Data Synopsis for HLY0803

July 3 – July 31, 2008

Dutch Harbor to Dutch Harbor

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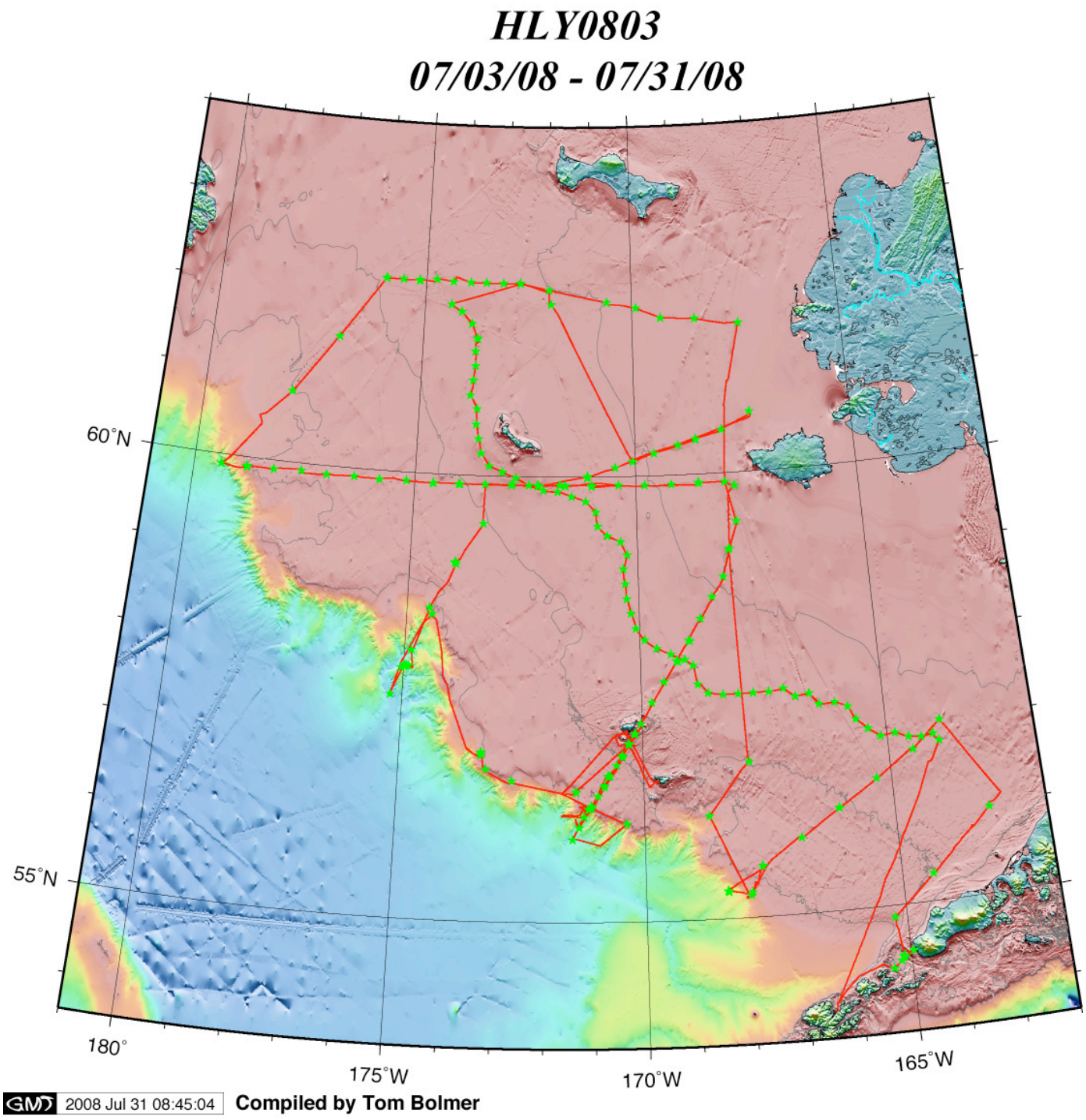
Project Summary

The Bering Ecosystem Study Project (BEST) focuses on the impact of seasonal sea ice on the environment of the eastern Bering Sea. More specifically, BEST seeks to clarify how sea ice influences the ecological pathways of nutrients and organic matter that lead to the abundant upper trophic levels and valuable fisheries on this extensive, high latitude continental shelf. More extensive background information can be found on the BEST home page (http://www.fish.washington.edu/research/best/). BEST also is part of a larger interagency effort to model the response of upper trophic levels to variations in climate forcing and more information on these collaborative efforts can be found on the web site of the Bering Sea Integrated Ecosystem Response Project (BSIERP; http://bsierp.nprb.org/index.htm).

The cruise described in this document is the third NSF funded, dedicated cruise for the BEST project. The first two took place in April-May of 2007 and 2008 and focused on the conditions directly associated with the retreating ice edge. HLY0803 will examine the summer conditions on the eastern Bering Sea shelf. Although this region is ice-free in summer, the presence of ice earlier in the year influences the subsequent development of physical and biological conditions. We hope to improve the understanding of these influences significantly during HLY0803. We will sample on the eastern shelf of the Bering Sea. The cruise will cover the entire shelf from the Aleutian Islands to St. Lawrence Island. A multidisciplinary sampling plan will be carried out that includes the deployment of moorings and physical oceanography, a hydrographic survey that will collect discrete samples for a variety of chemical and biological analyses, zooplankton and ichthyoplankton net hauls, sediment sampling with a coring device, a variety of biological rate measurements that will be done in on-board incubators on the bow, the deployment and retrieval of sediment traps that require small boat operations, as well as a variety of underway observations both from autonomous instruments sampling the sea chest water and visual observation of birds and marine mammals form the bridge.

The overall science objective for the cruise is to further the aims of the Bering Ecosystem Project that seeks to understand the role of sea ice in the structure and regulation of biological populations on the eastern Bering Sea shelf, and in particular the invertebrate, fish and marine mammal populations of importance to people. The specific objectives for the HLY0803 cruise will be to characterize summer conditions on the eastern shelf, particularly as they relate to the impact of the ice distribution from the prior winter. This includes the seasonal evolution of the nutrient and phytoplankton fields, as well as the distribution and abundance of the zooplankton and icthyoplankton.

Cruise Track



Personnel

Science Party Personnel

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Ship's Crew

HEALY Sailing List for July 03, 2008.

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Angelo, James YNC
Appleberry, Jason LT
Ayers, Silas LT
Bartlett, Charles MST1
Baldwin, Robin FS3
Beasley, Corey HSCS
Bender, Zachary ENS
Berringer, Mike ETC
Bitzer, Mary 1/C
Blas, Paul FN
Brogan, John MKC
Brown, Betty MK3
Buford, Aimee BM2
Combast, Jonathan ET3
Coombe, Jeffrey MK2
Dabe, Jeffrey IT1
Davis, Jonathon ET2
Dolton, Peter ENS
Dull, Steven FS2
Dunning, Lara BM3
Fernandez, Chelsey SN
Ford, Angela SN
Galvez, Oscar R. LT
Gaudette, Katherine 1/C
George, Lisa FS2
Glenzer, William BM1
Ghosn, Kathleen FN
Grey, Deidre SN
Hamilton, H. Mark FS3
Harbinsky, Mark ET2
Harris, Daniel SK1
Huneycutt, Gaines BM2
Hurtado, Daniell EM1
Imgarten, Christopher DC1
Irwin, Paul EM2
Jacobs, Bryson ENS
Jones, Greg MKCS
Kidd, Wayne BMC
Kruger, Thomas MST3
Laisure, Jeremy SK2
Lambert, Douglas MKC
Layman, Rich MST1
Liebrecht, Brian ET1
Lyons, Sean R CWO3
Manangan, Sorjen OSC
Marsden, George DCC
Mastrota, Leigh FN
McNally, Terence SK1
McNeil, Albert DC3
McManus, Gene SN
McQuillan, William 3/C
Merten, James SN
Miller, Valerie CWO2
Murphy, Nicholas MK2
Murray, Justin SN
Myatt, Lisa ENS
Olson, James EM3
O' Connor, Patrick MK2
O'Sullivan, Brandon MK2
Passalacqua, Joseph ETCM
Peterson, Jennifer 1/C
Podhora, Curtis EMCM
Powell, Gregory ET3
Quichocho, Robert MK1
Redd, Davion DC2
Reis, Brian BM1
Rieg, Mark MSTC
Rivera-Maldonado, Abner SKC
Rodermund, Michael, SA
Rose, John CWO
Roy, Evan BM3
Rudibaugh, Kenneth MK1
Schendorf, Tara ENS
Shaffer, Hans EM1
Siciak, Anthony MK3
Smith, Corey MK3
Smith, Josh LTJG
Starling, Wendy MK2
Sullivan, Timothy BMCS
Swanson, Shawn ET1
Thomas, Tasha ENS
Thompson, Emily SN
Tysin, Alley SNFS

Von Kauffmann, Daniel IT1

Wagner, Alexander FN

Whiting, Allan, MK1

Williams, Tony FSCS

Wilson, Thomas BMCM

Worrell, Kenneth EM1

Wright, Tiffany MST1

Yeckley, Andy BM3

Zehringer, Meghan 3/C

Zitting, Arrene FS1

Science Components and their major sampling activities

Project	*On the ship team*	*Sampling Activities*
Physics	Tom Weingartner Jim Johnson Dave Leech Kevin Taylor.	This group will deploy 10 moorings during the cruise and require up to 6 hours of wire time at each deployment.
Hydrography	Cal Mordy Bill Floering Dean Stockwell Sigrid Salo and Dave Kachel (leg 1) Dylan Righi and Ned Cokelet (leg 2).	This group will analyze salts, nutrients, oxygen and chlorophyll from the Niskin casts at each station as well as help manage cruise event information.
Carbon Productivity	John Casey Matt Tiahlo.	This group will collect water for productivity experiments on special casts and water for various other analyses from the standard casts.
Nitrogen uptake and cycling	Ray Sambrotto Didier Burdloff Kali McKee.	This group will collect water for rate experiments on special casts and water for various other analyses from the standard casts.
Particle flux	Roger Kelly	Roger will deploy floating sediment traps that will collect for 24 hr. periods as well as estimate productivity from the 3 isotopes of oxygen.
Iron analyses (leg 2 only)	Rob Rember Ana M Aguilar-Islas.	This group will collect samples on special casts from trace metal clean samplers.
Euphausiid and macrozooplankton collections	Alexei Pinchuk, Tracy Shaw	Alexei will collect macrozooplankton with a MOCNESS and CalVET net for quantitative distributions. Tracy will collect live euphausiids with a Bongo net for rate measurements and organic tracer assays.
Euphausiid rate measurements	Megan Bernhardt Tracy Shaw Virginia Engel	UW (Lessard group) will perform grazing, growth and reproduction experiments with euphausiids collected with Bongo nets using water collected on CTD casts.
Organic tracers of trophic transfer/euphausiid population age structure	Rachel Pleuthner Karen Taylor Charles Morgan	UMD (Harvey Group) will extract organic pools from zooplankton and their prey from net tows and water from CTD casts.
Ichthyolplankton	Nicola Hillgruber Elizabeth Siddon Ron Heintz.	This group will collect larval fish in collaboration with A. Pinchuk's net hauls.
Microzooplankton grazing	Diane Stoecker Kristin Blattner	This group will perform grazing experiments on water collected with the Niskin rosette from special casts.
Benthic characterization and fluxes	David Shull, and Greg Brusseau	This group will collect benthic samples with the multicorer in collaboration with Chris Moser.

Project	*On the ship team*	*Sampling Activities*
Benthic biogeochemical fluxes	Heather Whitney Amy Cash	This group will perform benthic flux measurements on cores retrieved from the multicorer.
Bird distribution and abundance	Paul Suchanek David Porter (leg 1) Tom Van Pelt Mark Rauzon (leg 2).	They will make observations from the bridge during the day.
CTD operations and support	Scott Hiller Sue Reynolds	
Cruise data visualization	Steve Roberts Tom Bolmer	
Data support	Janet Scannell (leg 1) Scott Loehrer (leg 2)	
Education component on board	Jillian Worsssam(PolarTrek) John Karavias (Armada) Alex Nanez (MATE intern)	
Marine mammal distribution and abundance	Gary Friedrechsen,	Gary will make observations from the bridge during the day.
Bio-optical and phytoplankton variations	Lisa Eisner	Lisa will add two instruments to the underway suite – a hyperspectral absorption instrument and a nitrate sensor. She will also collect samples from the Niskin rosette.
Water column bio-optics	Joaquim Goes Eurico J. D'Sa Puneeta Naik Maria Fatima Helga do R. Gomes.	This group will measure profiles in the upper 100 m with their own bio-optical package that includes an FRRF. They will also collect discrete samples from the Niskin rosette using newly developed fluorescent methods for phytoplankton characterization.

Distribution Contents

Introduction to Data

The Healy data acquisition systems continuously log data from the instruments used during the cruise. This document describes:

- The structure and organization of the data on the distribution media.
- The format and contents of the data strings.
- Formulas for calculating values.
- Information about the specific instruments in use during the cruise.
- A log of acquisition problems and events during the cruise that may affect the data.
- Scanned calibration sheets for the instruments in use during the cruise.

The data is distributed on a small USB disk drive.

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

There are two logging system on the Healy. The ship (ESU) runs the SCS logging system and the LDEO support group runs the LDS logging system. This provides some redundancy in logging. The main purpose of LDS is to support the sonars and the output is saved in LDS_Data.

The Scientific Computer System (SCS) (version 4.2) is a data acquisition, and display system designed for Oceanographic, Atmospheric, and Fisheries research applications. It acquires sensor data from shipboard oceanographic, atmospheric, and fisheries sensors and provides this information to scientists in real time via text and graphic displays, while simultaneously logging the data to disk for later analysis. SCS also performs quality checks by monitoring I/O, providing delta/range checks and plotting data after acquisition.

The LDEO Data System is somewhat distant relative of the logging code that has grown through more than a decade of use at LDEO. It is a significant revision of the current (2004) code used on the R/V Ewing (the Ewing Data System) and is architecturally much different. Because of this, LDS is still growing and at the moment (2008) this is the only operational implementation.

Data

Data are received via RS-232 serial connections. In SCS a time tag is added at the beginning of each line of data in the form,

mm/dd/yyyy,hh:mm:ss.sss,[data stream from instrument] where:

Format	Value used
ım	digit month of the year
d	digit ay of the year
yyy	digit year
h	digit hour of the day
ım	digit minute
.sss	conds

An example string from the Seabeam Centerbeam file is:

04/13/2007,06:49:20.920,$SBCTR,2007,4,13,06:49:09.437,57.158792,-165.664322 ,69.15,60*00

All times are reported in UTC. Each file type has it's own NEMA string name ($SBCTR as an example).

The delimiters that separate fields in the raw data files are commas. Care should be taken when reprocessing the data that the field's separations are clearly understood.

Directories:

1_Minute_Averaged_Data: This directory contains all of the under way data averaged over a 1 minute window in time.

SCS_Data*:* This directory contains serial data collected by the SCS version 4.2 data collection system in different directories. Directory names are labeled by the instrument name and string type of the data collected. A description of the data contained in this directory is below.

LDS_Data*:* This directory contains serial data collected by the Lamont LDS data collection system in different directories. Directory names are labeled by the instrument name and string type of the data collected. A description of the data contained in this directory is below.

Raw: This directory contains raw data as recorded by individual instruments and put into different directories. Directory names are labeled by the instrument name and string type of the data collected. A description of the data contained in this directory is below.

Meta_data: This directory contains documents useful in the post analysis of the data on this DVD media set. The data type are separated into different directories by type. A description of these directories is below.

1_Minute_Averaged_Data:

HLY0803_distance.csv.gz	Distance along track from port.
HLY0803_Averaged.csv.gz	All the Under way data averaged for 1 minute.
Shapefile	All of the 1 minute under way data averaged at 1 minute spacing in shp, shx and dbf GIS files.

