RVDAS Time Tag	
2	Julian date file string	Julian

Field	Data	Units
3	IR voltage reading	mV
4	Cell temperature	°C
5	Barometer	millibars
6	VCO2	mL
7	Equilibrator temperature	°C
8	PCO2	millibars
9	Gas flow	mL/min
10	Solenoid position ID	number
11	Valve Position ID	number
12	Measured gas	name

lguv – Biospherical GUV

```
08+037:14:17:59.211 020608 141758 -.000099 1.307E0 7.24E0 1.316E1 2.609E1 3.285E1 3.505E1 8.075E-
2 38.993 17.985
```

GUV only

Field	Data	Units
1	RVDAS Time Tag	
2	GUV Computer Date	mmddyy
3	GUV Computer Time	hhmmss
4	Ed0Gnd - GUV	Volts
5	Ed0305 - GUV	$\mu W/cm^2nm$
6	Ed0313 - GUV	$\mu W/cm^2nm$
7	Ed0320 - GUV	$\mu W/cm^2nm$
8	Ed0340 - GUV	$\mu W/cm^2nm$
9	Ed0380 - GUV	$\mu W/cm^2nm$
10	Ed0395 - GUV	$\mu W/cm^2nm$
11	Ed0PAR - GUV	$\mu E/cm^2sec$
12	Ed0Temp - GUV	°C
13	Ed0VIn	Volts

GUV and PUV

Field	Data	Units
1	RVDAS Time Tag	
2	GUV Computer Date	mmddyy
3	GUV Computer Time	hhmmss
4	EdZGnd -PUV	Volts
5	EdZ305 -PUV	$\mu W/cm^2nm$
6	EdZ313 -PUV	$\mu W/cm^2nm$
7	EdZ320 -PUV	$\mu W/cm^2nm$
8	EdZ395 -PUV	$\mu W/cm^2nm$
9	EdZ340 -PUV	$\mu W/cm^2nm$
10	EdZPAR -PUV	$\mu E/cm^2sec$
11	LuZChl -PUV	$\mu E/srm^2sec$
12	EdZ380 -PUV	$\mu W/cm^2nm$
13	WTemp -PUV	°C
14	Depth -PUV	m
15	EdZTemp -PUV	°C
16	LuZTemp -PUV	°C
17	Tilt -PUV	Degrees
18	Roll -PUV	Degrees
19	Ed0Gnd - GUV	Volts
20	Ed0305 - GUV	$\mu W/cm^2nm$
21	Ed0313 - GUV	$\mu W/cm^2nm$
22	Ed0320 - GUV	$\mu W/cm^2nm$
23	Ed0340 - GUV	$\mu W/cm^2nm$
24	Ed0380 - GUV	$\mu W/cm^2nm$
25	Ed0395 - GUV	$\mu W/cm^2nm$
26	Ed0PAR - GUV	$\mu E/cm^2sec$
27	Ed0Temp - GUV	°C
28	Ed0VIn	Volts

lsvp - Sound Velocity Probe in ADCP Transducer Well

```
00+348:01:59:52.128  1539.40
```

Field	Data	Units
1	RVDAS Time Tag	
2	Sound velocity	m/s

ladc – ADCP Speed Log

```
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[1] velocity[2], East vector	knots
5	Ship Speed relative to reference layer[1] velocity[2], North vector	knots
6	Ship heading	degrees

[1]The reference layer is an average velocity measured in a number of depth "bins". On the LMG, the bins are eight meters deep and bins 3-10 define the reference layer. Hence, the reference layer is the water column from 16-80 meters beneath the ship.

[2]The speed ouput is water velocity relative to the ship's hull and is therefore opposite of the actual movement of the ship. For example, if the ship's heading is due north, the North/South reference layer velocity is likely to be negative (southerly).

lash – Ashtech GPS

ATTD: Attitude Data

```
01+081:00:00:00.806 $PASHR,ATT,345605.0,165.03,+001.86,-01.96,0.0018,0.0173,0*22
```

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	Measurement RMS error	meters
8	Baseline RMS error	meters
9	attitude reset flag	

```
01+081:00:00:00.966 $GPGGA,235952.00,6051.7937,S,06030.2175,W,1,08,01.0,+00068,M,,M,,*79
```

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)	

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

lgyr - Gyro

```
02+315:23:59:58.194 $PASVW,00.1,A*1D
02+315:23:59:58.414 $IIVHW,287.7,T,,M,,N,,K*71
02+315:23:59:58.616 $HEHDT,287.7,T*25
02+315:23:59:58.821 $HEROT,001.6,A*2C
02+315:23:59:58.984 $HCHDT,,T*07
```

HDT: True Heading

```
01+083:00:00:02.893 $HEHDT,246.3,T*2C
```

Field	Data	Units
1	RVDAS Time Tag $HEHDT	
2	Heading XXXXX = ddd.d	degrees
3	T flag for true heading, checksum	

ROT: Rate of Turn

```
01+083:00:00:03.093 $HEROT,-006.3,A*03
```

Field	Data	Units
1	RVDAS Time Tag $HEROT	
2	Rate of turn	degrees/min
3	Status: A = data valid, checksum	

lgar - Garmin GPS

GGA: Global Positioning Fix Data

08+034:12:26:06.131 $GPGGA,122607,6446.4733,S,06403.4455,W,1,11,0.9,-193.4,M,9.7,M,,*5A

Field	Data	Units
1	RVDAS Time Tag	
2	$GPGGA Tag	
3	UTC of position	hhmmss.ss
4	Latitude in degrees with decimal minutes	ddmm.mmm
5	North (N) or South (S)	
6	Longitude in degrees with decimal minutes	ddmm.mmm
7	East (E) or West (W)	
8	GPS quality (1=GPS 2=DGPS)	
9	Number of GPS satellites used	
10	Horizontal dilution of precision (HDOP)	
11	Antenna height above/below mean-sea-level (geoid)	meters

Field	Data	Units
12	Units for antenna height (M = Meters)	
13	Geoidal Separation[1]	
14	Units for Geoidal Separation (M = Meters)	meters
15	Age of differential GPS data, number of seconds since last SC104 Type 1 or 9	
16	Differential reference station ID	

[1]Geoidal Separation: the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid). A negative value represents mean-sea-level below ellipsoid.

GLL: Geographic Position – Latitiude/Logitude

```
08+034:12:26:06.211 $GPGLL,6446.4733,S,06403.4455,W,122607,A
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPGLL Tag	
3	Latitude	ddmm.mmm
4	North (N) or South (S)	
5	Logitude	ddmm.mmm
6	East (E) or West (W)	
7	UTC of position	hhmmss.ss
8	Status: A = Data Valid, V =Data Not Valid	

VTG: Track Made Good and Speed over Ground

```
08+034:12:26:06.211 $GPVTG,167,T,151,M,000.0,N,0000.0,K
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPVTG Tag	
3	Track, degrees true	degrees
3	T flag for True	
4	Track, degrees magnetic	degrees
5	M flag for Magnetic	
6	Speed over Ground	knots
7	N flag for Knots	
8	Speed over Ground	kmhr
9	K flag for km/hr	

tgps – Trimble Centurion GPS

GGA: Global Positioning Fix Data

08+034:12:26:06.131 $GPGGA,122607,6446.4733,S,06403.4455,W,1,11,0.9,-193.4,M,9.7,M,,*5A

Field	Data	Units
1	RVDAS Time Tag	
2	$GPGGA Tag	
3	UTC of position	hhmmss.ss
4	Latitude in degrees with decimal minutes	ddmm.mmm
5	North (N) or South (S)	
6	Longitude in degrees with decimal minutes	ddmm.mmm
7	East (E) or West (W)	
8	GPS quality (1=GPS 2=DGPS)	

Field	Data	Units
9	Number of GPS satellites used	
10	Horizontal dilution of precision (HDOP)	
11	Antenna height above/below mean-sea-level (geoid)	meters
12	Units for antenna height (M = Meters)	
13	Geoidal Separation[1]	
14	Units for Geoidal Separation (M = Meters)	meters
15	Age of differential GPS data, number of seconds since last SC104 Type 1 or 9	
16	Differential reference station ID	

[1]Geoidal Separation: the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid). A negative value represents mean-sea-level below ellipsoid.

GLL: Geographic Position – Latitiude/Logitude

```
08+034:12:26:06.211 $GPGLL,6446.4733,S,06403.4455,W,122607,A
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPGLL Tag	
3	Latitude	ddmm.mmm
4	North (N) or South (S)	
5	Logitude	ddmm.mmm
6	East (E) or West (W)	
7	UTC of position	hhmmss.ss
8	Status: A = Data Valid, V =Data Not Valid	