SCS_Data:

/aft_a_frame	Wire tension, wire out, and wire speed for the Aft A frame sheaves.
/air_temp_f	Temperature data from the RM Young wind sensor in Fahrenheit. Data is derived from data from files in the rmyoung_air directory
/ashtech_attitude	Attitude in NMEA format from the Ashtech ADU5 GPS receiver
/ashtech_gga	Position data in NMEA GGA format from the Ashtech ADU5 GPS receiver
/ashtech_gll	Position data in NMEA GLL format from the Ashtech ADU5 GPS receiver
/ashtech_hdt	Heading data in NMEA HDT format from the Ashtech ADU5 GPS receiver
/dew_point_f	Dew point temperature derived from air temp
/flomet_a	Flow meter data just upstream of the A TSG and Fluorometer.
/fluro_a	Flurometer for A TSG sensor.
/glonass_gga	Position data in NMEA GGA format from the GLONASS GPS receiver.
/glonass_gll	Position data in NMEA GLL format from the GLONASS GPS receiver.
/gyro_mk27	Heading data in NMEA HDT format from the Sperry MK27gyro compass
/gyro_mk39	Heading data in NMEA HDT format from the Sperry MK39 gyro compass
/ibs_waypoints	Waypoints from the Healy's Integrated Bridge System
/isus	ISUS Nitrate Sensor small file
/isus3v	ISUS Nitrate Sensor 3V full file
/knudsen	Depth data in a proprietary PKEL format received from Knudsen 320 B/R serial output
/met3a_sen	Meterology data from the top of the Jackstaff.
/oxygen_a	Oxygen values from A TSG.

/pcode_aft_gga	Position data in NMEA GGA format from the Trimble Centurion receiver located in the Computer lab
/pcode_aft_gll	Position data in NMEA GLL format from the Trimble Centurion receiver located in the Computer lab
/pcode_aft_vtg	Course and speed over ground in NMEA VTG format from the Trimble Centurion receiver located in the Computer lab
/pcode_aft_zda	Time and date data in the NMEA ZDA format. Data retrieved from the Trimble Centurion receiver located in the Computer lab
/pcode_bridge_gga	Position data in NMEA GGA format from the Trimble GPS receiver located on the bridge.
/pcode_bridge_gll	Position data in NMEA GLL format from the Trimble GPS receiver located on the bridge.
/pcode_bridge_vtg	Course and speed over ground data in NMEA VTG format from the Trimble GPS receiver located on the bridge.
/posmv_gga	Position data in NMEA GGA format from the POS/MV
/posmv_gst	Pseudorange error statistics in NMEA GST format from the POS/MV
/posmv_hdt	Heading data in NMEA HDT format from the POS/MV
/posmv_pashr	Roll, pitch and heave from POS MV inertial navigation system.
/posmv_vtg	Course and speed over ground in NMEA VTG format from the POS/MV
/posmv_zda	Time and date data in NMEA ZDA format from the POS/MV
/pressure_sen	Pressure sensor in the Uncontaminated Seawater System before the Bio Chem Lab which measures header pressure in PSI.
/rmyoung_air	Temperature, humidity, air pressure data in NMEA XDR format from the RM Young meteorological system
/rmyportwind	Wind speed and direction data in NMEA WMV format from the RM Young weather vane on the port side of the Healy.
/rmystbdwind	Wind speed and direction data in NMEA WMV format from the RM Young weather vane on the starboard side of the Healy.
/samos_data	Meterology data for SAMOS.
/sbd_a_frame	Wire tension, wire out, and wire speed for the starboard A frame sheaves.
/seabeam_center	Center depth data from the Seabeam 2112
/solar_radiometers	Solar Radiometer data for SW and IW.
/sperry_speedlog	ground/water speed data from the Sperry Speed Log
/surface_par	Photosynthetic Active Radiation volts and Microeinstens/m2 se from the surface par sensor
/sv2000	Sound Velocity data from the SV2000 sound velocimeter located in the ADCP BB150 sonar well
/true_wind_port	True wind speed data derived from gyro data and rmyportwind

/true_wind_stbd	True wind speed data derived from gyro data and rmystbdwind
/winch_data	Line out and speed data from the winch system.
/wind_sen_a	Wind data from the Jack Staff.
/wind_sen_b	Wind data from the Yard.

Extra files in the directory SCS_Data*:*

ACQLOG.LOG	Contains the data as to what occurred with SCS data. It shows when data collection was started and stopped.
Incidents_YYYYMMDD-TTTTTT.DTM	Contains any incident data, which were triggered in SCS.
sensor_YYYYMMDD-TTTTTT.scf	Contains the configuration file for data collection as configured by SCS.

LDS_Data:

/AloftConCam	Contains picture files separated by folders named by YearJulian (YYYYJJJ). The picture files are in 5 minute JPEG format.
/FantailCam	Contains picture files separated by folders named by YearJulian (YYYYJJJ).). The picture files are in 5 minute JPEG format.
/adu5	Contains the data from the ADU5 GPS.
/aggps	Contains the data from the AG GPS.
/bgm221	Contains the data from the BGM221 Gravimeter.
/bgm222	Contains the data from the BGM222 Gravimeter.
/events	Contains the logs of event for different systems.
/mk27	Contains the data from the MK27 Gyro.
/mk30	Contains the data from the MK30 Gyro.
/posatt	Contains the attitude data from the POSMV GPS.
/posnav	Contains the navigation data from the POSMV GPS.
/posreform2sb	Contains the navigation data from the POSMV GPS reformatted for the SeaBeam.
/sbctr	Contains the center beam data from the SeaBeam.
/sbsv	Contains the surface sound velocity data for the SeaBeam.
/seabeam	Contains the raw SeaBeam 2112 multibeam data.
/tsg_met	Contains the all data from SIO TSG and Met sensors.

Meta_Data:

/elog	Contains the technician's narrative of important events, which occurred both to the network and to individual sensors.
/Bridge_Logs	
DDMMMYY.doc	The "smooth log" containing events recorded by the bridge watch.
DDMMMYYWX.xls	Weather log recorded by the watch.
DDMMMYYNAV.xls	Navigation logs recorded by the watch.
/WHOisWHO	Contains files of Science Party Members emails and addresses.
/Sensor_Formats	Contains Html and PDF file of the formats of all the files collected under way during the cruise.

Raw:

/adcp75	75 KHz ADCP data (not on HLY0803)
/adcp150	150 Khz ADCP data
/ctd	CTD data in directories by Cast number.
/xbt	Expendable Bathythermograph data. (not on HLY0803)
/knudsenraw	Knudsen 320B/R data

/Satellite_Images:

Contains satellite imagery in jpeg format

/dmsp	dmsp folders labeled by Year, Month, Day
/hrpt	hrpt folders labeled by Year, Month, Day

ice_observations*:*

Directories of the Ice Observations taken for each day March 14 to March 25. (not on HLY0803)

Contents by directory:

SCS_Data:

aft_a_frame
air_temp_f
ashtech_attitude
ashtech_gga
ashtech_gll
ashtech_hdt
dew_point_f
flomet_a
fluro_a
glonass_gga
glonass_gll
gyro_mk27
gyro_mk39
ibs_waypoints
isus
knudsen
met3a_sen
oxygen_a
pcode_aft_gga
pcode_aft_gll
pcode_aft_vtg
pcode_aft_zda
pcode_bridge_gga
pcode_bridge_gll
pcode_bridge_vtg
posmv_gga
posmv_gst
posmv_hdt
posmv_pashr
posmv_vtg
posmv_zda
rmyoung_air
rmyportwind
rmystbdwind
samos_data
seabeam_center
solar_radiometers
sperry_speedlog
stbd_a_frame
surface_par
surface_temp
sv2000
true_wind_port
true_wind_stbd
tsg_a
wind_sen_a
wind_sen_b

Raw:

adcp150
adcp75
ctd
knudsenraw
xbt

***Satellite*_Images:**

dmsp
hrpt

LDS_Data:

AloftConnCam
FantailCam
adu5
aggps
bgm221
bgm222
events
mk27
mk30
posatt
posnav
posreform2sb
sbctr
sbsv
seabeam
tsg_met

Meta_Data:

Bridge_Logs
Systems_Calibration_Data
Elog
WHOisWHO
Sensor_Formats

Merged Data

LDEO Averaged One Minute Data File

The data are summarized into an averaged one (1) minute data file by the LDEO technician. This file takes the average value centered around the minute, (30 seconds either side of the whole minute). The data are the raw values as they are logged. There has been no quality control done on these files. Those wishing more accurate and quality controlled values should process the data in the directories described below in the document.

HLY0803_track.csv

25485,2008/07/20 10:15,56.8421422,-173.2905390,354.9,11.3,352.2,158.1,7.546,7.652,33.1845,32.084,1.828,0.183,0.000,0.011,2.97,0.08,367.54,281.33,281.32,1.66,8.05,100.00,1009.72,11.88,298.92,14.40,267.05,12.75,286.31,13.58,251.95,13.35,6.269,7.652,0.083,-6.128,3,-377,8,0,1,-156,1,0,18.73,251.2,6.78,0.51

25486,2008/07/20 10:16,56.8452412,-173.2910445,354.7,11.2,352.0,160.5,7.546,7.666,33.1987,32.086,1.783,0.178,0.000,0.011,2.97,0.20,364.65,281.34,281.33,1.66,8.05,100.00,1009.73,11.87,300.49,14.68,269.73,13.17,287.56,13.94,253.32,13.17,6.263,7.666,0.144,-4.494,3,-377,8,0,1,-157,1,0,19.06,258.4,6.78,0.51

25487,2008/07/20 10:17,56.8483228,-173.2915862,354.4,11.2,351.5,161.9,7.550,7.684,33.2140,32.086,1.754,0.175,0.000,0.011,2.97,0.20,364.71,281.36,281.32,1.66,8.04,100.00,1009.71,11.88,301.11,15.82,271.81,14.19,287.68,13.41,253.85,13.21,6.256,7.684,0.001,-8.363,3,-378,8,0,1,-157,1,0,19.02,261.3,6.77,0.52

Field	*Data*	*Example*	*Units*
01	ID	25485	sample count
02	date	2008/07/20 10:15	date & time UTC (year/month/day hour:minute)
03	lat	56.8421422	$INGGA, POSMV Latitude (decimal degrees)
04	lon	-173.2905390	$INGGA, POSMV Longitude (decimal degrees)
05	cog	354.9	$INVTG, POSMV Course Over Ground (angular distance from 0 (North) clockwise through 360, 1 minute average)
06	sog	11.3	$INVTG, POSMV Speed Over Ground (Knots, 1 minute average
07	heading	352.2	$PASHR, POSMV ship heading (angular distance from 0 (North) clockwise through 360, 1 minute average)
08	depth	158.1	$SBCTR, Seabeam centerbeam depth(meters, 1 minute average)
09	SST	7.546	$PSSTA, SBE3s RemoteTemperature, Sea Chest intake (Celsius, 1 minute average)
10	TSG_InTemp	7.652	$PSTSA, SBE45 internal temperature (Celsius, 1 minute average)
11	TSG_Cond	33.1845	$PSTSA, SBE45 Water Conductivity (millisiemens/centimeter, 1 minute average)
12	TSG_Sal	32.084	$PSTSA, SBE45 Water Salinity (PSU, 1 minute average)
13	SCF-FL	1.828	$PSFLA, SCF Fluorometer (Ug/l, 1 minute average)
14	SCF-FL-V	0.183	$PSFLA, SCF Fluorometer (Volts, 1 minute average)
15	SCF-Turb	0.000	$PSFLA, SCF Turbidity (NTU, 1 minute average)

Field	*Data*	*Example*	*Units*
16	SCF-Turb-V	0.011	$PSFLA, SCF Turbidity (Volts, 1 minute average)
17	tsg_flow_A	2.97	$PSFMA, Flowmeter in-line with PSTSGA, PSOXA, PSFLA (LitersPerMinute, minimum value in 1 minute interval)
18	SWR	0.08	$PSSRA, Short Wave Radiation (W/M^2, 1 minute average)
19	LWR	367.54	$PSSRA, Long Wave Radiation (W/M^2, 1 minute average)
20	LWR_Dome_T	281.33	$PSSRA, LWD Dome Temperature (Deg K, 1 minute average)
21	LWR_Body_T	281.32	$PSSRA, LWD Body Temperature (Deg K, 1 minute average)
22	PAR	1.66	$PSSPA, Surface PAR (uE/Sec/M^2, 1 minute average)
23	MET3A_Temp	8.05	$PSMEA, MET3A Air Temperature (Deg C, 1 minute average)
24	MET3A_RH	100.00	$PSMEA, MET3A Relative Humidity (%, 1 minute average)
25	MET3A_Baro	1009.72	$PSMEA, MET3A Barometric Pressure (millibars, 1 minute average)
26	MET3A_Precip	11.88	$PSMEA, MET3A Precipitation (mm, 1 minute average)
27	JS_WndDirR	298.92	$PSWDA, Jackstaff Relative wind direction (deg, 1 minute average)
28	JS_WndSpdR	14.40	$PSWDA, Jackstaff Relative wind speed (m/s, 1 minute average)
29	JS_WndDirT	267.05	$PSWDA, Jackstaff True wind direction (deg, 1 minute average)
30	JS_WndSpdT	12.75	$PSWDA, Jackstaff True wind speed (m/s, 1 minute average)
31	MM_WndDirR	286.31	$PSWDB, Main Mast Relative wind direction (deg, 1 minute average)
32	MM_WndSpdR	13.58	$PSWDB, Main Mast Relative wind speed (m/s, 1 minute average)
33	MM_WndDirT	251.95	$PSWDB, Main Mast True wind direction (deg, 1 minute average)
34	MM_WndSpdT	13.35	$PSWDB, Main Mast True wind speed (m/s, 1 minute average)
35	SBE_Oxy	6.269	$PSOXA, SBE-43 Oxygen (ml/l, 1 minute average)
36	SBE_Oxy_T	7.652	$PSOXA, SBE-43 Oxygen Temperature(Deg C, 1 minute average)
37	Isus_1	0.083	$PSNTA, Isus Aux 1(Volts, 1 minute average)
38	Isus_2	-6.128	$PSNTA, Isus Aux 2(Volts, 1 minute average)
39	WinchAft	3	Aft A-Frame Winch number
40	TensionAft	-377	Aft A-Frame Winch Wire tension (Pounds, 1 minute average)
41	WireOutAft	8	Aft A-Frame Winch Wire out (Meters, 1 minute average)
42	SpeedAft	0	Aft A-Frame Winch Wire speed (Meters/minute, 1 minute average)
43	WinchSbd	1	Starboard A-Frame Winch number
44	TensionSbd	-156	Starboard A-Frame Winch Wire tension (Pounds, 1 minute average)
45	WireOutSbd	1	Starboard A-Frame Winch Wire out (Meters, 1 minute

Field	*Data*	*Example*	*Units*
			average)
46	SpeedSbd	0	Starboard A-Frame Winch Wire speed(Meters/minute, 1 minute average)
47	StbdWndSpdT	18.73	RMYoung True Wind Speed, starboard (Knots, 1 minute average)
48	StbdWndDirT	251.2	RMYoung True Wind Direction, starboard (angular distance from 0 (North) clockwise through 360, 1 minute average)
49	OxySat	6.78	Dissolved oxygen (DO) saturation as a funciton of T and S (Weiss)(ml/L, 1 minute average)
50	AOU	0.51	Apparent Oxygen Utilization (AOU)(ml/L,1 minute average)

File Formats of Data Collected Underway

The formats of the Under way data files that were collected on this cruise are in a separate document named HLY0803_Sensors. This is now a separate document due to it's large size. The file HLY0803_Sensors.htm is in the Meta_Data. This file is also in a PDF file. To use this html file you will need to have the directory HLY0803_Sensors_files in the same directory as the html file.

Also in the Meta_Data directory are some PDF files for data that was collected but not part of the normal science routine.

APPENDIX:

Acquisition Problems and Events

This table summarizes problems with acquisition noted during this cruise including instrument failures, data acquisition system failures and any other factor affecting this data set. Times are reported in GMT (UTC, Z). You should look for more complete details for these events in the ELOG accounts.