VTG: Track Made Good and Speed over Ground

```
08+034:12:26:06.211 $GPVTG,167,T,151,M,000.0,N,0000.0,K
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPVTG Tag	
3	Track, degrees true	degrees
3	T flag for True	
4	Track, degrees magnetic	degrees
5	M flag for Magnetic	
6	Speed over Ground	knots
7	N flag for Knots	
8	Speed over Ground	kmhr
9	K flag for km/hr	

RMC: Recommended Minimum Specific GNSS Data

08+034:13:17:26.627 $GPRMC,131726.605,A,6446.4820,S,06403.3075,W,000.0,094.4,030208,16.3,E

Field	Data	Units
1	RVDAS Time Tag	
2	$GPRMC Tag	
3	UTC of position	hhmmss.ss
4	Status A = Data Valid, V = Navigation Receiver Warning	
5	Latitude in degrees with decimal minutes	ddmm.mmm
6	North (N) or South (S)	

Field	Data	Units
7	Longitude in degrees with decimal minutes	ddmm.mmm
8	East (E) or West (W)	
9	Speed Over Ground, knots	knots
10	Course Over Ground, degrees True	degrees
11	Date	ddmmyy
12	Magnetic Variation, degrees E/W	degrees
13	Mode Indicator E= Estimated Mode	

LMG Sensors

Shipboard Sensors

Sensor	Description	Serial #	Cal. Date	Status
Port Anemometer	Gill Ultrasonic Wind Observer II	840019		Collected
Starboard Anemometer	Gill Ultrasonic Wind Observer II	71738		Collected
Barometer	R.M. Young 61201	BP00873	10-Feb-2009	Collected
Humidity/Wet Temp	RM Young 41372LC	06719	10-Feb-2009	Collected
PAR for Mast	Biosph. Inst. QSR-240P	6393	02 July, 2008	Collected
PIR	Eppley PIR	32031F3	22 May, 2008	Collected
PSP	Eppley PSP	31701F3	22 May, 2008	Collected
GUV (Mast)	Biosph. Inst. GUV-2511	25110805127	02-Dec-2008	Collected
Transmissometer	WET Labs C-Star 25 cm deep	CST-553DR	15-May-2008	Collected
Fluorometer	Turner 10AU-005-CE	6592 RTX		Collected
MicroTSG	Sea-Bird 45	227	12-Jan-2008	Collected
Digital Remote Temp	Sea-Bird 38	262	07-Jan-2008	Collected
Fluorometer	WET Labs ECO-FL	FLRTD-398	30-Oct-2007	Collected

CTD Sensors

Sensor	Description	Serial #	Cal. Date
CTD Fish	Seabird SBE9Plus	0919	24-Nov-2008
Primary Temperature	Seabird SBE3	5025	24-Oct-2008
Secondary Temperature	Seabird SBE3	5034	29-Oct-2008
Primary Conductivity	Seabird SBE4	3534	12-Nov-2008
Secondary Conductivity	Seabird SBE4	3519	01-Nov-2008
Primary Dissolved Oxygen	Seabird SBE43	430200	20-June-2008
Secondary Dissolved Oxygen	Seabird SBE43	430201	02-July-2008
Fluorometer	Wet Labs ECO	FLRTD-867	28-July-2008
PAR	Biosph. Inst. QSP-2300	4722	30-June-2008
Transmissometer	Wet Labs C-Star	CST-830DR	20-Apr-2007

Underway Calibration Sheets

Remote Temperature (SBE-38)

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

SENSOR SERIAL NUMBER: 0262
CALIBRATION DATE: 07-Jan-08

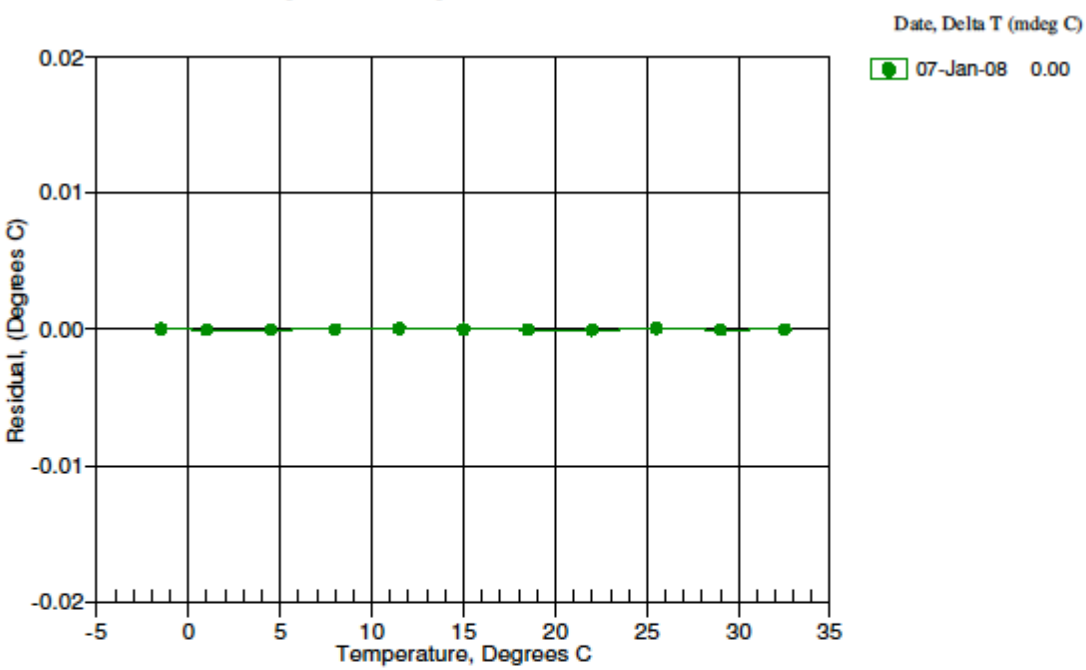
SBE 38 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS
a0 = -2.602085e-005
a1 = 2.811337e-004
a2 = -2.667958e-006
a3 = 1.663429e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.50010	702896.2	-1.50006	0.00004
0.99990	628320.9	0.99986	-0.00004
4.49990	538544.5	4.49988	-0.00002
7.99990	463090.7	7.99989	-0.00001
11.49990	399460.2	11.49997	0.00007
14.99990	345627.5	14.99992	0.00002
18.50000	299936.1	18.49998	-0.00002
22.00000	261037.3	21.99993	-0.00007
25.49990	227819.7	25.49997	0.00007
28.99990	199372.5	28.99986	-0.00004
32.49990	174939.0	32.49992	0.00002

Temperature ITS-90 = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



Transmissometer (Wetlabs C-Star)

PO Box 518
620 Applegate St.
Philomath, OR 97370

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

WET Labs

C-Star Calibration

Date May 15, 2008 S/N# CST-553DR Pathlength 25cm

	Analog meter
V_d	0.059 V
V_{air}	4.794 V
V_{ref}	4.684 V

Temperature of calibration water	22.7 °C
Ambient temperature during calibration	26.7 °C

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x): $Tr = e^{-cx}$

To determine beam transmittance: $Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$

To determine beam attenuation coefficient: $c = -1/x * \ln(Tr)$

V_d Meter output with the beam blocked. This is the offset.
V_{air} Meter output in air with a clear beam path.
V_{ref} Meter output with clean water in the path.
Temperature of calibration water: temperature of clean water used to obtain V_{ref}.
Ambient temperature: meter temperature in air during the calibration.
V_{sig} Measured signal output of meter.

Revision I 4/17/08

Fluorometer (Wetlabs ECO-FL)

PO Box 518
620 Applegate St.
Philomath, OR 97370

WET Labs

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

ECO Chlorophyll Fluorometer Characterization Sheet

Date: 10/30/2007 S/N: FLRTD-398

Chlorophyll concentration expressed in µg/l can be derived using the equation:

CHL (µg/l) = Scale Factor * (Output - Dark Counts)

	Analog Range 1	Analog Range 2 (default)	Analog Range 4	Digital
Dark Counts	0.102	0.057	0.034 V	74 counts
Scale Factor (SF)	6	13	26 µg/l/V	0.0077 µg/l/count
Maximum Output	4.92	4.92	4.92 V	16331 counts
Resolution	0.5	0.5	0.5 mV	0.9 counts

Ambient temperature during characterization 21.5 °C

Analog Range: 1 (most sensitive, 0–4,000 counts), 2 (midrange, 0–8,000 counts), 4 (entire range, 0–16,000 counts).

Dark Counts: Signal output of the meter in clean water with black tape over detector.

SF: Determined using the following equation: SF = x ÷ (output - dark counts), where x is the concentration of the solution used during instrument characterization. SF is used to derive instrument output concentration from the raw signal output of the fluorometer.

Maximum Output: Maximum signal output the fluorometer is capable of.

Resolution: Standard deviation of 1 minute of collected data.

The relationship between fluorescence and chlorophyll-a concentrations *in-situ* is highly variable. The scale factor listed on this document was determined using a mono-culture of phytoplankton (*Thalassiosira weissflogii*). The population was assumed to be reasonably healthy and the concentration was determined by using the absorption method. To accurately determine chlorophyll concentration using a fluorometer, you must perform secondary measurements on the populations of interest. This is typically done using extraction-based measurement techniques on discrete samples. For additional information on determining chlorophyll concentration see "Standard Methods for the Examination of Water and Wastewater" part 10200 H, published jointly by the American Public Health Association, American Water Works Association, and the Water Environment Federation.

FLRTD-398.xls Revision I 10/2/07

PSP (Eppley model PSP)

THE EPPLEY LABORATORY, INC.

12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA

Telephone: 401-847-1020 Fax: 401-847-1031

Email: info@eppleylab.com Internet: www.eppleylab.com

EPLAB

Scientific Instruments for Precision Measurements Since 1917

STANDARDIZATION OF EPPLEY PRECISION SPECTRAL PYRANOMETER Model PSP

Serial Number: 31701F3

Resistance: 674 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).

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

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

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 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 Tenth International Pyrheliometric Comparisons (IPC X) at Davos, Switzerland in September-October 2005.

Eppley recommends a minimum calibration cycle of five (5) years but encourages annual calibrations for highest measurement accuracy. Unless otherwise stated in the remarks section below or on the Sales Order, the results are "AS FOUND / AS LEFT".

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: National Science Foundation
Port Hueneme, CA

Date of Test: May 20, 2008

In Charge of Test: R.T. Egeman

S.O. Number: 61623

Date: May 22, 2008

Reviewed by: Thomas D Kirk

Remarks:

PIR (Eppley model PIR)

THE EPPLEY LABORATORY, INC.
12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA
Telephone: 401-847-1020 Fax: 401-847-1031
Email: info@eppleylab.com Internet: www.eppleylab.com

EPLAB
Scientific Instruments for Precision Measurements Since 1917

STANDARDIZATION OF EPPLEY PRECISION INFRARED RADIOMETER Model PIR

Serial Number: 32031F3

Resistance: 709 Ω at 23 °C
Temperature Compensation Range: -20° to +40 °C

This pyrgeometer has been compared against Eppley's Blackbody Calibration System under radiation intensities of approximately 200 watts meter^{-2} and an average ambient temperature of 23 °C as measured by Standard Omega Temperature Probe, RTD#1.

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

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

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 Temperature Scale (IPTS) through a precision low-temperature blackbody.

Eppley recommends a minimum calibration cycle of five (5) years but encourages annual calibrations for highest measurement accuracy. Unless otherwise stated in the remarks section below or on the Sales Order, the results are "AS FOUND / AS LEFT".

Shipped to: National Science Foundation
Port Hueneme, CA

Date of Test: May 21, 2008

In Charge of Test: R.T. Egeman

S.O. Number: 61623
Date: May 22, 2008

Reviewed by: Thomas Kirk

Remarks:

PAR (QSR-240P)

Biospherical Instruments Inc.

CALIBRATION CERTIFICATE

Calibration Date	2/7/2008
Model Number	QSR-240
Serial Number	6393
Operator	TPC
Standard Lamp	91537(10/25/2005)
Probe Excitation Voltage Range	6 to 18 VDC(+)
Output Polarity	Positive

<u>Probe Conditions at Calibration(in air):</u>

Calibration Voltage:	6	VDC(+)
Probe Current:	1.3	mA

<u>Probe Output Voltage:</u>

Probe Illuminated	88.7	mV
Probe Dark	0.8	mV
Probe Net Response	87.9	mV
RG780	2.1	mV

<u>Corrected Lamp Output:</u>

Output In Air (same condition as calibration):

8.95E+15	quanta/cm²sec
0.01487	uE/cm²sec

<u>Calibration Scale Factor:</u>

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

Dry	9.9453E-18	V/(quanta/cm²sec)
	5.9891E+00	V/(uE/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

Temperature/Relative Humidity (RMYoung model 41372LC)

YOUNG
R.M. Young Company
2801 Aero Park Drive
Traverse City, Michigan 49686 USA

CALIBRATION REPORT
Temperature Sensor

Customer: *Raytheon Technical Services Co LLC*

Test Number: 89914
Test Date: 26 September 2008

Customer PO: RR41830-01
Sales Order: 9970

Test Sensor:
Model: 41372LC Serial Number: *6719*
Description: Temperature/Relative Humidity Sensor

Report of calibration comparison of test temperature sensor with National Institute of Standards and Technology traceable standard thermometers at three temperatures in the R.M. Young Company controlled temperature calibration bath facilities. Calibration accuracy ± 0.1° Celsius.

Bath Temperature (degrees C)	Current Output (milliamps)	Indicated (1) Temperature (degrees C)
-49.93	4.009	-49.94
0.03	12.003	0.02
49.83	19.972	49.83

(1) Calculated from current output

All reference equipment used in this calibration procedure have been tested by comparison to traceable standards certified by the National Institute of Standards and Technology.

Reference Instrument	Serial #	NIST Test Reference
Brooklyn Thermometer Model 43-FC	8006-118	204365
Brooklyn Thermometer Model 22332-D5-FC	25071	249763
Brooklyn Thermometer Model 2X400-D7-FC	77532	228060
Keithley Multimeter Model 191	15232	234027

Tested By: E Chennming

METEOROLOGICAL INSTRUMENTS
Tel: 231-946-3980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

Barometer (RMYoung model 61201)

R.M. Young Company
2801 Aero Park Drive
Traverse City, Michigan 49686 USA

CALIBRATION REPORT

Barometric Pressure Sensor

Customer: *Raytheon Technical Services Co LLC*

Test Number: 89101 Customer PO: RR42365-01
Test Date: 10 September 2008 Sales Order: 9955

Test Sensor:
Model: 61201 Serial Number: *BP00873*
Description: Barometric Pressure Sensor

Report of calibration comparison of test barometric pressure sensor with National Institute of Standards and Technology traceable standard pressure calibrator at five pressures in the R.M. Young Company controlled pressure facility. Calibration accuracy ± 1.0 hPa.

Reference Pressure (hPa)	Voltage Output (millivolts)	Indicated (1) Pressure (hPa)
800.0	1	800.1
875.0	1251	875.1
950.0	2500	950.0
1025.0	3748	1024.9
1100.0	4994	1099.6

(1) Calculated from voltage output

All reference equipment used in this calibration procedure have been tested by comparison to traceable standards certified by the National Institute of Standards and Technology.

Reference Instrument	Serial #	NIST Test Reference
Druck Pressure Controller Model DPI515	51500497	UKAS Lab 0221
Fluke Multimeter Model 8060A	4865407	234027

Tested By: E Chen[signature]

METEOROLOGICAL INSTRUMENTS

Tel: 231-946-3980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

Micro TSG (Seabird SBE45 Conductivity)

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SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 0227
CALIBRATION DATE: 12-Jan-08

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -1.015905e+000
h =  1.574425e-001
i = -4.543106e-004
j =  6.120110e-005
```

```
CPcor = -9.5700e-008
CTcor =  3.2500e-006
WBOTC =  1.0472e-006
```