Date	*Time (UTC)*	*Event*
07/03/08	17:23	Start LDS for HLY0803
07/03/08	21:01	Start SeaBeam 2112 for HLY0803
07/03/08	21:02	Start Knudsen Sub Bottom for HLY0803
07/03/08	21:10	Start ADCP 150 for HLY0803
07/03/08	21:21	Science Seawater requested to be turned on
07/03/08	21:35	SCS started for HLY0803
07/04/08	07:05	New SVP from CTD 002
07/04/08	10:01	Note that no data from the SIO Met Sensors on the Yard Arm
07/04/08	19:59	New SVP from CTD 008
07/04/08	22:17	SIO Met Sensors on the Yard Arm working
07/05/08	02:58	SCS secured to work on shared disks and then restarted
07/05/08	20:11	Note drop outs in SIO data to SCS, due to hlymet01 web page????
07/05/08	20:31	New SVP from CTD 011
07/06/08	02:38	Gyro input to ADCP 150 has been frozen for awhile
07/06/08	05:54	New SVP from CTD 014 and ARGO array float R4900799_047
07/06/08	10:36	New SVP from CTD 015 and ARGO array float R4900799_047
07/06/08	17:08	New SVP from CTD 017 and ARGO array float R4900799_047
07/06/08	17:20	Gyro input to ADCP 150 reset and working
07/06/08	20:33	New SVP from CTD 018 and ARGO array float R4900799_047
07/07/08	01:04	New SVP from CTD 0189
07/07/08	15:45	Reload SVP from CTD 018 and ARGO array float R4900799_047
07/07/08	18:01	Winch data interval from 1 to 4 per second

Date	*Time (UTC)*	*Event*
07/08/08	00:47	ADU5 lost Attitude
07/08/08	01:06	ADU5 no Lat/Long since 7/7/23:54Z
07/08/08	01:51	ADU5 reset with no improvement
07/08/08	02:53	New SVP from CTD 025
07/08/08	06:38	ADU5 ft antenna connector replaced, working again
07/08/08	11:04	change setup for ADCP 150
07/08/08	11:16	New SVP from CTD 026 and CTD 25 for deep
07/08/08	19:03	Stop SCS
07/08/08	1910	Restart SCS
07/08/08	22:24	New SVP from CTD 027 and CTD 25 for deep
07/08/08	23:00	Knudsen from Sub Bottom mode to 12 Khz to search for Optics package
07/09/08	02:57	Knudsen back to Sub Bottom mode
07/09/08	09:14	Gyro input to ADCP 150 reset since it was frozen
07/09/08	10:27	New SVP from CTD 030 and CTD 25 for deep
07/09/08	10:28	Note Gyro to ADCP 150 frozen again
07/09/08	15:44	Note Gyro to ADCP 150 is working again
07/09/08	21:53	New SVP from CTD 035
07/10/08	00:54	New SVP from CTD 036
07/10/08	04:54	New SVP from CTD 037
07/10/08	09:14	SeaBeam shutdown for generator changeover
07/10/08	09:28	Knudsen to Internal timing since SeaBeam is down and no trigger
07/10/08	11:04	SeaBeam running again Tape #2
07/10/08	11:04	Knudsen triggering off of SeaBeam
07/10/08	14:51	New SVP from CTD 040 and CTD 25 for deep
07/10/08	16:38	Note Gyro to ADCP 150 lost again
07/10/08	16:49	Gyro to ADCP 150 working again
07/10/08	18:48	New SVP from CTD 042 and CTD 25 for deep
07/10/08	21:46	Reload SVP from CTD 033
07/10/08	23:06	Knudsen to 12 Khz to compare with Sub Bottom
07/10/08	23:33	New SVP from CTD 043
07/10/08	23:58	Knudsen back to Sub Bottom mode
07/11/08	03:44	Set top 200 of SVP 043 to 1469.5
07/11/08	08:30	New SVP from CTD 045
07/11/08	11:23	Reload SVP from CTD 042
07/11/08	14:16	Set Knudsen to Internal timing since no SeaBeam
07/11/08	14:18	Shutting down SeaBeam since no data since 13:15
07/11/08	14:35	SeaBeam back running, no idea why stopped, Tape #3
07/11/08	14:39	Set Knudsen to External timing off of SeaBeam
07/11/08	17:34	SeaBeam to Idle to Release Mooring
07/11/08	17:34	ADCP 150 stopped to Release Mooring
07/11/08	17:34	No Knudsen data since no SeaBeam Trigger
07/11/08	18:22	ADCP 150 restarted
07/11/08	18:22	SeaBeam to Survey
07/11/08	18:23	Knudsen data since SeaBeam Trigger is working again
07/12/08	04:52	New SVP from CTD 049
07/12/08	07:33	New SVP from CTD 050
07/12/08	18:48	New SVP from CTD 053

Date	*Time (UTC)*	*Event*
07/12/08	22:18	New SVP from CTD 054
07/13/08	00:26	New SVP from CTD 055
07/13/08	02:44	Note ADCP 150 Gyro input frozen again, for how long?
07/13/08	03:29	New SVP from CTD 056
07/13/08	04:20	Manually adjust SVP from CTD 056 down to 200m to 1464.5
07/13/08	07:56	Reload SVP from CTD 045
07/13/08	14:46	New SVP from CTD 029 and CTD 25 for deep
07/13/08	16:38	ADCP150 gyro reset at 1855 (L)
07/13/08	18:32	New SVP from CTD 058 and CTD 25 for deep
07/13/08	18:57	Note ADCP150 gyro frozen again
07/13/08	19:14	Note ADCP150 gyro working again
07/13/08	19:27	Reload SVP from CTD 027
07/13/08	23:36	Knudsen to 12KHz more for awhile and then back to Subbottom
07/13/08	23:58	Knudsen using 12KHz and Subbottom
07/13/08	23:59	SeaBeam to Idle
07/14/08	00:53	SeaBeam to Survey
07/14/08	00:58	Knudsen using only Subbottom
07/14/08	03:33	New SVP from CTD 060
07/14/08	04:52	ADCP150 getting gyro from new card but data is 40 degrees too high
07/14/08	06:09	New SVP from CTD 061
07/14/08	09:44	New SVP from CTD 062 and CTD 25 for deep
07/14/08	11:46	ADCP150 Gyro heading stuck again
07/14/08	14:54	New SVP from CTD 065 and CTD 25 for deep
07/14/08	20:53	New SVP from CTD 068
07/14/08	22:27	New SVP from CTD 069
07/14/08	23:10	SCS stopped, to change ISUS settings
07/14/08	23:16	SCS restarted
07/15/08	01:12	New SVP from CTD 070
07/15/08	06:45	New SVP from CTD 072 and ARGO float R4900843_028 for deep
07/15/08	10:35	New SVP from CTD 073 and ARGO float R4900843_028 for deep
07/15/08	15:04	New SVP from CTD 075 and ARGO float R4900843_028 for deep
07/15/08	18:53	New SVP from CTD 077 and ARGO float R4900843_028 for deep
07/15/08	21:40	New SVP from CTD 078 and Levitus for deep
07/16/08	01:57	Knudsen to pinger mode for multicore
07/16/08	02:01	SeaBeam to Idle mode for multicore
07/16/08	06:21	Knudsen to SubBottom mode
07/16/08	06:22	SeaBeam to Survey
07/16/08	08:25	ADCP150 Gyro heading stuck again
07/16/08	12:37	Lost some depths in Knudsen Sub Bottom with minimum setting too deep
07/16/08	14:03	Strange dip at 10L00Z noted on TSG
07/17/08	00:22	New SVP from CTD 080
07/17/08	00:27	SCS stopped to implement ISUS changes
07/17/08	00:28	SCS restarted
07/17/08	00:46	Reload SVP from CTD 077
07/17/08	02:45	Reload SVP from CTD 073
07/17/08	02:50	ADCP150 gyro heading still frozen
07/17/08	04:42	New SVP from CTD 082

Date	*Time (UTC)*	*Event*
07/17/08	07:01	Reload SVP from CTD 072
07/17/08	07:54	New SVP from CTD 083
07/17/08	08:46	Reload SVP from CTD 081
07/17/08	09:11	Lost some Knudsen Sub Bottom data with minimum too deep
07/17/08	10:52	New SVP from CTD 084 and CTD 69 for deep
07/17/08	16:39	Water depths here should be questionable as we sit off of the island
07/17/08	23:06	UPS for BioChem is finally died
07/18/08	06:05	SeaBeam is acting funny since 0523Z, Nav is very erratic
07/18/08	06:10	SeaBeam center beam is being recorded OK
07/18/08	06:57	SeaBeam shutdown and restarted with no improvement, new 8mm tape
07/18/08	07:19	SeaBeam $NVZDA time is 7 minutes slow
07/18/08	07:43	IBS work done at time the SeaBeam navigation became erratic
07/18/08	10:02	IBS rebooted to PCODE time sync
07/18/08	10:02	SeaBeam back to normal
07/18/08	11:03	SeaBeam rebooted just to be safe, same tape used, SVP from CTD 073
07/18/08	18:21	New SVP from CTD 090 and CTD 78 and ARGO float R4900843_028 for deep
07/18/08	20:36	Reload SVP from CTD 077
07/18/08	20:57	Reload SVP from CTD 080
07/18/08	21:41	Reload SVP from CTD 078
07/18/08	23:06	BioChem UPS replaced
07/18/08	23:07	ADCP 150 shutdown for circuit board changes
07/18/08	23:27	ADCP 150 back up and heading is right
07/19/08	00:05	New SVP from CTD 092
07/19/08	03:29	Reload SVP from CTD 080
07/19/08	04:59	New SVP from CTD 093 and CTD 092 for deep
07/19/08	06:33	ADU5 has no Attitude data since 00:45Z
07/19/08	06:53	ADU5 reset
07/19/08	07:21	Reload SVP from CTD 090
07/19/08	10:24	Knudsen lost some data due to Minimum set too deep
07/19/08	11:52	New SVP from CTD 094 and CTD 078 for deep
07/19/08	14:30	Reload SVP from CTD 072
07/19/08	19:52	Reload SVP from CTD 071
07/19/08	22:40	Reload SVP from CTD 088
07/20/08	00:41	New SVP from CTD 094 and CTD 080 and 94 for deep
07/20/08	06:20	New SVP from CTD 098 and CTD 080 for deep
07/20/08	14:44	New SVP from CTD 101 and CTD 080 and ARGO float R4900799_047 for deep
07/20/08	15:47	SeaBeam very off for last 45 minutes. Lost auto track
07/20/08	20:03	New SVP from CTD 100 and CTD 101 and Levitus
07/21/08	03:44	New SVP from CTD 103 and Levitus
07/21/08	17:03	MK 27 Gyro input from Northsar to Furuno GP37
07/21/08	17:33	New SVP from CTD 106 and Levitus
07/21/08	20:57	New SVP from CTD 109 and Levitus
07/21/08	23:16	Knudsen to Pinger for Multicore
07/21/08	23:18	SeaBeam to Idle for Multicore
07/22/08	00:27	SeaBeam to Survey Multicore

Date	*Time (UTC)*	*Event*
07/22/08	00:28	Knudsen to SubBottom
07/22/08	05:20	Reload SVP from CTD 103 with CTD 109 for deep
07/22/08	06:45	New SVP from CTD 111 with CTD 109 for deep
07/22/08	13:07	New SVP from CTD 112 with CTD 109 for deep
07/22/08	17:09	Knudsen to internal trigger. SeaBeam stopped and no Knudsen data
07/22/08	17:38	SeaBeam restarted and in Survey mode. Tape #5
07/22/08	17:42	Knudsen triggering off of SeaBeam
07/22/08	17:50	Reload SVP from CTD 112
07/22/08	18:21	ADCP150 gyro headings will be off as ETs work on Gyro syncro
07/22/08	19:00	ADCP150 stopped and restarted
07/22/08	21:28	ADCP150 Gyro Heading back
07/23/08	00:05	New SVP from CTD 116
07/23/08	03:55	New SVP from CTD 117
07/23/08	07:00	shutdown and restart SeaBeam with new MO disk. New 8mm tape?
07/23/08	08:09	New SVP from CTD 118
07/23/08	14:32	New SVP from CTD 121
07/23/08	14:56	Knudsen to internal trigger
07/23/08	15:03	Knudsen to external trigger
07/23/08	21:30	New SVP from CTD 124
07/23/08	23:04	New SVP from CTD 123
07/23/08	23:45	SeaBeam lost time input form IBS for awhile
07/24/08	06:18	New SVP from CTD 125
07/24/08	11:18	New SVP from CTD 129
07/24/08	15:54	New SVP from CTD 130
07/24/08	19:32	New SVP from CTD 132
07/24/08	21:28	New SVP from CTD 133
07/25/08	00:57	New SVP from CTD 134 and argo array float R4900597_111 for the deep
07/25/08	05:36	New SVP from CTD 135 and argo array float R4900597_111 for the deep
07/25/08	08:44	New SVP from CTD 136 and argo array float R4900597_111 for the deep
07/25/08	10:46	New SVP from CTD 137 and argo array float R4900597_111 for the deep
07/25/08	14:06	New SVP from CTD 138 and argo array float R4900597_111 for the deep
07/25/08	16:50	MK27 gyro switched back to Northstar for GPS feed
07/25/08	19:45	add deep values to SVP from CTD 138
07/25/08	21:56	New SVP from CTD 141 and argo array float R4900597_111 for the deep
07/26/08	04:04	New SVP from CTD 142
07/26/08	08:35	New SVP from CTD 143
07/26/08	12:39	New SVP from CTD 144
07/26/08	14:34	New SVP from CTD 146
07/26/08	16:37	New SVP from CTD 147
07/26/08	22:19	New SVP from CTD 149
07/27/08	02:02	Stop SCS149
07/27/08	02:03	Restart SCS
07/27/08	02:37	New SVP from CTD 151
07/27/08	11:31	New SVP from CTD 155
07/27/08	14:37	New SVP from CTD 157
07/27/08	20:04	TSG Fluorometer off for cleaning. It has been noisy.
07/27/08	21:18	TSG Fluorometer off for cleaning, again

Date	*Time (UTC)*	*Event*
07/27/08	21:48	New SVP from CTD 160
07/28/08	01:21	New SVP from CTD 164
07/28/08	02:34	It looks like ADCP 150 Gyro heading has been frozen for 24+ hours
07/28/08	03:30	New SVP from CTD 165
07/28/08	04:23	New SVP from CTD 166
07/28/08	05:47	New SVP from CTD 167
07/28/08	06:18	ADCP 150 Gyro syncro reset and is working
07/28/08	06:51	Knudsen Delay set from 0 to .5 seconds, 12Hz on
07/28/08	07:02	New SVP from CTD 168
07/28/08	07:23	Knudsen 12Hz off
07/28/08	08:16	New SVP from CTD 169
07/28/08	09:23	New SVP from CTD 170
07/28/08	10:41	New SVP from CTD 171
07/28/08	12:08	New SVP from CTD 172
07/28/08	12:56	New SVP from CTD 173
07/28/08	14:15	New SVP from CTD 174
07/28/08	14:27	Restart Profile Display on SeaBeam after it had stopped
07/28/08	15:01	New SVP from CTD 175
07/28/08	16:12	New SVP from CTD 176
07/28/08	18:02	New SVP from CTD 177
07/28/08	18:32	New SVP from CTD 178
07/28/08	19:34	New SVP from CTD 179
07/28/08	21:14	ADCP 150 Gyro heading stopped, running test to TACAN to Dutch
07/28/08	21:21	New SVP from CTD 180
07/29/08	01:13	New SVP from CTD 183
07/29/08	04:11	New SVP from CTD 185
07/29/08	06:53	New SVP from CTD 187
07/29/08	09:32	New SVP from CTD 189
07/29/08	13:01	New SVP from CTD 191
07/29/08	16:21	New SVP from CTD 193
07/29/08	18:55	New SVP from CTD 194
07/29/08	21:35	New SVP from CTD 196
07/30/08	00:13	Reconnected Aloft Con Web camera to network
07/30/08	06:14	TSG Salinity adjusted down .035 psu
07/30/08	06:14	New SVP from CTD2 02
07/30/08	08:53	New SVP from CTD 204
07/30/08	12:06	New SVP from CTD 206
07/30/08	12:11	SeaBeam tape #6 was ejected sometime, inserted #7
07/30/08	16:28	New SVP from CTD 209 and CTD 024 for the deep
07/30/08	18:11	New SVP from CTD 210 and CTD 024 for the deep
07/31/08	01:11	SeaBeam displays are not working right, GUIs gone, data working
07/31/08	01:38	SeaBeam rebooted
07/31/08	03:57	New SVP from recent CTD and CTD 019 for the deep
07/31/08	08:57	Adjust recent SVP removing last 20 meters of last CTD data
07/31/08	16:43	Request to secure Science Sea water, for end of HLY0803
07/31/08	16:45	Stop ADCP 150, for end of HLY0803
07/31/08	16:45	SeaBeam to Idle, for end of HLY0803

Date	*Time (UTC)*	*Event*
07/31/08	16:48	Stop Sub Bottom, for end of HLY0803
07/31/08	17:27	Stop LDS, for end of HLY0803
07/31/08	17:27	Stop SCS. End of HLY0803. Tied up in Dutch Harbor.

Comments that might help when using the data

The SCS system has stopped recording every now and then. If this is the case. You should look for the corresponding data in the LDS_Data directories. The data may have been recorded there.

The Knudsen data written into SCS_Data/Knudsen has an inconsistent time in the data. The time that the SCS writes to the start of the file should be used. The Knudsen internal clock adds about 22.8 seconds to the3 internal clock each day near 00:00. But this is reset when the recording program is started up. Use only the SCS time stamp for time in this data and it should be fine.

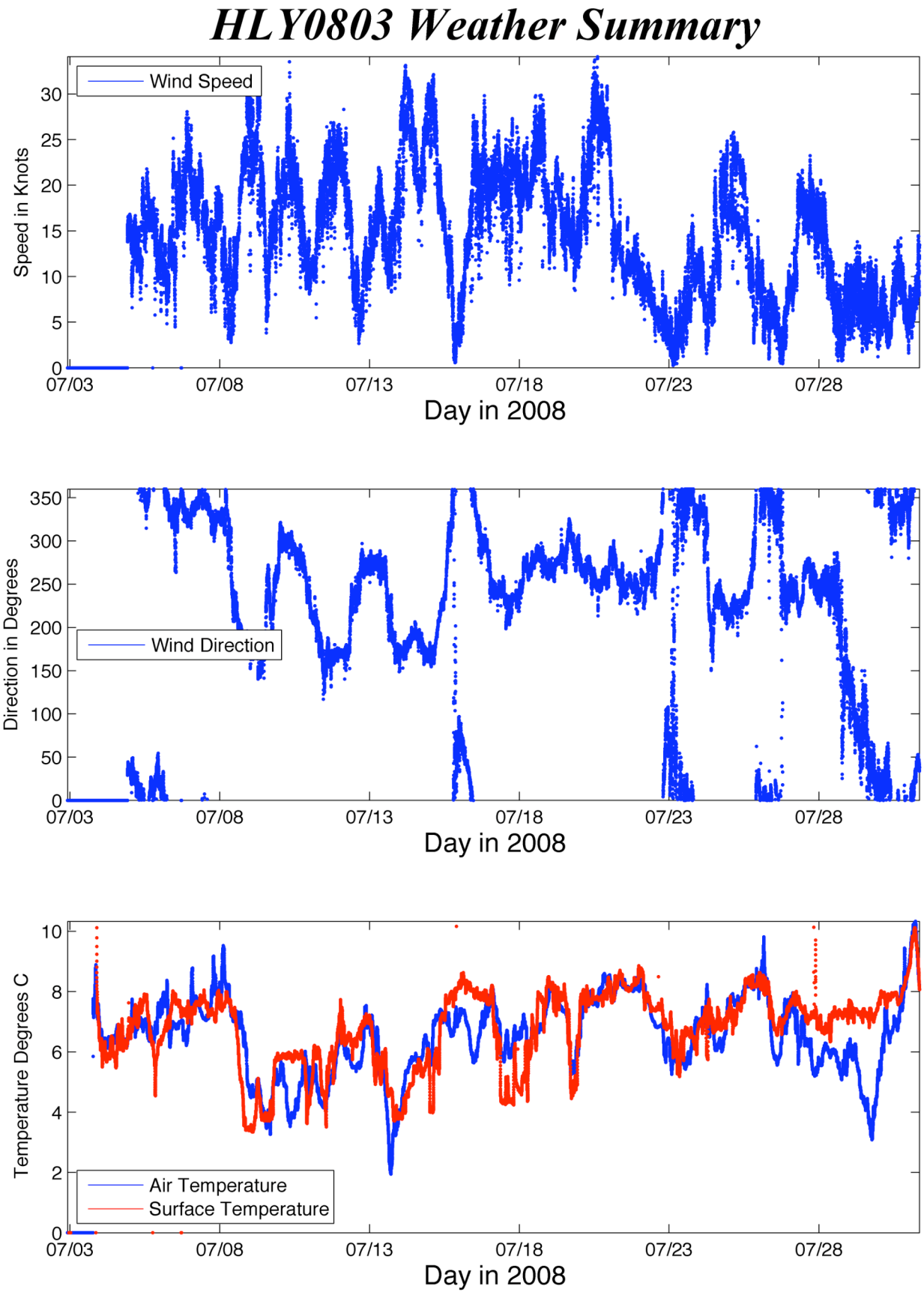
The SeaBeam data is raw and unedited. This data needs MAJOR editing and care to use. The Knudsen sub bottom data is perhaps more accurate but it uses only the single Speed of Sound Velocity Profile of 1500 meters/second.

Information to calibrate the Optotech Oxygen Sensor from the Bio Chem lab is in the Meta_Data directory.

For much of HLY0803 the “analog” heading in from the bridge has been locked to a fixed value. This is a signal from the synchro converter on the bridge of the Gyro data. This signal is very finicky and headings in the raw data will be questionable. For good heading data you should use the POSMV heading, which is in the data but is not used in the first quick looks data.

During HLY0803 the logging rate for the winch data was changed from 1 to 4 Hz.

Cruise Weather Summary



Underway Sensors and Calibrations

Sensors and Calibrations

HLY0803 Shipboard Sensors

Sensor	Description	Serial #	Last Calibration Date	Status
Meteorology & Radiometers				
Port Anemometer	RM Young 09101	L001	02/06/07	Collected
Stbd Anemometer	RM Young 09101	L003	03/07/07	Collected
Barometer	RM Young 612011	BP01643	02/22/08	Collected
Air Temp/Rel. Hum.	RM Young 41382V	13352	02/22/08	Collected
Helo shack PAR	BSI QSR-2200	20270	01/09/07	Collected
Shortwave Radiation	Eppley labs - PSP	35032F3	08/01/07	Collected
Longwave Radiation	Eppley labs - PIR	34955F3	08/17/07	Collected
Barometer	Paroscientific MET3A	101757	06/27/07	Collected
Bow Temperature	Paroscientific MET3A	101757	06/27/07	Collected
Precipitation	Paroscientific MET3A	101757	06/27/07	Collected
Relative Humidity	Paroscientific MET3A	101757	06/27/07	Collected
Jack Staff Ultrasonic Anemometer	RM Young 85004	00703	09/20/07	Collected
Yard Arm Stb Ultrasonic Anemometer	RM Young 85004	00704	09/20/07	Collected
Underway Ocean				
TSG A	SeaBird SBE45	0215	08/01/07	Collected
Remote Sea Temp	SeaBird SBE3S	4063	12/13/07	Collected
Fluorometer A	Seapoint SCF	SCF2957	12/15/07	Collected
Oxygen Sensor A	SeaBird SBE-43	1307	09/28/07	Collected
Nitrate Sensor	MBARI ISUS v3	141	10/11/07	Collected
Flowmeter A	Flocat C-ES45-B003	09061005	01/07/08	Collected
AC-S Spectral Attenuation and Absorption Meter	Wetlabs	053	010/10/8	Colected
Sonars				

Sensor	Description	Serial #	Last Calibration Date	Status
Knudsen- subbottom	320 B/R	K2K-00-0013	N/A	Collected
ADCP 150 kHz	Broad Band (BB150)	80	N/A	Collected
ADCP 75 kHz	Ocean Surveyor	172	N/A	Not Collected
Multibeam	Seabeam 2112	?	N/A	Collected
Speed log	Sperry	?	N/A	Collected
Navigation				
P-Code GPS (aft)	Trimble Centurion	0220035469	N/A	Collected
Attitude GPS	Ashtech ADU5	AD520033513	N/A	Collected
DGPS	Trimble AGGPS-AG132	0224016199	N/A	Collected
POSMV	Model- MV V4	2306	N/A	Collected
P-Code GPS (fwd)	Rockwell	?	N/A	Collected
Glonass	?	?	N/A	Collected
GYRO 1	Sperry MK39 PN 03956-1982416-2	340	?	Collected
GYRO 2	Sperry MK27A 4800880-1	025	N/A	Collected

HLY0802- CTD Sensors

Sensor	Comments	Serial #	Last service/ Calibration Date	Status
CTD fish	SBE 911plus	639	01/18/08	
Pressure Sensor #1	Digiquartz with TC	83012	01/18/08	Collected
Temperature #1	SBE3- Primary	2855	01/21/08	Collected
Temperature #2	SBE3- Secondary	2796	01/27/08	Collected
Temperature #3	SBE 35	0011	03/08	Collected
Conductivity #1	SBE4- Primary	2568	01/18/08	Collected
Conductivity #2	SBE4- Secondary	2561	01/18/08	Collected
Pump	SBE5 Primary	3115	01/08	NA
Pump	SBE5 Secondary	3112	01/08	NA
Deck Unit	SBE 11-Plus V2	0417	12/07	NA
Altimeter	PSA916	843	01/08	Collected
Oxygen	SBE43	458	12/12/07	Collected
Fluorometer	Chelsea-Aquatrack3	088234	03/07	Collected
Transmisometer	Wetlabs	CST-390DR	01/08	Collected
PAR	Bioshperical QSP2300	70115	01/07	Collected
Carousel	SBE32- 12 place	347	01/08	NA

HLY0802 Sensor Calculations

The coefficients for temperature, conductivity, fluorometer and turbidity sensors can be found in the calibrations sheets below in the Appendix.

Calculating Temperature – ITS-90

T = decimal equivalent of bytes 1-4

Temperature Frequency: f = T/19 +2100

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

Calculating Conductivity – ITS-90

C = decimal equivalent of bytes 5-8

Conductivity Frequency f = sqrt(C*2100+6250000)

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

t = temperature (°C); p = pressure (decibars); δ = Ctcor; ε = CPcor

Calculating Fluorometry Voltage

f = decimal equivalent of bytes 15-17

Fluorometry Voltage = f/819

Calculating Transmittance

V_{dark} = 0.058 V

V_{ref} = 4.765 V

t = decimal equivalent of bytes 18 – 20

Transmissometer Voltage (V_{signal}) = t/819

% Transmittance = $(V_{signal} – V_{dark}) / (V_{ref} - V_{dark})$

Calculating PAR for surface PAR

raw data = mV

calibration scale = 6.08 V/(μEinstiens/cm ^{2}sec)

offset (V_{dark}) = 0.3 mV

(*raw* mV - V_{dark})/scale x 10^4 cm^2/m^2 x 10^{-3} V/mV= μEinstiens/m^2sec or

(*data* mV – 0.3 mV) x 1.65 (μEinstiens/m^2sec)/mV = μEinstiens/m^2sec

Calculating Pyrgeometer Values

V = Eppley PIR Thermopile voltage

S = Sensitivity (Calibration factor from Eppley Cal sheet)

S = 3.32

J = Stefan-Boltzmann Constant

J = 5.6697e-8

B = [absorption constant (for Eppley Black paint formula) 0.985 / dome glass IR transmission 0.5]

B= 3.5 for Stock Eppley PIR

Tb = Eppley Body Temperature in degrees Kelvin

Td = Eppley Dome Temperature in degrees Kelvin

Tb and Td calculated as follows:

T = 1/ (a + ln(Vo/Irt)*(b + c*(ln(Vo/Irt)**2)));

Irt = (Vref-Vin)/R1

On Healy R1 = 82500 Vref = 5.0

a= 0.0010295 b= 0.0002391 c = 1.568e-7

$W/M2 = V/S + (J * Tb^4) + (B*J*(Tb^4 - Td^4))$

Calculating Apparent Oxygen Utilization (AOU) in the 1 minute average file

Ts = ln [(298.15 T) / (273.15 + T)]

Oxsol(T,S) = exp {A0 + A1(Ts) + A2(Ts) **2 + A3(Ts) **3 + A4(Ts) **4 + A5(Ts) **5 + S * [B0 + B1(Ts) + B2(Ts) **2 + B3(Ts) **3] + C0(S) **2}

Where

Oxsol(T,S) = oxygen saturation value = volume of oxygen gas at standard temperature and pressure conditions (STP) absorbed from humidity-saturated air at a total pressure of one atmosphere, per unit volume of the liquid at the temperature of measurement (ml/l)

S = salinity (psu)

T = water temperature (oC)

A0 = 2.00907 A1 = 3.22014 A2 = 4.0501 A3 = 4.94457 A4 = 0.256847 A5 = 3.88767

B0 = -0.00624523 B1 = -0.00737614 B2 = -0.010341 B3 = -0.00817083

C0 = -0.000000488682

Calibrations

The following pages are replicas of current calibration sheets for the sensors used during this cruise.

Meteorology & Radiometers

R.M. Young Wind Bird, Starboard

Serial # L001

R. M. Young Wind bird Calibration Results
Model # 09101, S/N L003 (Starboard Windbird)
As per Young Meteorological Instruments
Wind System Calibration Manual

Date: 07 Mar 07 Technician: ET1 Berringer / ETC Rodda

Wind speed torque: Passed

Maximum toque = 2.4 gm/cm
Test results:
CW 0.7
CCW 0.7

Wind direction torque: Passed

Maximum toque = 30 gm/cm

Test results:
CW 20 gm/cm
CCW 22 gm/cm

Wind speed signal:

Maximum % error = 1%

Test results: Passed

Actual RPM	Actual Wind Speed	Measured	% Error
200	1.90	1.9	0.21
500	4.76	4.8	0.84
1200	11.42	11.4	0.21
3600	34.27	34.3	0.08
5000	47.60	47.6	0.00

Note; Wind speed in knots = 0.00952 * shaft RPM

Wind direction signal:

Maximum error = +/- 2 degrees

Test results: Failed – off by 1 degree

Actual	Meaured	Error
0	358	-2
30	27	3
60	58	2
90	88	2
120	118	2
150	149	1
180	178	2
210	207	3
240	238	2
270	268	2
300	297	3
330	327	3

R.M. Young Wind Bird Port

Serial # L001

R. M. Young Wind bird Calibration Results
Model # 09101, S/N L001 (Port Windbird)

As per Young Meteorological Instruments
Wind System Calibration Manual

Date: 06 Feb 07 Technician: ET3 Daem / ET2 Davis

Wind speed torque: Passed

Maximum toque =2.40 gm/cm

Test results:

CW	.2 gm/cm
CCW	.2 gm/cm

Wind direction torque: Passed

Maximum toque = 30 gm/cm

Test results:

CW	10gm/cm
CCW	10gm/cm

Wind speed signal: Passed

Maximum % error = 1%

Test results:

Actual RPM	Actual Wind Speed	Measured	% Error
200	1.90	1.9	0.21
500	4.76	4.8	0.84
1200	11.42	11.4	0.21
3600	34.27	34.3	0.08
5000	47.60	47.6	0.00

Note; Wind speed in knots = 0.00952 * shaft RPM

Wind direction signal: Passed

Maximum error = +/- 2 degrees

Test results:

Actual	Meaured	Error
0	359	-1
30	29	1
60	59	1
90	90	0
120	120	0
150	150	0
180	180	0
210	210	0
240	240	0
270	269	1
300	298	2
330	330	0

Barometer

Serial # BP01643

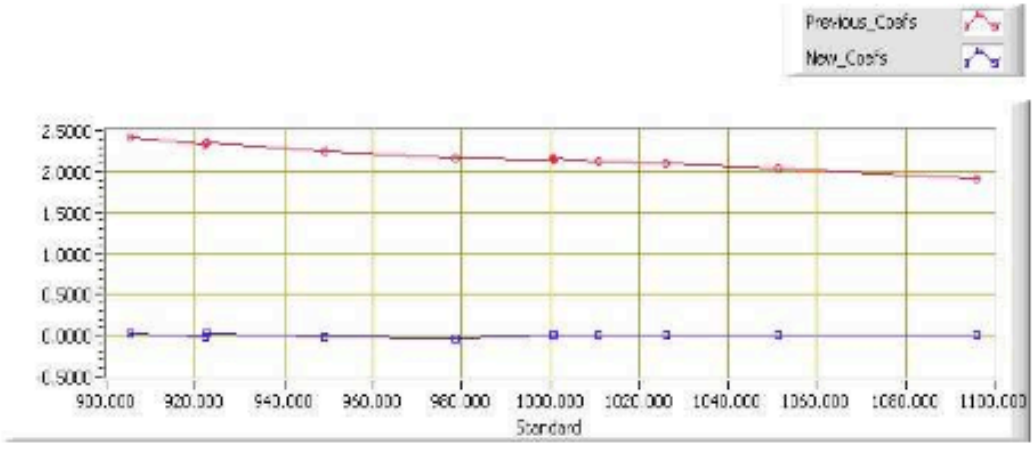
Baro Pres Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: BP01643
CALIBRATION DATE: 22-Feb-08
SENSOR ID: BPR80
Mfg: RM Young Model: 612011
Previous Cal Date: 01-Jan-00
Calibration Tech: CM
CALIBRATION AT 25.0 DegC