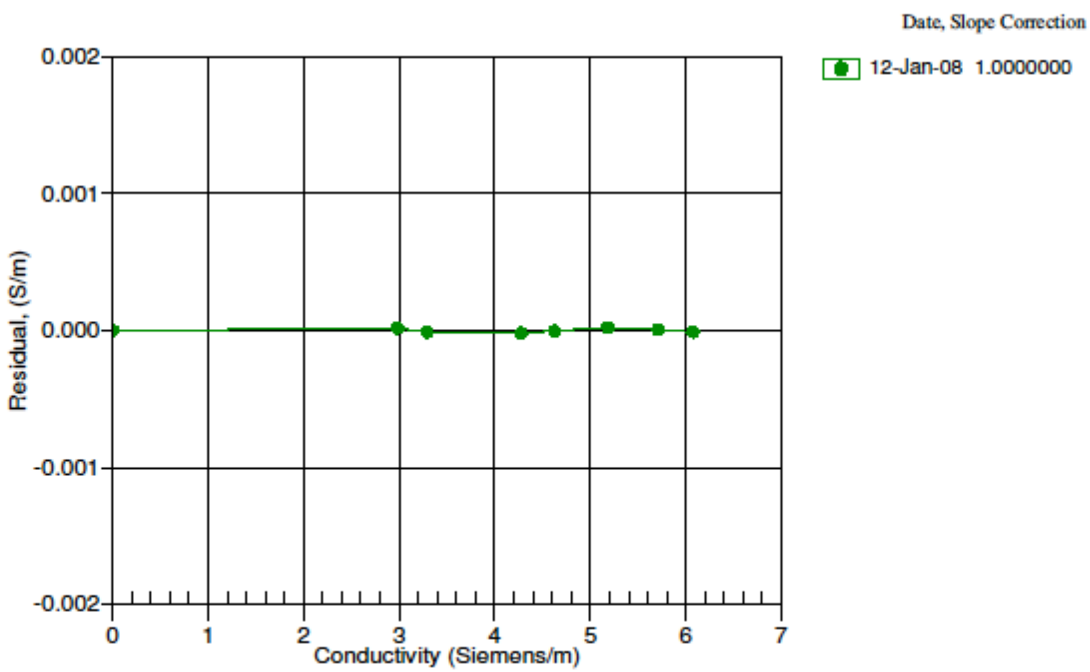
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2546.31	0.00000	0.00000
1.0000	34.9254	2.98440	5052.43	2.98442	0.00002
4.4999	34.9056	3.29231	5242.70	3.29230	-0.00001
15.0000	34.8618	4.27660	5808.54	4.27659	-0.00002
18.5000	34.8524	4.62264	5994.50	4.62264	-0.00000
24.0000	34.8419	5.18201	6283.14	5.18203	0.00002
29.0000	34.8360	5.70518	6541.20	5.70519	0.00001
32.5000	34.8334	6.07863	6719.12	6.07862	-0.00001

f = INST FREQ * sqrt(1.0 + WBOTC * t) / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



Micro TSG (Seabird SBE45 Temperature)

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SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 0227
CALIBRATION DATE: 12-Jan-08

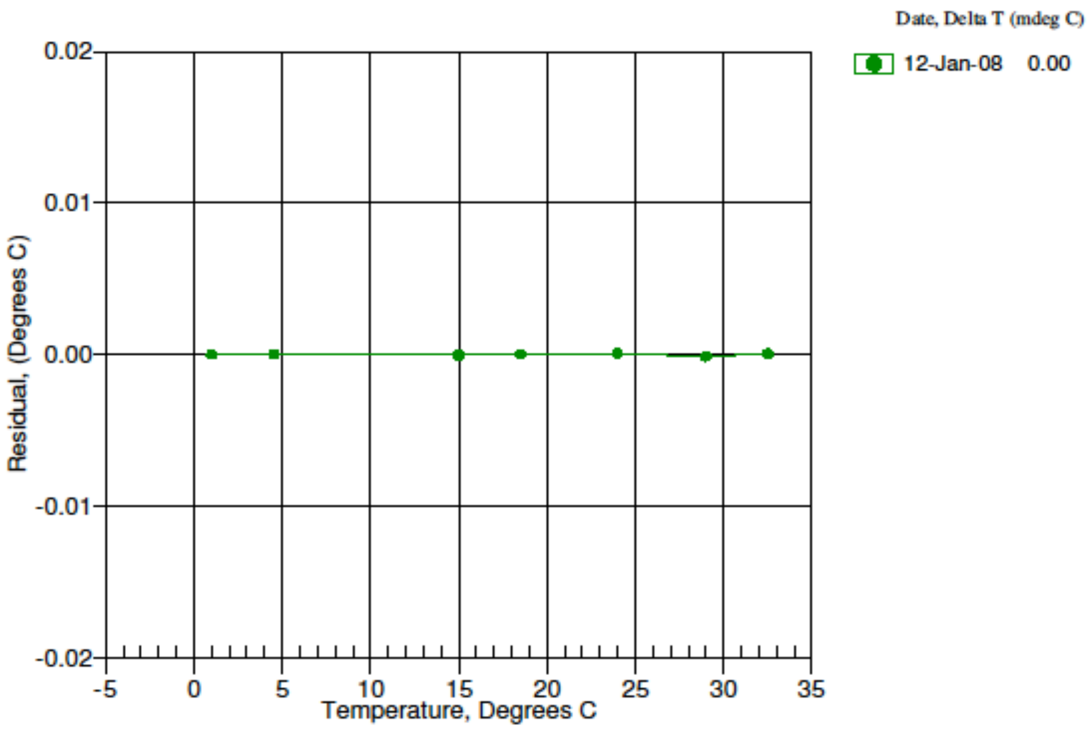
SBE 45 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS
a0 = 1.750051e-006
a1 = 2.794345e-004
a2 = -2.721644e-006
a3 = 1.612953e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	664677.5	1.0000	0.0000
4.4999	568096.6	4.4999	-0.0000
15.0000	361662.4	15.0000	-0.0000
18.5000	313050.9	18.5000	0.0000
24.0000	251002.5	24.0001	0.0001
29.0000	206582.7	28.9999	-0.0001
32.5000	180847.8	32.5001	0.0001