A= 5.98528E+1
B= 8.02635E+2

Calibration Standard: Mfg: Paroscientific Model: 765-16B s/n: 101778
Polynomial Order = 1
Xcalc = A*X+B

SENSOR VOLTS	STANDARD DATA	SENSOR New_Coefs	SPRT-INST Prev_Coefs	SPRT-INST New_Coefs
4.901	1095.960	1095.953	1.920	0.007
4.151	1051.090	1051.086	2.028	0.004
3.731	1025.970	1025.963	2.092	0.007
3.475	1010.640	1010.645	2.118	-0.005
3.306	1000.490	1000.479	2.159	0.011
3.314	1000.990	1000.986	2.151	0.004
2.939	978.480	978.517	2.165	-0.037
2.445	948.980	949.001	2.254	-0.021
2.004	922.570	922.555	2.355	0.015
1.998	922.190	922.205	2.326	-0.015
1.713	905.210	905.180	2.413	0.030



Air Temperture / Relative Humidity

Serial # 13352

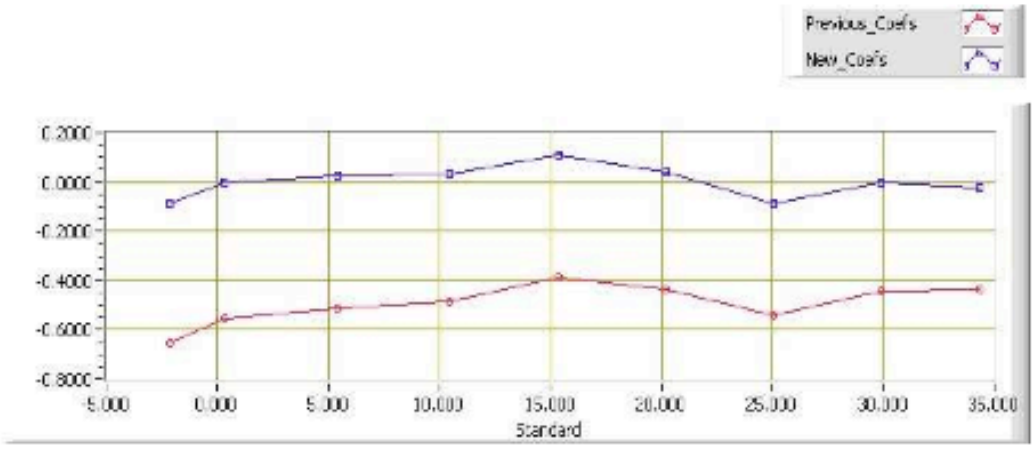
Air Temperature Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 13352
CALIBRATION DATE: 22-Feb-08
SENSOR ID: HRH17
Mfg: RM Young Model: 41382V
Previous Cal Date: 01-Jan-2000
Calibration Tech: CM

A= 1.01413E+2
B= -5.07642E+1

Calibration Standard: Mfg: Seabird Model: SBE35 s/n: 0006
Polynomial Order = 1
Xcalc = A*X+B

SENSOR	STANDARD DATA	SENSOR New_Coefs	SPRT-INST Prev_Coefs	SPRT-INST New_Coefs
0.480	-2.122	-2.035	-0.652	-0.087
0.504	0.337	0.338	-0.557	-0.001
0.554	5.421	5.398	-0.513	0.023
0.603	10.448	10.418	-0.485	0.030
0.651	15.345	15.235	-0.386	0.110
0.699	20.190	20.154	-0.439	0.036
0.748	25.029	25.113	-0.539	-0.084
0.796	29.914	29.920	-0.442	-0.006
0.840	34.361	34.382	-0.439	-0.021



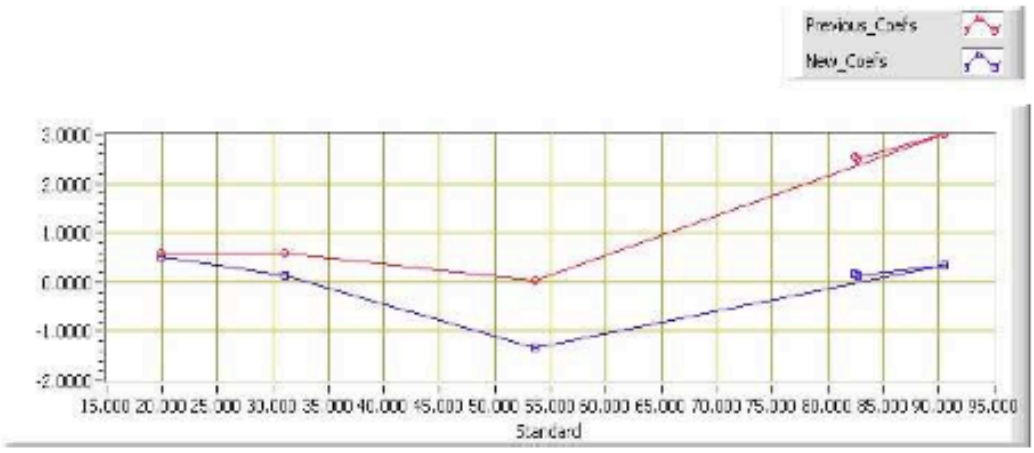
HUMIDITY Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 13352
CALIBRATION DATE: 24-Feb-08
SENSOR ID: HRH17
Mfg: RM Young Model: 41382V
Previous Cal Date: 01-Jan-2000
Calibration Tech: CM

A= 1.04836E+2
B= -6.79727E-1

Calibration Standard: Mfg: GE Sensing Model: Humilab s/n: 0240507
Polynomial Order = 1
Xcalc = A*X+B

SENSOR	STANDARD DATA	SENSOR New_Coefs	SPRT-INST Prev_Coefs	SPRT-INST New_Coefs
0.791	82.450	82.266	2.539	0.184
0.794	82.710	82.560	2.516	0.150
0.866	90.460	90.108	2.994	0.352
0.530	53.570	54.904	0.020	-1.334
0.301	31.000	30.876	0.599	0.124
0.192	19.920	19.396	0.579	0.524



PAR

Serial # 20270

Biospherical Instruments Inc.

CALIBRATION CERTIFICATE

Calibration Date	1/9/2007			
Model Number	QSR-2200			
Serial Number	20270			
Operator	TPC			
Standard Lamp	F-863			
Probe Excitation Voltage Range:	6	to	18	VDC(+)
Output Polarity:	Positive			

Probe Conditions at Calibration(in air):

Calibration Voltage:	6	VDC(+)
Probe Current:	4.0	mA

Probe Output Voltage:

Probe Illuminated	95.87	mV
Probe Dark	1.32	mV
Probe Net Response	94.55	mV

Corrected Lamp Output:

Output In Air (same condition as calibration):

9.43E+15	quanta/cm²sec
0.01566	uE/cm^{2}sec

Calibration Factor:

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

Dry:	1.00E-17	V/(quanta/cm²sec)
	6.04E+00	V/(uE/cm^{2}sec)

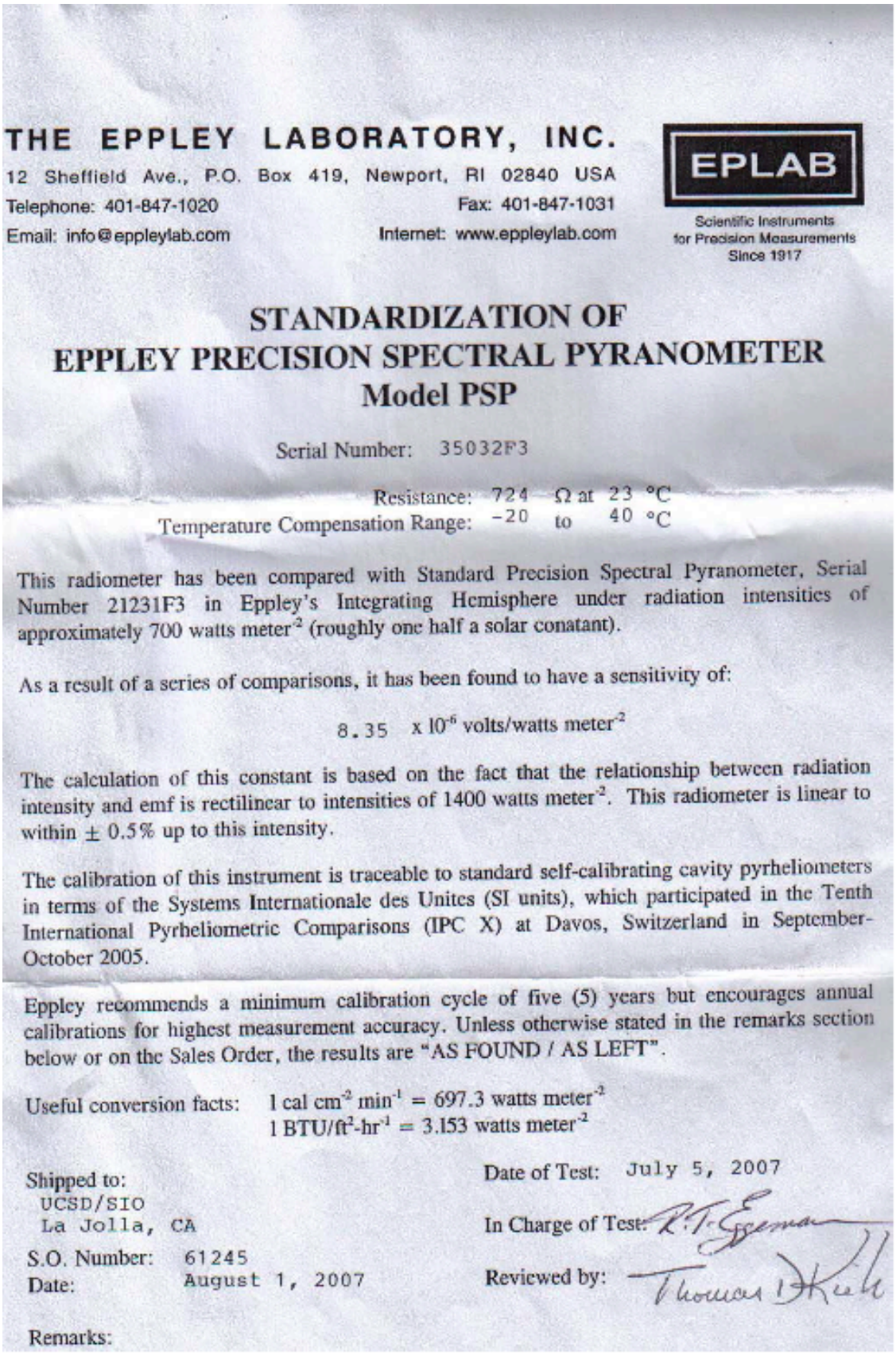
Notes:

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

Shortwave Radiation Pyranometer

Serial # 35032F3



THE EPPLEY LABORATORY, INC.
12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA
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Email: info@eppleylab.com Internet: www.eppleylab.com

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STANDARDIZATION OF EPPLEY PRECISION SPECTRAL PYRANOMETER Model PSP

Serial Number: 35032F3

Resistance: 724 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 conatant).

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

8.35 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:
UCSD/SIO
La Jolla, CA

Date of Test: July 5, 2007

In Charge of Test: R. T. Eppley

S.O. Number: 61245
Date: August 1, 2007

Reviewed by: Thomas D Kirk II

Remarks:

Longwave Radiation Pyrgeometer

Serial # 34955F3

THE EPPLEY LABORATORY, INC.
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Email: info@eppleylab.com Internet: www.eppleylab.com

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STANDARDIZATION OF EPPLEY PRECISION INFRARED RADIOMETER Model PIR

Serial Number: 34955F3

Resistance: 708 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 25°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:

3.32 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:
UCSD/SIO
La Jolla, CA

S.O. Number: 61272
Date: August 17, 2007

Date of Test: May 31, 2007

In Charge of Test: P.T. Eppley

Reviewed by: Thomas J. Kub

Remarks:

Jack Staff MET Station

Serial # 101757

Paroscientific, Inc.
Pressure Instrument Configuration

SN: 101757 Part Number: 1539-004 Model: MET3A Port:

Calibration Date: 27-Jun-07 Report No: 7238 Technician: WMR

Pressure Range: 500 to 1100 hPa Temperature Range: -50 to -60

Customer: Scripps Inst. of Oceanography Report Date: 27-Jun-07

Address : 8825 Biological Grade Sales Order: 24367

La Jolla, CA 92037 USA S/R Number :

Configuration

BL: 0	PT: N
BR: 9600	QD: -
DD: -	QO: -
DL: -	SL: -
DM: -	SN: 101757
DO: -	ST: -
DP: -	SU: -
ID: 01	TI: -
IM: -	TR: 00952
LL: -	TU: -
LH: -	UF: 1.000000
MC: Y	UL: -
MD: 0	UM: -
MN: -	UN: 3
OP: -	US: -
PP: -	VR: M1.02
PI: -	ZI: -
PL: -	ZS: -
PO: -	ZL: -
PR: 00238	ZV: -
PS: -	

Calibration Coefficients

U0:	5.766908	µsec
Y1:	-4015.975	deg C / µsec
Y2:	-17065.37	deg C / µsec²
Y3:	-140256.4	deg C / µsec³
C1:	94.87589	psi
C2:	3.545282	psi / µsec
C3:	-114.9551	psi / µsec²
D1:	0.0345157	
D2:	0.0000000	
T1:	28.00064	µsec
T2:	0.837535	µsec / µsec
T3:	16.78157	µsec / µsec²
T4:	-150.7085	µsec / µsec³
T5:	-129.729	µsec / µsec⁴
TC:	0.6782145	
PA:	0.0000000	
PM:	1.0000000	

Met3/3A Coefficients

R1:	-0.551136	R2:	0.84
F1:	-264.3591	F2:	3.152
G1:	12.56743	G2:	0.00216
H1:	RHT894	H2:	0.0036
K1:	01842	K2:	0.00511
M1:	1	M2:	1
Z1:	0	Z2:	0

Paroscientific, Inc.
4500 148th Ave. N.E. Redmond, WA 98052
Phone: (425)883-8700 Fax: (425)867-5407
Web:http://www.paroscientific.com
Email: support@paroscientific.com

Prepared by

PARO TEST 17

Digiquartz® Technology

Page 1 of 1

Paroscientific, Inc.
4500 148th Avenue N. E.
Redmond, WA 98052-5194
Telephone: (425) 883-8700
Facsimile: (425) 867-5407
Email:salessupport@paroscientific.com
Internet:http://www.paroscientific.com

CERTIFICATE OF CALIBRATION

TRANSDUCER MODEL: MET3A

SERIAL NUMBER: 101757

The Paroscientific transducer(s) identified above has been calibrated and tested with one or more of the following primary pressure and temperature standards. All have traceability to the National Institute of Standards and Technology.

Bell and Howell Primary Pressure Standard

Pneumatic Absolute or Gauge Dead Weight Tester Part Number: 6-201-0001, S/N 4034 and S/N 1014

___ Piston/Cylinder: 6-001-0002, P2-919/C2-1523,
Weight Set 1: 6-002-0002
Range: 1.5 to 50 psi [10 to 345 kPa]
Accuracy: 0.010 percent of reading

✓ Piston/Cylinder: 6-001-0002, P2-652/C2-1378,
Weight Set 2: 6-002-0002
Range: 1.5 to 50 psi [10 to 345 kPa]
Accuracy: 0.010 percent of reading

___ Piston/Cylinder: 6-001-0001, P1-949/C1-922 ,
Weight Set 2: 6-002-0002
Range: 0.3 to 5 psi [2 to 34 kPa]
Accuracy: 0.015 percent of reading

DH Primary Pressure Standard

Pneumatic Absolute or Gauge Dead Weight Tester Part Number: PG7601 S/N 161

___ Piston/Cylinder: S/N 305, Mass Set: S/N 2052
Range: 0.7 to 50 psi [5 to 345 kPa] absolute mode, 0.29 to 50 psi [2 to 345 kPa] gauge mode
Accuracy: 0.002 percent of reading

DH Primary Pressure Standard

Pneumatic Gauge Dead Weight Tester, Model 5203, S/N 5557

___ Piston/Cylinder: S/N 4845, Mass Sets: S/N 2032, S/N 3293
Range: 20 to 1,600 psi [0.14 to 11 MPa]
Accuracy: 0.005 percent of reading

DH Primary Pressure Standard

Oil Operated Gauge Dead Weight Tester, Model 5306, S/N 3505

___ Piston/Cylinder: S/N 3375, Mass Set: S/N 2032
Range: 40 to 20,000 psi [0.3 to 138 MPa]
Accuracy: 0.01 percent of reading above 200 psi [1.4 MPa]
or 0.02 psi [0.14 kPa] at lower pressure

___ Piston/Cylinder: S/N 3511, Mass Set: S/N 2032
Range: 145 to 72,500 psi [1 to 500 MPa]
Accuracy: 0.02 percent of reading above 725 psi [5 MPa]
or 0.145 psi [1 kPa] at lower pressure

Hart Scientific Precision Thermometer (MET3A only)

✓ Black Stack model 1560 S/N 97568, PRT Scanner model 2562 S/N A34523, Temperature Probe Model A1959: S/Ns 4424A-02, 4424A-04, 4424A-05, 4424A-06 and 5177C-02.
Range: -50° to 60° C.
Accuracy: .015°C.

PARO TEST 17

Tested By: _____ DATE 6-27-07

Underway Ocean Flow through Sensors

Seabird ThermoSalinograph

Serial # 0215

Temperature

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: 0215
CALIBRATION DATE: 01-Aug-07

SBE 45 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

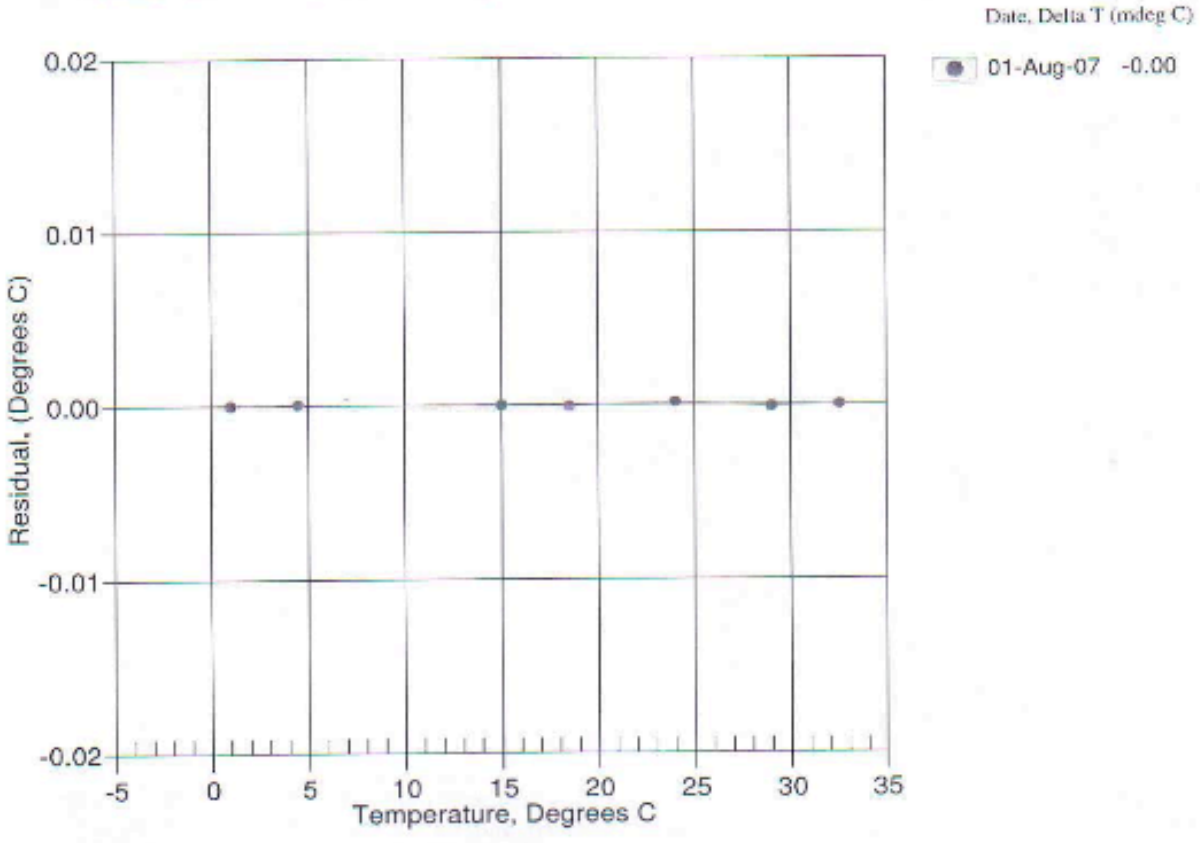
ITS-90 COEFFICIENTS

a0 = -1.277283e-006
a1 = 2.800988e-004
a2 = -2.767325e-006
a3 = 1.635307e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	657810.8	0.9999	-0.0001
4.5000	562392.5	4.5000	0.0000
15.0000	358324.1	14.9999	-0.0000
18.5001	310251.4	18.5000	-0.0001
24.0000	248855.2	24.0001	0.0002
29.0001	204884.7	29.0000	-0.0001
32.4999	179404.2	32.5000	0.0000

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

Residual = instrument temperature - bath temperature



Conductivity

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: 0215
CALIBRATION DATE: 01-Aug-07

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

COEFFICIENTS:

g =	-9.817728e-001	CPcor =	-9.5700e-008
h =	1.408372e-001	CTcor =	3.2500e-006
i =	-1.671624e-004	WBOTC =	2.4202e-005
j =	3.431539e-005		

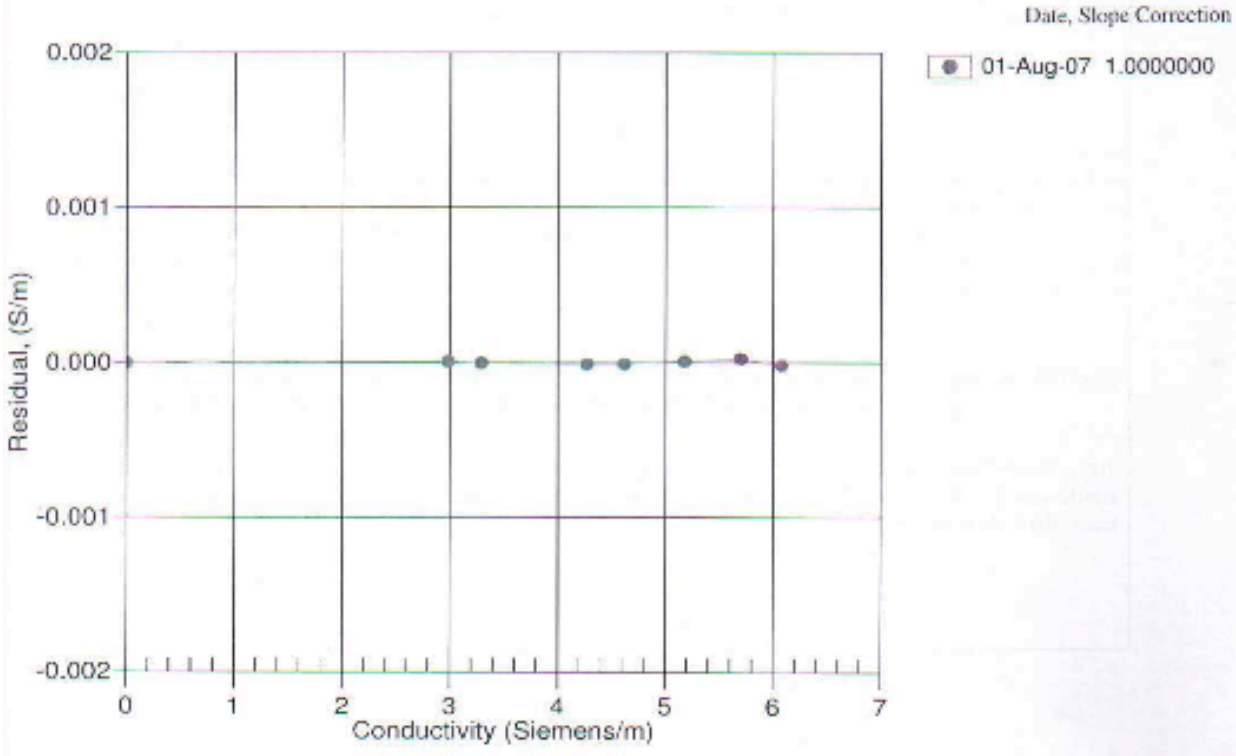
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2641.45	0.00000	0.00000
1.0000	34.8934	2.98132	5303.53	2.98193	0.00001
4.5000	34.8731	3.28955	5504.48	3.28955	-0.00000
15.0000	34.8297	4.27308	6101.73	4.27307	-0.00001
18.5001	34.8207	4.61830	6297.94	4.61889	0.00001
24.0000	34.8111	5.17793	6602.44	5.17794	0.00001
29.0001	34.8062	5.70086	6874.67	5.70088	0.00002
32.4999	34.8046	6.07417	7062.34	6.07415	-0.00002

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



Remote Sea Temperature (Sea Chest)

Serial # 4063

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: 4063
CALIBRATION DATE: 13-Dec-07

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.29921671e-003
h = 6.36406488e-004
i = 2.06912541e-005
j = 1.52019386e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS

a = 3.68121265e-003
b = 5.99688417e-004
c = 1.61521904e-005
d = 1.52164480e-006
f0 = 2721.791

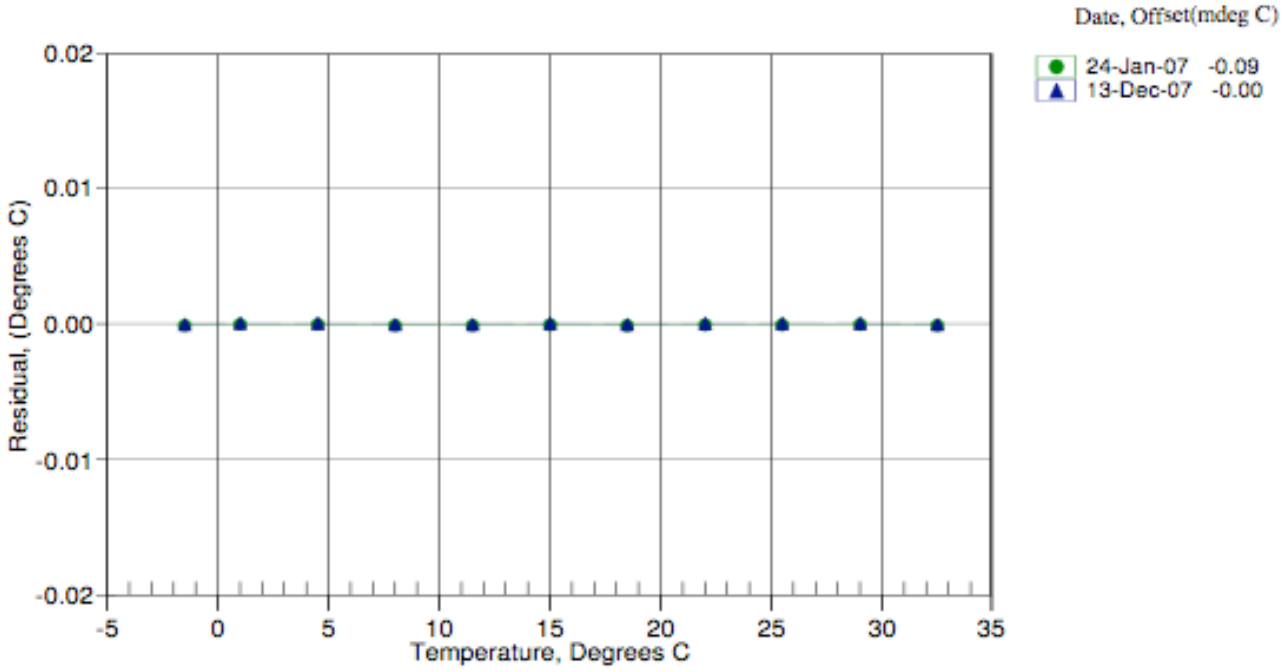
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	2721.791	-1.5000	-0.00002
1.0000	2878.781	1.0000	0.00003
4.5000	3109.455	4.5000	0.00002
8.0000	3353.176	8.0000	-0.00001
11.5000	3610.316	11.5000	-0.00001
15.0000	3881.236	15.0000	0.00002
18.5000	4166.278	18.5000	-0.00004
22.0000	4465.803	22.0000	0.00000
25.5000	4780.134	25.5000	0.00003
29.0000	5109.596	29.0000	0.00002
32.5000	5454.501	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



Oxygen Sensor A

Serial # 1307

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: 1307
CALIBRATION DATE: 28-Sep-07p

SBE 43 OXYGEN CALIBRATION DATA

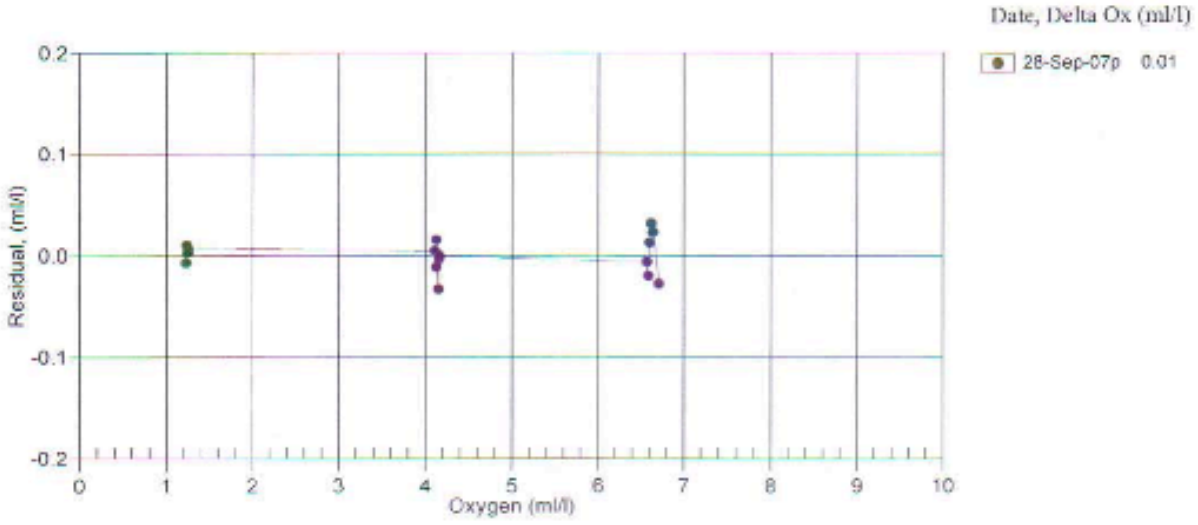
COEFFICIENTS

Soc = 0.3834
Boc = 0.0000
Voffset = -0.4781

TCor = 0.0025
PCor = 1.350e-04

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.22	2.00	0.00	0.805	1.22	-0.01
1.24	12.00	0.01	0.898	1.25	0.01
1.24	20.00	0.01	0.966	1.25	0.01
1.24	26.00	0.01	1.016	1.25	0.00
1.25	6.00	0.00	0.848	1.25	0.00
1.25	30.00	0.01	1.057	1.26	0.01
4.11	20.00	0.01	2.086	4.11	0.00
4.13	26.00	0.01	2.254	4.11	-0.01
4.13	12.00	0.01	1.870	4.14	0.02
4.15	2.00	0.00	1.583	4.11	-0.03
4.15	30.00	0.01	2.382	4.15	-0.00
4.15	6.00	0.00	1.705	4.15	-0.00
6.57	30.00	0.01	3.491	6.57	-0.01
6.58	26.00	0.01	3.311	6.56	-0.02
6.60	20.00	0.01	3.061	6.61	0.01
6.62	12.00	0.01	2.712	6.65	0.03
6.64	6.00	0.00	2.447	6.67	0.02
6.71	2.00	0.00	2.273	6.68	-0.03

oxygen (ml/l) = (Soc * (V + Voffset)) * exp(Tcor * T) * Oxsat(T,S) * exp(Pcor * P)
V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU]
Oxsat(T,S) = oxygen saturation [ml/l], P = pressure [dbar]
Residual = instrument oxygen - bath oxygen