Temperature ITS-90 = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



GUV (Biospherical Instruments 2511)

Biospherical Instruments Inc.

GUV-2511 Calibration Certificate

System Serial Number	25110805127	Date of Calibration	12/2/08
Calibration database	25110805127v3.mdb	Date of Certificate	12/4/2008
DASSN	0111	Standard of Spectral Irradiance	91537(10/25/06)
Microprocessor Tag Number	2	Operator	TC

Monochromatic Channels	Address	Wavelength [nm]	Responsivity [Amps per µW/(cm²·nm)]	ScaleSmall [Volts per µW/(cm²·nm)]	ScaleMedium [Volts per µW/(cm²·nm)]	ScaleLarge [Volts per µW/(cm²·nm)]	OffsetSmall [volts]	OffsetMedium [volts]	OffsetLarge [volts]	Measurement Units
Ed0305	2	305	3.8400E-11	3.9533E-06	1.1621E-03	3.5561E-01	-3.1100E-04	-3.1400E-04	-3.2200E-04	µW/(cm²nm)
Ed0313	6	313	1.7300E-10	1.7613E-05	5.1598E-03	1.8121E+00	2.4700E-04	2.5200E-04	1.3090E-03	µW/(cm²nm)
Ed0320	8	320	2.5643E-10	2.6108E-05	7.6668E-03	2.5121E+00	-1.6900E-04	-1.6900E-04	-3.6000E-05	µW/(cm²nm)
Ed0340	10	340	1.9390E-10	1.9792E-05	5.7828E-03	2.0723E+00	1.7900E-04	1.9300E-04	1.2780E-03	µW/(cm²nm)
Ed0380	12	380	7.3738E-11	7.5266E-06	2.2042E-03	7.5742E-01	-1.5300E-04	-1.4600E-04	1.3300E-04	µW/(cm²nm)
Ed0395	13	395	3.1478E-10	3.2257E-05	9.4259E-03	3.2088E+00	-1.1700E-04	-1.1400E-04	-2.1000E-05	µW/(cm²nm)

Broadband Channels	Address	Wavelength [nm]	Responsivity [Amps per µE/(cm²·s)]	ScaleSmall [Volts per µE/(cm²·s)]	ScaleMedium [Volts per µE/(cm²·s)]	ScaleLarge [Volts per µE/(cm²·s)]	OffsetSmall [volts]	OffsetMedium [volts]	OffsetLarge [volts]	Measurement Units
Ed0PAR	18	400-700	1.6951E-05	1.7283E+00	5.0613E+02	1.6683E+05	-2.0000E-06	0.0000E+00	7.9900E-04	µE/(cm²sec)

Auxilliary Channels	Address	Wavelength	Responsivity	ScaleS	ScaleM	ScaleL	OffsetS	OffsetM	OffsetL	Measurement Units
Ed0Temp	22	0	1.0000E+00	1.0000E-02	1.0000E-02	1.0000E-02	0.0000E+00	0.0000E+00	0.0000E+00	°C
Ed0VIn	27	0	1.0000E+00	-2.5000E-01	-2.5000E-01	-2.5000E-01	0.0000E+00	0.0000E+00	0.0000E+00	V

CTD Calibration Sheets

Primary Temperature (Seabird SBE3)

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

SENSOR SERIAL NUMBER: 5025
CALIBRATION DATE: 24-Oct-08

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS
g = 4.37644839e-003
h = 6.37929046e-004
i = 2.18131552e-005
j = 1.95126620e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS
a = 3.68121255e-003
b = 5.96280319e-004
c = 1.52309632e-005
d = 1.95269888e-006
f0 = 3092.639

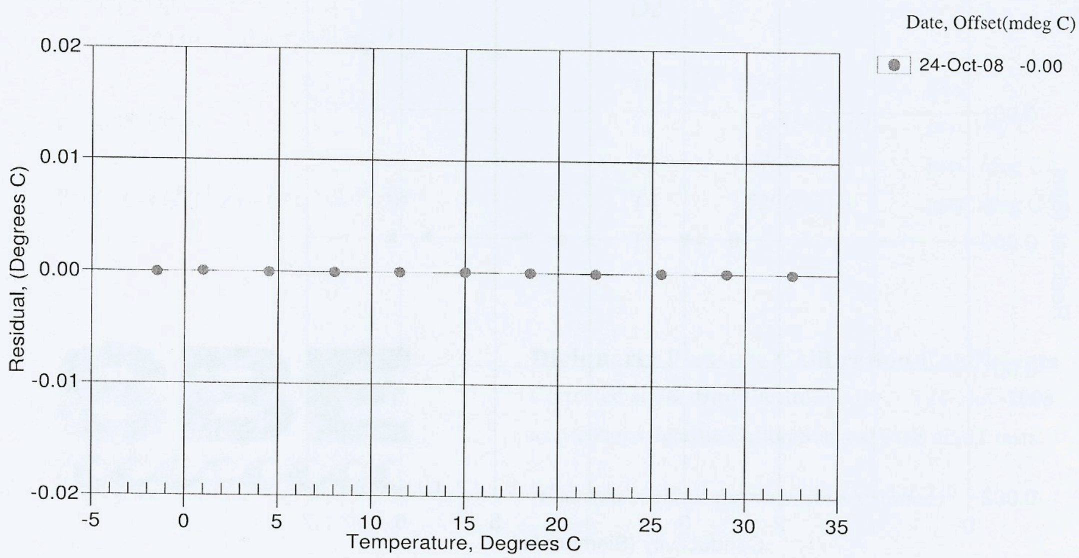
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	3092.639	-1.5000	-0.00002
1.0000	3272.054	1.0000	0.00003
4.5001	3535.732	4.5001	-0.00001
8.0001	3814.367	8.0001	-0.00002
11.5001	4108.376	11.5001	0.00001
15.0001	4418.157	15.0001	0.00002
18.5001	4744.095	18.5001	-0.00001
22.0001	5086.570	22.0001	-0.00004
25.5001	5445.955	25.5001	0.00001
29.0000	5822.578	29.0000	0.00003
32.5001	6216.806	32.5001	-0.00002

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

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



Secondary Temperature (Seabird SBE3)

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

SENSOR SERIAL NUMBER: 5034
CALIBRATION DATE: 29-Oct-08

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS
g = 4.33948598e-003
h = 6.35912417e-004
i = 2.12495480e-005
j = 1.91784061e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS
a = 3.68121221e-003
b = 5.97178966e-004
c = 1.51218409e-005
d = 1.91926291e-006
f0 = 2914.557

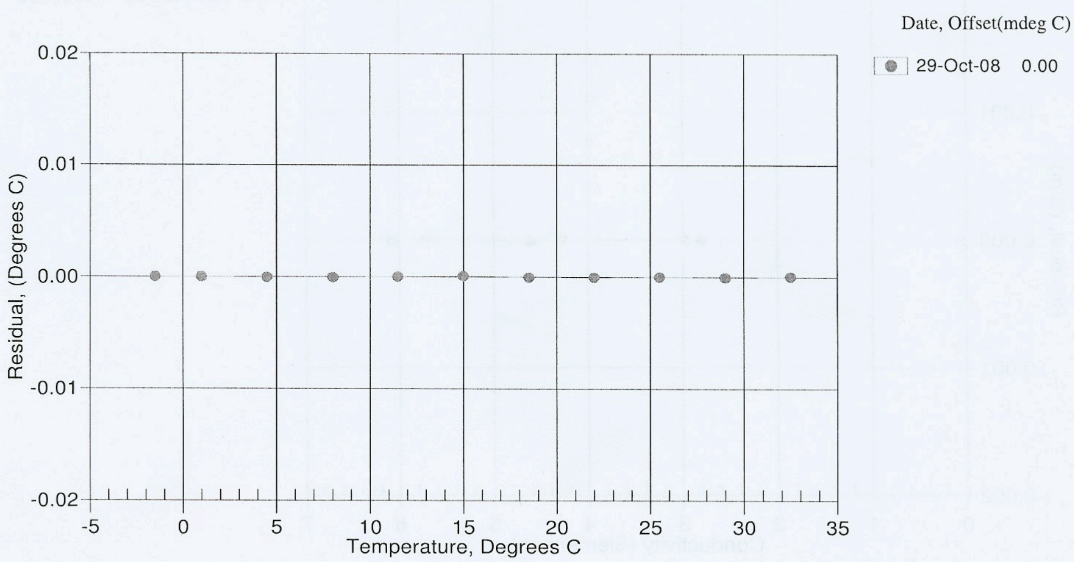
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	2914.557	-1.5000	0.00001
1.0000	3083.373	1.0000	0.00001
4.5000	3331.439	4.5000	-0.00003
8.0000	3593.543	8.0000	-0.00001
11.5000	3870.064	11.5000	-0.00001
15.0000	4161.382	15.0001	0.00008
18.5000	4467.837	18.5000	-0.00001
22.0000	4789.801	22.0000	-0.00003
25.5000	5127.611	25.5000	-0.00000
29.0000	5481.586	29.0000	-0.00001
32.5000	5852.046	32.5000	0.00002

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

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



Primary Conductivity (Seabird SBE4)

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

SENSOR SERIAL NUMBER: 3534
CALIBRATION DATE: 12-Nov-08

SBE4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS
g = -9.95195702e+000
h = 1.21052358e+000
i = -1.28893515e-003
j = 1.39059827e-004
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS
a = 9.43471437e-007
b = 1.20682553e+000
c = -9.94273706e+000
d = -8.07425402e-005
m = 5.7
CPcor = -9.5700e-008 (nominal)

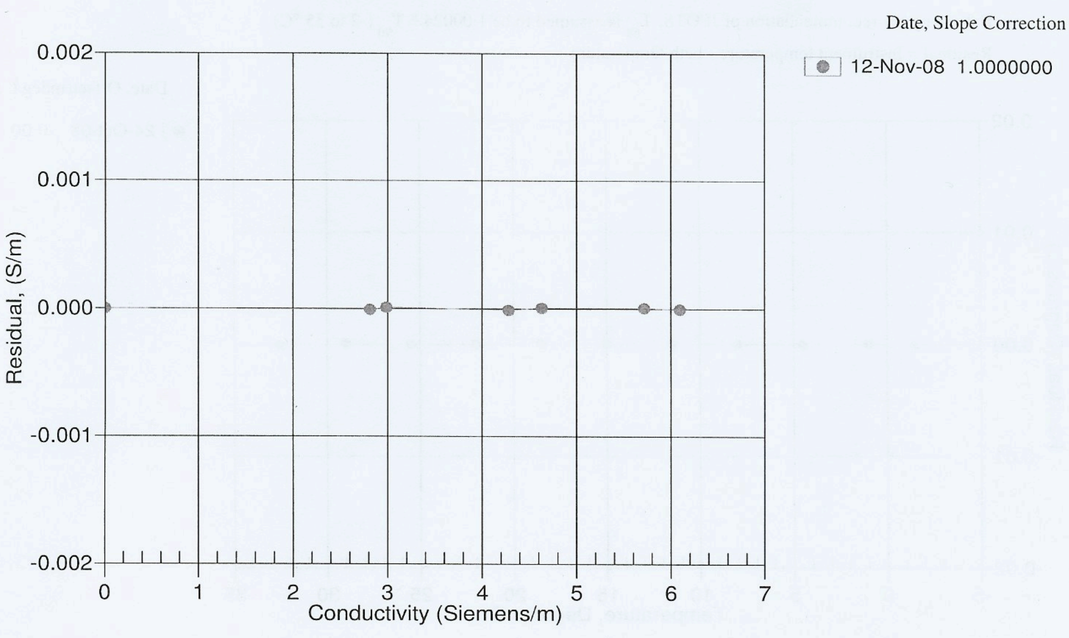
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.87029	0.00000	0.00000
-1.0002	34.9197	2.81211	5.61479	2.81210	-0.00001
0.9998	34.9202	2.98398	5.74007	2.98399	0.00001
14.9998	34.9219	4.28317	6.61013	4.28316	-0.00001
18.4998	34.9215	4.63079	6.82402	4.63080	0.00001
28.9998	34.9201	5.71738	7.45270	5.71738	0.00001
32.4998	34.9152	6.09126	7.65695	6.09126	-0.00000

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



Secondary Conductivity (Seabird SBE4)

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

SENSOR SERIAL NUMBER: 3519
CALIBRATION DATE: 01-Nov-08

SBE4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS
g = -9.90617154e+000
h = 1.22954337e+000
i = -1.06567901e-003
j = 1.28229221e-004
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS
a = 2.00376025e-006
b = 1.22670085e+000
c = -9.89986907e+000
d = -8.52697390e-005
m = 5.4
CPcor = -9.5700e-008 (nominal)