CTD Sensors

Pressure Sensor

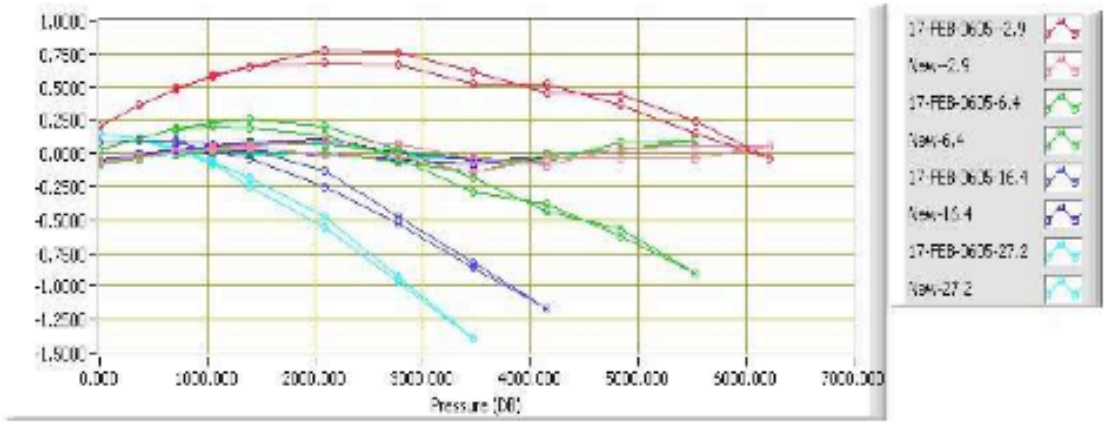
Serial # 83012

Pressure Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 639
CALIBRATION DATE: 18-JAN-2008
Mfg: Seabird Model: SBE9P CTD Prs s/n: 83012

C1= -3.841449E+4
C2= 4.630485E-1
C3= 1.014581E-2
D1= 3.051116E-2
D2= 0.000000E+0
T1= 3.019016E+1
T2= -1.746821E-4
T3= 4.517296E-6
T4= -9.087207E-9
T5= 0.000000E+0
AD590M= 1.27551E-2
AD590B= -9.09133E+0
Slope = 1.0
Offset = 0.0

Calibration Standard: Mfg: Ruska Model: 2400 s/n: 34336
t0=t1+t2*td+t3*td*td+t4*td*td*td
w = 1-t0*t0*f*f
Pressure = (0.6894759*((c1+c2*td+c3*td*td)*w*(1-(d1+d2*td)*w)-14.7)



Temperature #1

Serial # 2855

Temperature Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 2855
CALIBRATION DATE: 21-JAN-2008
Mfg: Seabird Model: SBE3Plus
Previous Cal Date: 24-Jan-07
Calibration Tech: CM

g= 4.35951439E-3
h= 6.45648951E-4
i= 2.38075037E-5
j= 2.35385504E-6
f0 = 1000.0
Slope = 1.0
Offset = 0.0

Calibration Standard: Mfg: ASL Model: F18 s/n: 245-5149
Temperature ITS-90 = 1/{g+h[ln(f0/f)]+i[ln2(f0/f)]+j[ln3(f0/f)]} - 273.15 (°C)

SBE3 Freq	SPRT	SBE3 New_Coefs	SPRT-SBE3 Prev_Coefs	SPRT-SBE3 New_Coefs
5479.6760	28.1875	28.1875	0.00140	0.00002
5798.0010	31.2142	31.2142	0.00189	-0.00002
5174.8630	25.1737	25.1737	0.00101	0.00002
4839.0220	21.7073	21.7073	0.00066	-0.00000
4563.9390	18.7410	18.7410	0.00045	-0.00003
4313.5900	15.9306	15.9306	0.00036	-0.00000
4062.6960	12.9964	12.9964	0.00029	0.00002
3819.2680	10.0242	10.0242	0.00019	-0.00001
3580.6660	6.9771	6.9771	0.00011	-0.00001
3359.2520	4.0167	4.0167	0.00007	0.00004
3216.0510	2.0264	2.0264	-0.00010	-0.00004
3143.3570	0.9916	0.9916	-0.00010	0.00002
3042.0950	-0.4792	-0.4792	-0.00018	0.00003
3003.6410	-1.0471	-1.0471	-0.00029	-0.00003
2934.0140	-2.0888	-2.0888	-0.00036	-0.00001

Temperature #2

Serial # 2796

Temperature Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 2796
CALIBRATION DATE: 21-JAN-2008
Mfg: Seabird Model: SBE3Plus
Previous Cal Date: 27-Jan-07
Calibration Tech: CM

g= 4.30545772E-3
h= 6.41541965E-4
i= 2.26535491E-5
j= 2.15838215E-6
f0 = 1000.0
Slope = 1.0
Offset = 0.0

Calibration Standard: Mfg: ASL Model: F18 s/n: 245-5149
Temperature ITS-90 = 1/{g+h[ln(f0/f)]+i[ln2(f0/f)]+j[ln3(f0/f)]} - 273.15 (°C)

SBE3 Freq	SPRT	SBE3 New_Coefs	SPRT-SBE3 Prev_Coefs	SPRT-SBE3 New_Coefs
5034.9080	28.1869	28.1869	0.00129	-0.00001
5327.3120	31.2134	31.2134	0.00145	0.00001
4754.9570	25.1736	25.1736	0.00117	-0.00003
4446.4900	21.7075	21.7075	0.00113	0.00003
4193.8400	18.7414	18.7414	0.00105	0.00000
3963.9100	15.9311	15.9311	0.00097	-0.00004
3733.4680	12.9969	12.9969	0.00098	0.00001
3509.8970	10.0249	10.0248	0.00098	0.00005
3290.7460	6.9777	6.9777	0.00087	-0.00002
3087.3980	4.0175	4.0175	0.00082	-0.00001
2955.8690	2.0273	2.0273	0.00077	-0.00001
2889.1220	0.9928	0.9928	0.00074	-0.00001
2796.0920	-0.4783	-0.4783	0.00068	-0.00002
2760.7580	-1.0463	-1.0463	0.00070	0.00001
2696.7970	-2.0881	-2.0881	0.00067	0.00003

Temperature #3

Serial # 0011

SBE35 V 2.0a SERIAL NO. 0011 25 Jun 2008
number of measurement cycles to average = 8
number of data points stored in memory = 0
bottle confirm interface = SBE 911plus

SBE35 V 2.0a SERIAL NO. 0011
29-mar-08
A0 = 5.030840630e-03
A1 = -1.387153030e-03
A2 = 2.040326840e-04
A3 = -1.129031550e-05
A4 = 2.392311380e-07
SLOPE = 1.000000
OFFSET = 0.000000

Conductivity #1

Serial # 2568 See the attached PDF file SBE4-2568-18Jan08.pdf in the Meta_Data directory.

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: 2568
CALIBRATION DATE: 18-Jan-08

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

CPCOR COEFFICIENTS

g = -1.03570721e+001
h = 1.48463602e+000
i = 3.18405743e-004
j = 6.13207682e-005
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS

a = 1.84938470e-004
b = 1.48483200e-004
c = -1.03867251e+001
d = 8.28372679e-007
m = 3.5
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)
3.0000	0.0000	0.00000	2.64369	0.00000	0.00000
-1.0000	34.3297	3.81315	3.98747	3.81313	-0.00001
1.0000	34.3240	3.96300	3.10962	3.96306	0.00002
15.0000	34.3362	4.28624	4.28797	4.28456	0.00004
18.5000	34.3305	4.67273	4.67084	4.67277	-0.00004
29.0000	34.3293	5.71674	5.72469	5.71667	-0.00007
32.5000	34.3196	6.09199	6.09277	6.09201	0.00003

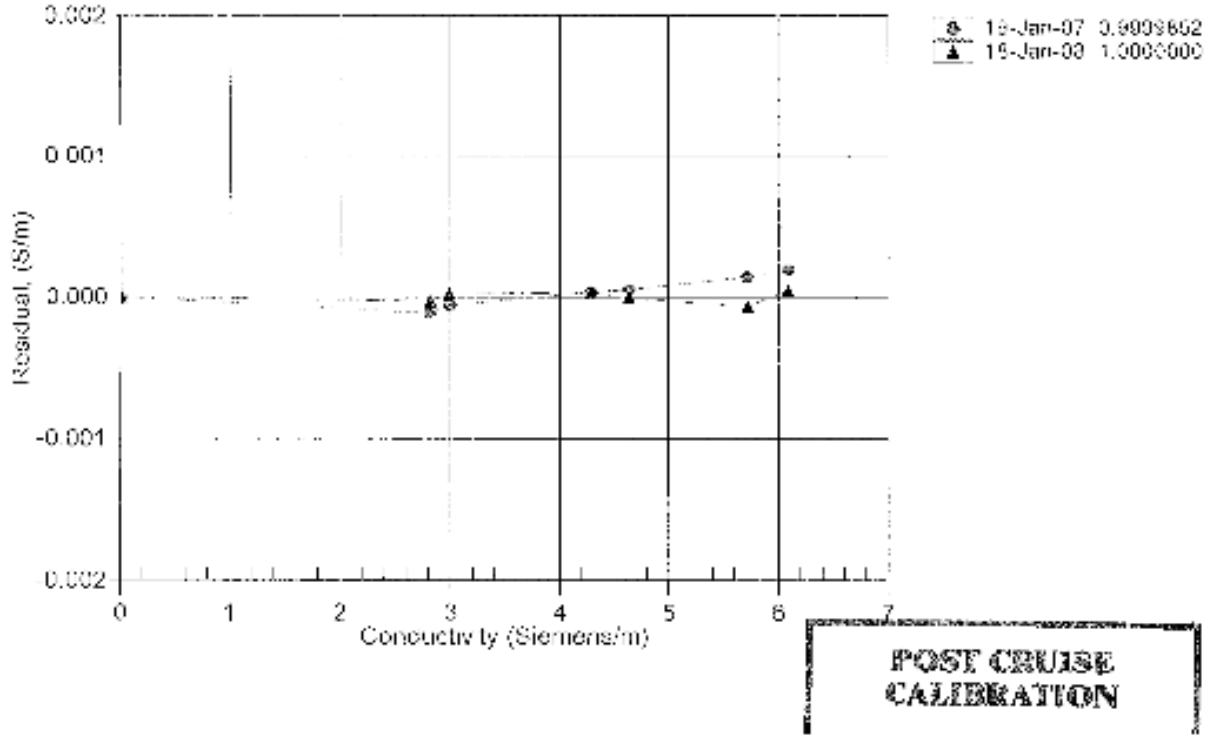
Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m - bf^3 + c + dt) / 10(1 + \varepsilon p)$ Siemens/meter

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

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

Date, Scope Correction



POST CRUISE CALIBRATION

Conductivity # 2

Serial # 2561 See the attached PDF file SBE4-2561-18Jan08.pdf in the Meta_Data directory.

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: 2561
CALIBRATION DATE: 18-Jan-08

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

GHIJ COEFFICIENTS

g = [illegible]
h = [illegible]
i = [illegible]
j = [illegible]
CPcor = [illegible] (nominal)
CTcor = [illegible] (nominal)

ABCDM COEFFICIENTS

a = [illegible]
b = [illegible]
c = [illegible]
d = [illegible]
m = [illegible]
CPcor = [illegible] (nominal)

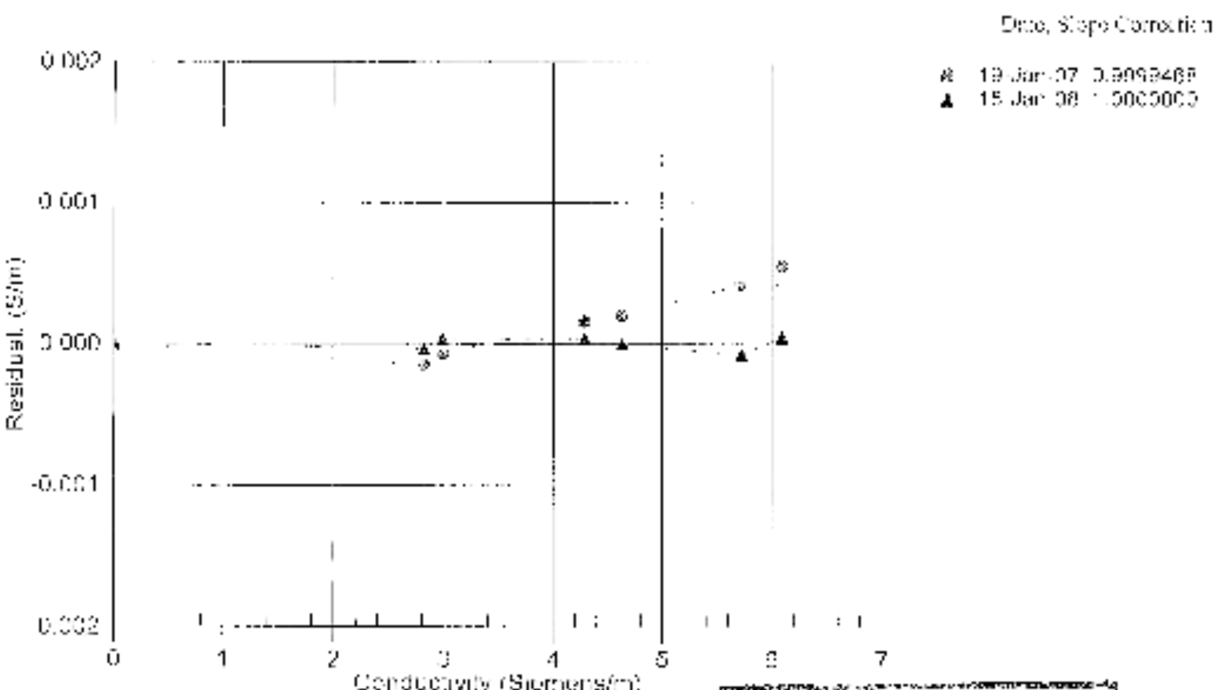
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
[illegible]	[illegible]	0.00000	[illegible]	0.00000	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	4.[illegible]454	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]2228	[illegible]
[illegible]	34.9293	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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



POST CRUISE CALIBRATION

Oxygen

Serial # 0458

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: 0458
CALIBRATION DATE: 12-Dec-07p

SBE 43 OXYGEN CALIBRATION DATA

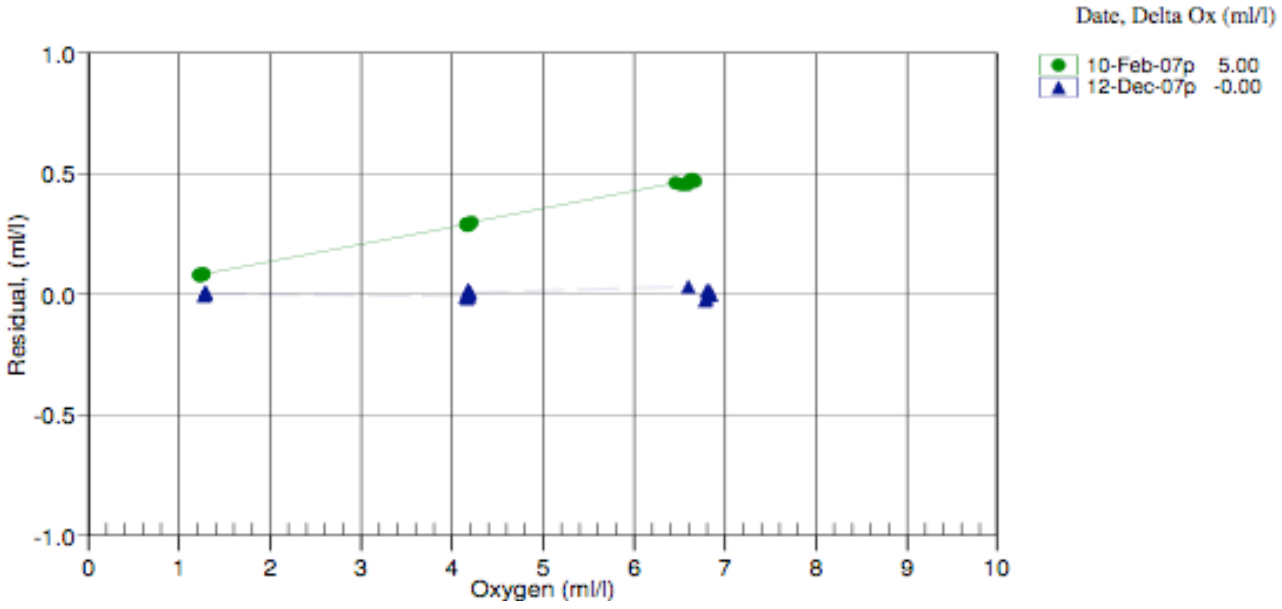
COEFFICIENTS

```
Soc =  0.4060
Boc =  0.0000
Voffset = -0.4927

TCor =  0.0006
PCor =  1.350e-04
```