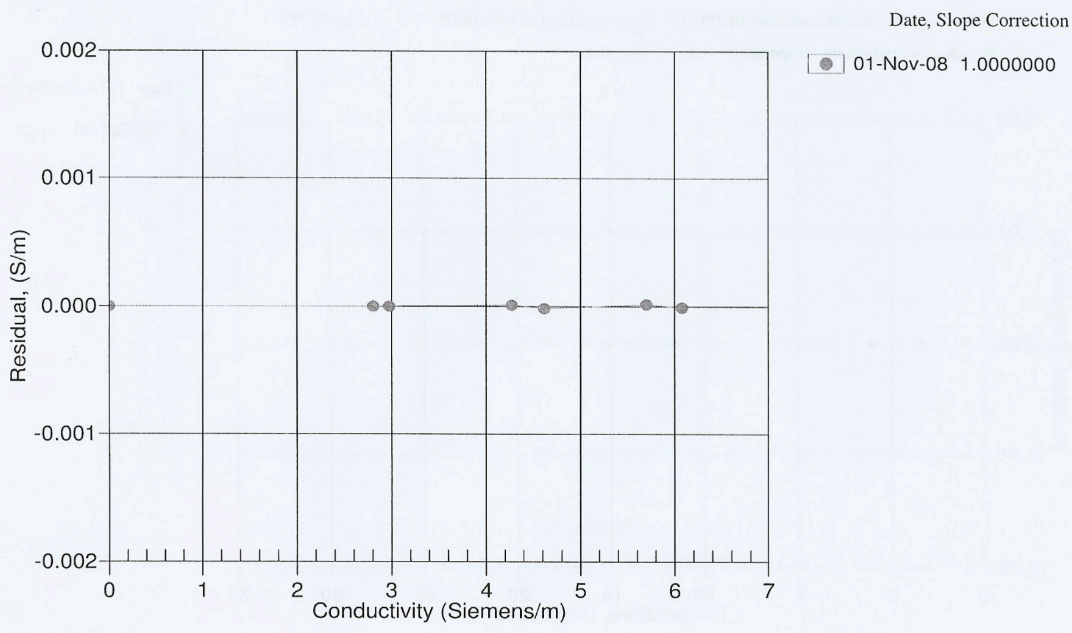
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.84075	0.00000	0.00000
-1.0002	34.8135	2.80435	5.56005	2.80435	-0.00000
0.9998	34.8144	2.97580	5.68416	2.97580	0.00000
14.9998	34.8161	4.27157	6.54609	4.27158	0.00001
18.4998	34.8161	4.61833	6.75797	4.61831	-0.00002
28.9998	34.8147	5.70206	7.38077	5.70208	0.00001
32.4998	34.8105	6.07507	7.58315	6.07506	-0.00001

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 = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ϵ = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



Primary Dissolved Oxygen (Seabird SBE 43)

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

SENSOR SERIAL NUMBER: 0200
CALIBRATION DATE: 20-Jun-08p

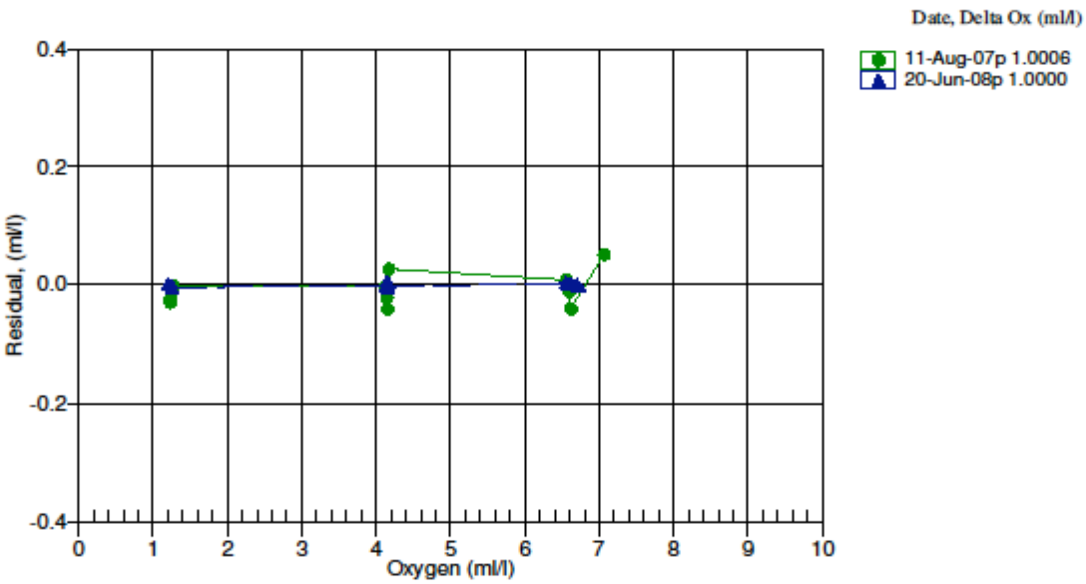
SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS
Soc = 0.3612
Voffset = -0.5042
Tau20 = 1.02

A = -1.7174e-004
B = 8.7231e-005
C = -1.4044e-006
E nominal = 0.036

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.20	2.00	0.00	0.847	1.20	0.00
1.20	6.00	0.01	0.886	1.20	0.00
1.21	12.00	0.01	0.946	1.21	0.00
1.24	20.00	0.01	1.034	1.24	-0.00
1.24	26.00	0.01	1.092	1.24	-0.00
1.26	30.00	0.02	1.140	1.26	-0.00
4.13	20.00	0.01	2.266	4.13	0.00
4.13	26.00	0.01	2.460	4.13	-0.00
4.14	6.00	0.01	1.818	4.14	0.00
4.14	12.00	0.01	2.014	4.15	0.00
4.14	2.00	0.00	1.692	4.15	0.01
4.16	30.00	0.02	2.607	4.16	-0.00
6.55	30.00	0.02	3.819	6.56	0.00
6.58	26.00	0.01	3.622	6.58	0.00
6.63	20.00	0.01	3.332	6.63	0.00
6.69	12.00	0.01	2.942	6.69	0.00
6.70	6.00	0.01	2.629	6.70	-0.00
6.73	2.00	0.00	2.429	6.73	-0.00

Oxygen (ml/l) = Soc * (V + Voffset) * (1.0 + A * T + B * T^2 + C * T^3) * OxSol(T,S) * exp(E * P / K)
V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU] K = temperature [deg K]
OxSol(T,S) = oxygen saturation [ml/l], P = pressure [dbar], Residual = instrument oxygen - bath oxygen



Secondary Dissolved Oxygen (Seabird SBE 43)

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

SENSOR SERIAL NUMBER: 0201
CALIBRATION DATE: 02-Jul-08p

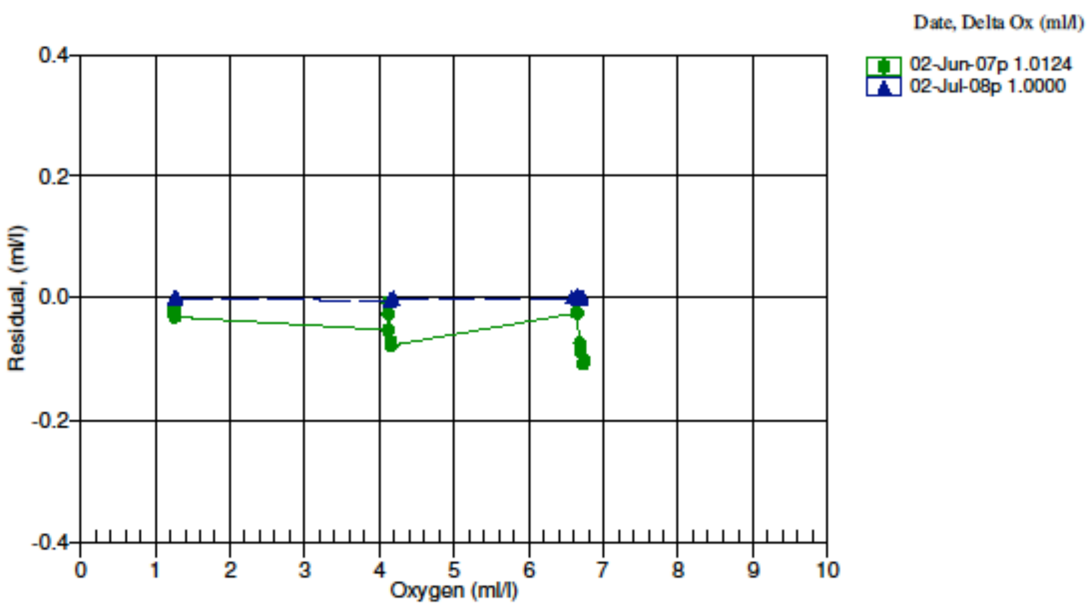
SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS
Soc = 0.3933
Voffset = -0.4820
Tau20 = 0.89

A = -3.2310e-004
B = 7.8811e-005
C = -1.6353e-006
E nominal = 0.036

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.26	12.00	0.01	0.906	1.26	0.00
1.27	20.00	0.01	0.982	1.27	0.00
1.27	6.00	0.00	0.853	1.27	0.00
1.27	2.00	0.00	0.817	1.27	0.00
1.27	26.00	0.01	1.043	1.27	-0.00
1.29	30.00	0.01	1.089	1.28	-0.00
4.15	26.00	0.01	2.310	4.15	-0.00
4.15	20.00	0.01	2.121	4.15	-0.00
4.17	12.00	0.01	1.879	4.16	-0.00
4.18	2.00	0.00	1.579	4.18	0.00
4.18	6.00	0.00	1.701	4.18	0.00
4.18	30.00	0.01	2.458	4.18	-0.00
6.58	30.00	0.01	3.590	6.58	0.00
6.65	26.00	0.01	3.414	6.65	0.00
6.65	20.00	0.01	3.109	6.65	-0.00
6.66	12.00	0.01	2.719	6.66	-0.00
6.71	2.00	0.00	2.244	6.71	-0.00
6.71	6.00	0.00	2.440	6.71	0.00

Oxygen (ml/l) = Soc * (V + Voffset) * $(1.0 + A * T + B * T^2 + C * T^3)$ * OxSol(T,S) * exp(E * P / K)
V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU] K = temperature [deg K]
OxSol(T,S) = oxygen saturation [ml/l], P = pressure [dbar], Residual = instrument oxygen - bath oxygen



Fluorometer (Wet Labs ECO)

PO Box 518
620 Applegate St.
Philomath, OR 97370

WET Labs

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

ECO Chlorophyll Fluorometer Characterization Sheet

Date: 7/28/2008 S/N: FLRTD-867

Chlorophyll concentration expressed in µg/l can be derived using the equation:

CHL (µg/l) = Scale Factor * (Output - Dark Counts)

	Analog Range 1	Analog Range 2	Analog Range 4 (default)	Digital
Dark Counts	0.088	0.054	0.036 V	54 counts
Scale Factor (SF)	6	13	25 µg/l/V	0.0077 µg/l/count
Maximum Output	4.95	4.95	4.95 V	16326 counts
Resolution	0.8	0.8	0.8 mV	0.8 counts

Ambient temperature during characterization 22.3 °C

Analog Range: 1 (most sensitive, 0–4,000 counts), 2 (midrange, 0–8,000 counts), 4 (entire range, 0–16,000 counts).

Dark Counts: Signal output of the meter in clean water with black tape over detector.

SF: Determined using the following equation: SF = x ÷ (output - dark counts), where x is the concentration of the solution used during instrument characterization. SF is used to derive instrument output concentration from the raw signal output of the fluorometer.

Maximum Output: Maximum signal output the fluorometer is capable of.

Resolution: Standard deviation of 1 minute of collected data.

The relationship between fluorescence and chlorophyll-a concentrations *in-situ* is highly variable. The scale factor listed on this document was determined using a mono-culture of phytoplankton (*Thalassiosira weissflogii*). The population was assumed to be reasonably healthy and the concentration was determined by using the absorption method. To accurately determine chlorophyll concentration using a fluorometer, you must perform secondary measurements on the populations of interest. This is typically done using extraction-based measurement techniques on discrete samples. For additional information on determining chlorophyll concentration see "Standard Methods for the Examination of Water and Wastewater" part 10200 H, published jointly by the American Public Health Association, American Water Works Association, and the Water Environment Federation.

FLRTD-867_workbookj1.xls Revision J 3/17/08

Transmissometer (Wet Labs C-Star)

PO Box 518
620 Applegate St.
Philomath, OR 97370

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

C-Star Calibration

Date April 20, 2007 | Customer Raytheon Polar Services | Work order 004

Job # 0412005 | S/N# CST-830DR | Pathlength 25 cm

	Analog meter
V_d	0.057 V
V_{air}	4.828 V
V_{ref}	4.721 V

Temperature of calibration water 21.9 °C
Ambient temperature during calibration 22.1 °C

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x): $Tr = e^{-cx}$

To determine beam transmittance: $Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$

To determine beam attenuation coefficient: $c = -1/x * \ln (Tr)$

V_d Meter output with the beam blocked. This is the offset.
V_{air} Meter output in air with a clear beam path.
V_{ref} Meter output with clean water in the path.
Temperature of calibration water: temperature of clean water used to obtain V_{ref}.
Ambient temperature: meter temperature in air during the calibration.
V_{sig} Measured signal output of meter.

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Acquisition and Processing Information

Processing Specifics

Refer to the InstCoef.txt file along with the specific instrument calibration sheets, both located in the Cal/ directory of the data distribution, for information on how the RVDAS data was collected and processed.

Errors and Events

This section lists all significant events and known problems with acquisition during this cruise including instrument failures, data acquisition system failures, and other factors affecting this data set.

Date (Julian)	Time (GMT)	Event	Location
043	0624	Began logging data	@68W
050	1100	Stopped sonars/seawater	@Palmer Station
051	1411	Restarted data logging	@Palmer Station
061	1800	Found sound speed on sonar was set to 1450 ft/sec. Corrected to 1500 ft/sec.	
067	1220	Discovered that ADCP to DAS was not logging since 1740 GMT on 9066 – all DAS screens showed green and no issues. Figures concurred with message. Stopped logging ADCP and restarted. Corrected issue and web page is now updating with correct information.	64 40.8°S, 65 43.2°W
068	0805	Stopped sonars/seawater	@ Palmer Station
068	0805	Found out that ADCP is locked up again and cannot quit out – trying to kill the process from command line	@ Palmer Station
068	0950	Rebooted ADCP machine in attempt to stop logging and make it work again. It has returned to a “normal” state.	@ Palmer Station
069	0923	Brought up all systems except for uncontaminated sea water wall – engineers currently de-icing.	@ Palmer Station
069	0927	Brought up remaining sea water systems	64 47.4°S, 64 4.8°W
070	1130	Rebooted ADCP. Locked up.	63 40.8°S, 56 46.2°W
071	All Day	Multiple ADCP data processing issues.	
073		Resolved most of the ADCP issues. Most raw data on independent ADCP logging machine should not have been impacted. Contact tchereskin@ucsd.edu for processed data or see http://currents.soest.hawaii.edu	
075	0935	Stopped data logging	@68W