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.27	20.00	0.01	0.979	1.27	-0.01
1.28	26.00	0.01	1.037	1.27	-0.01
1.28	12.00	0.01	0.909	1.28	0.00
1.28	2.00	0.00	0.820	1.28	0.00
1.29	6.00	0.00	0.858	1.29	0.01
1.29	30.00	0.01	1.085	1.29	0.00
4.15	26.00	0.01	2.265	4.13	-0.01
4.16	20.00	0.01	2.083	4.15	-0.02
4.17	12.00	0.01	1.847	4.17	0.00
4.18	30.00	0.01	2.419	4.19	0.02
4.19	2.00	0.00	1.556	4.18	-0.01
4.19	6.00	0.00	1.677	4.20	0.01
6.59	30.00	0.01	3.535	6.62	0.03
6.78	20.00	0.01	3.082	6.75	-0.03
6.79	26.00	0.01	3.397	6.77	-0.02
6.80	12.00	0.01	2.706	6.81	0.01
6.82	6.00	0.00	2.420	6.83	0.01
6.84	2.00	0.00	2.234	6.84	-0.00

oxygen (ml/l) = (Soc * (V + Voffset)) * exp(Tcor * T) * Oxsat(T,S) * exp(Pcor * P)
V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU]
Oxsat(T,S) = oxygen saturation [ml/l], P = pressure [dbar], Residual = instrument oxygen - bath oxygen



Fluorometer

Serial # 088234

CERTIFICATE OF CALIBRATION

All test equipment and standards used are of known accuracy and are traceable to national standards. Details of test equipment and standards relevant to this certificate are available upon request.

Chelsea Technologies Group

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West Molesey
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Date of issue	06 March 2007
Description	Mk III Aquatracka (Chlorophyll-a)
Serial Number	088234
Part No	3598C

REPORT

The fluorimeter was exposed to various concentrations of Chlorophyll-a dissolved in acetone in addition to pure water and pure acetone. The following formula was derived from the readings to relate instrument output to chlorophyll-a concentration.

$$\text{Conc.} = (0.00779 \times 10^{\text{Output}}) - 0.0211$$

Where -

Conc. = fluorophor concentration in µg/l
Output = Aquatracka output in volts

The above formula can be used in the range 0 - 100 microgrammes per litre to an uncertainty of 0.02 microgrammes per litre plus 5% of value.

Notes

The above formula has been derived using Chlorophyll-a dissolved in acetone. No guarantee is given as to the performance of the instrument to biologically active chlorophyll in sea-water.

The zero offset has been determined in the laboratory using purified water from a reverse osmosis/ion exchange column. It is possible that purer water may be found in clean deep ocean conditions. Under these conditions, the offset shown in the above formula should be replaced by the antilogarithm of the Aquatracka output in the purest water found, multiplied by the scale factor.

Transmisometer

Serial # CST-390DR

PO Box 518
620 Applegate St.
Philomath, OR 97370

(541) 929-565
Fax (541) 929-527
www.wetlabs.co

WET Labs

C-Star Calibration

Date February 27, 2007 Customer US Coast Guard Work order 004

Job # 0012004 S/N# CST-390DR Pathlength 25 cm

	Analog meter
V_d	0.058 V
V_{air}	4.788 V
V_{ref}	4.707 V

Temperature of calibration water	18.8 °C
Ambient temperature during calibration	23.4 °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.

PAR

Serial # 70115

Calibration Date:	01/09/07			Job No.:	L9511
Model Number:	QSP2300				
Serial Number:	70115				
Operator:	TPC				
Standard Lamp:	F-863(9/30/05)				
Operating Voltage Range:	6	to	15	VDC (+)	

Note: The QSP-2300 output is a voltage that is proportional to the log of the incident irradiance.
To calculate irradiance, use this formula:

Irradiance = Calibration factor * (10^Light Signal Voltage - 10^Dark Voltage)

Dry Calibration Factor:	**3.22E+12**	**quanta/cm²·sec per volt**	**5.34E-06**	**µEinsteins/cm²·sec per volt**
Wet Calibration Factor:	**5.42E+12**	**quanta/cm²·sec per volt**	**9.00E-06**	**µEinsteins/cm²·sec per volt**

Sensor Test Data and Results[2)]

Sensor Supply Current (Dark):	3.5	mA		
Supply Voltage:	6	Volts		
Lamp Integrated PAR Irradiance:	9.43E+15	quanta/cm²·sec	0.01566	µEinsteins/cm²sec
SC3 Immersion Coefficient:	0.594			

Nominal Filter OD	Expected Transmission	Calibrated Trans.	Sensor Voltage	Expected Voltage	Voltage % Error	Measured Trans.	Transmission Error (%)	Test Irrad. (quanta/ cm²·sec)
No Filter	100%	100.00%	3.467	3.467	0%	100.00%	0.0	9.43E+15
0.3	50%	36.10%	3.007	3.024	-1%	34.66%	4.2	3.27E+15
0.5	32%	27.60%	2.897	2.908	0%	26.87%	2.7	2.54E+15
1	10%	9.27%	2.478	2.434	2%	10.22%	-9.3	9.66E+14
2	1%	1.11%	1.608	1.512	6%	1.35%	-17.7	1.30E+14
3	0.10%	0.05%	0.500	0.194	61%	0.07%	-27.4	1.02E+13

Dark Before:	0.003	Volts
Light - No Filter Hldr.:	3.467	Volts
Dark After - NFH:	0.003	Volts
Average Dark	0.00274	Volts

Notes:

1. Annual calibration is recommended.

2) This section is for internal use and for more advanced analysis.

Instrument Locations on the Healy

Layout plot of instrument locations

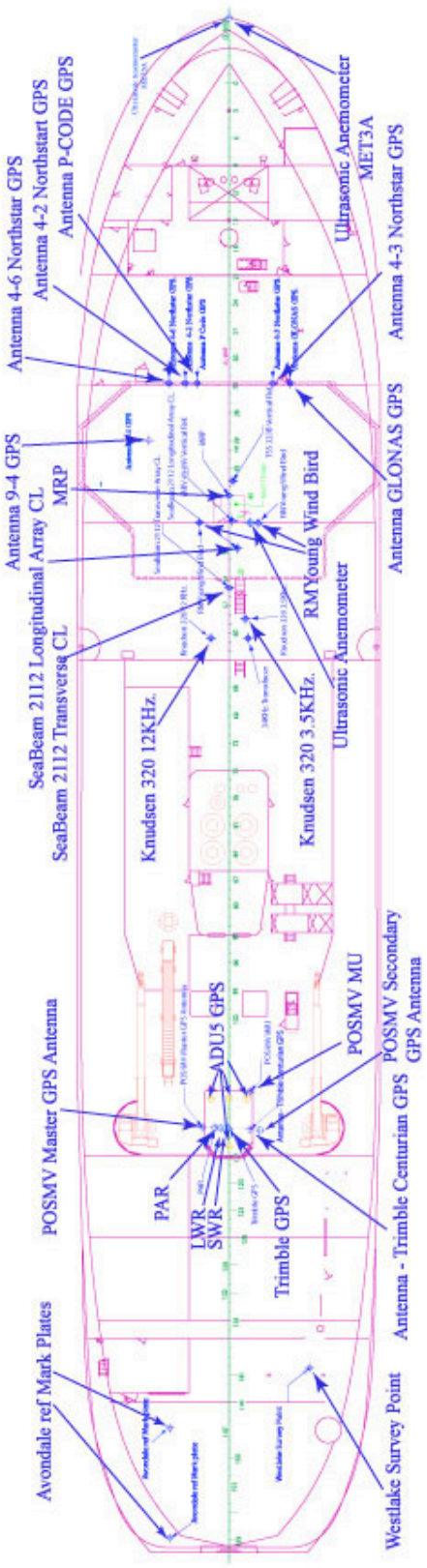

Table of Survey measurements

Consolidated Survey Data						
	Elements of:					
		Avondale Survey				
		Westlake Survey				
		Lamont Survey				
	All Measurements in *Meters* relative to MRP unless otherwise stated					
	X = fore & aft with + foreward					
	Y = port & starboard with + to starboard					
	Z= vertical with + upwards					
				X	Y	Z
Item	***Survey***	***Description***		***North***	***East***	***Elevation***
1	Avondale	**MRP**	See discussion Westlake Final Report	34.30	0.00	9.15
2	Westlake	**MRP**	by Definition	0.00	0.00	0.00
3	Westlake	**Seabeam 2112**				
		Transverse Array	Centerline	-7.679	0.030	9.242
		Longitudinal Array	Centerline	-4.386	0.711	9.238
4	Westlake	**Transducers**				
		Starboard - Forward to Aft				
		Transducer -	Bathy 2000 3.5 kHz	-10.252	1.362	9.243
		Transducer -	Bathy 1500 34 kHz *	-11.866	1.559	9.245
		Transducer -	Doppler Speed Log	-12.168	0.414	9.245
		Transducer -	Spare Transducer Well	-13.081	1.449	9.237
5	Westlake	**Port - Forward to Aft**				

		Transducer -	VM 150	-9.726	-1.395	9.230
		Transducer -	Ocean Surveyor 75 kHz	-10.819	-1.290	9.230
		Transducer -	Bathy 2000 12 kHz	-11.859	-1.492	9.234
		Transducer -	Spare Transducer Well	-13.078	-1.394	9.235
6	Westlake	Gyros				
		Starboard Gyro	Centerline	4.741	0.207	-19.604
		Port Gyro	Centerline	4.746	-0.207	-19.609
7	Westlake	**Antennas**				
		REF DWG TBD	Antenna 9-4 * - GPS Antenna (4.1.5)	4.587	-6.622	-24.000
			Antenna 4-6 * - Northstar GPS (4.1.1)	9.374	-4.970	-23.406
			Antenna 4-2 * - Northstar (4.1.2)	9.362	-3.617	-23.451
			P CODE GPS Antenna *	9.368	-2.645	-23.609
			Antenna 4-3 * - Northstar (4.1.4)	9.355	3.638	-23.363
			GLONAS GPS Antenna *	9.379	5.066	-23.515
			Antenna base (4A)	-53.872	-0.011	-22.025
			Antenna base (4B)	-49.758	0.038	-22.010
			Antenna base (4C)	-49.785	1.629	-22.020
			Antenna base (4D)	-49.771	-1.546	-22.008
			Trimble Centurion**	-52.726	-1.717	-21.113
			Time Server **	-52.671	1.838	-21.115
8	Westlake	**Vertical Ref**				
			MRV-M-MV -			
			Measured at Top of mounting bracket			

			Center (mid-point) - calculated	-2.100	0.291	-0.775
			TSS 333B - Marine Motion Sensor -			
			scribe atop mounting plate			
			Center of TSS 333B	1.210	0.329	-0.013
9	LDEO	**POS/MV**				
		From	**TO**	**X**	**Y**	**Z**
		IMU	Port Antenna (Master)	-2.9719	-3.9140	-5.5310
		MRP	IMU	-49.5710	1.7110	-16.7990
		MRP	Transmit array	-4.3860	0.7110	9.2380
		MRP	Port Antenna (Master)	-52.5429	-2.2030	-22.3300
10	Westlake Raw	**Fan Tail**				
			Aft/Port	-86.737	-4.906	-3.617
			Forward/Port	-77.600	-4.881	-3.589
			Forward/Starboard	-72.590	6.676	-3.653

SBE 21 SEACAT Thermosalinograph Data Output Formats

This is extracted from page 33 of the SBE 21 SEACAT Thermosalinograph User's Manual (SeaBird Manual Version #022, 03/30/07).

The SBE 21 outputs data in raw, hexadecimal form as described below.

The inclusion of some output parameters is dependent on the system configuration - if the specified sensor is not enabled (see *Command Descriptions* above), the corresponding data is not included in the output data stream, shortening the data string.

• SBE 21 Format (**F1**) - ttttccccrrrrrruuuvvvwwwxxx (use this format if you will be using SEASAVE to acquire real-time data and/or SBE Data Processing to process the data)

• SBE 16 Format (**F2**) - #ttttccccrrrrrruuuvvvwwwxxxnnnn (custom format)

where

tttt = primary temperature

cccc = conductivity

rrrrrr = remote temperature (from SBE 38 or SBE 3 remote sensor)

uuu, vvv, www, xxx = voltage outputs 0, 1, 2, and 3 respectively

= attention character

nnnn = lineal sample count (0, 1, 2, etc.)

Data is output in the order listed, with no spaces or commas between parameters. Shown with each parameter is the number of digits.

Calculation of the parameter from the data is described below (use the decimal equivalent of the hex data in the equations).

1. Temperature

    temperature frequency (Hz) = (tttt / 19) + 2100

2. Conductivity

    conductivity frequency (Hz) = square root [(cccc * 2100) + 6250000]

3. SBE 3 secondary temperature (if **SBE3=Y**)

    SBE 3 temperature frequency (Hz) = rrrrrr / 256

4. SBE 38 secondary temperature (if **SBE38=Y**)

    SBE 38 temperature *psuedo* frequency (Hz) = rrrrrr / 256

5. External voltage 0 (if 1 or more external voltages defined with **SVx**)

    external voltage 0 (volts) = uuu / 819

6. External voltage 1 (if 2 or more external voltages defined with **SVx**)

    external voltage 1 (volts) = vvv / 819

7. External voltage 2 (if 3 or more external voltages defined with **SVx**)

    external voltage 2 (volts) = www / 819

8. External voltage 3 (if 4 external voltages defined with **SVx**)

external voltage 3 (volts) = xxx / 819

Example: SBE 21 with SBE 38 and two external voltages sampled,

example scan = ttttccccrrrrrruuuvvv = A80603DA1B58001F5A21

• Temperature = tttt = A806 (43014 decimal);

temperature frequency = (43014 / 19) + 2100 = 4363.89 Hz

• Conductivity = cccc = 03DA (986 decimal);

conductivity frequency =

square root [986 *2100) + 6250000] = 2884.545 Hz

• SBE 38 = rrrrrr = 1B5800 (1,792,000 decimal)

temperature *pseudo* frequency (Hz) = (1,792,000 / 256) = 7000 Hz

• First external voltage = uuu = 1F5 (501 decimal);

voltage = 501 / 819 = 0.612 volts

• Second external voltage = vvv = A21 (2593 decimal);

voltage = 2593 / 819 = 3.166 volts

Note:

SBE 21 always outputs an even number of voltage characters. If you enable 1 or 3 voltages, it adds a *0* to the data stream before the last voltage, as shown below:

• Remote temperature and 1 voltage enabled –

ttttccccrrrrrr0uuu or

#ttttccccrrrrrr0uuunnnn

• Remote temperature and 3 voltages enabled –

ttttccccrrrrrruuuvvv0www

#ttttccccrrrrrruuuvvv0wwwnnnn

Notes:

• Sea-Bird's software (SEASAVE and SBE Data Processing) uses the equations shown to perform these calculations; it then uses the calibration coefficients in the configuration (.con) file to convert the raw frequencies and voltages to engineering units. Alternatively, you can use the equations to develop your own processing software.

• See *Notes on SBE 38 Remote Temperature Data Output Format* below for details on how Sea-Bird handles SBE 38 data.