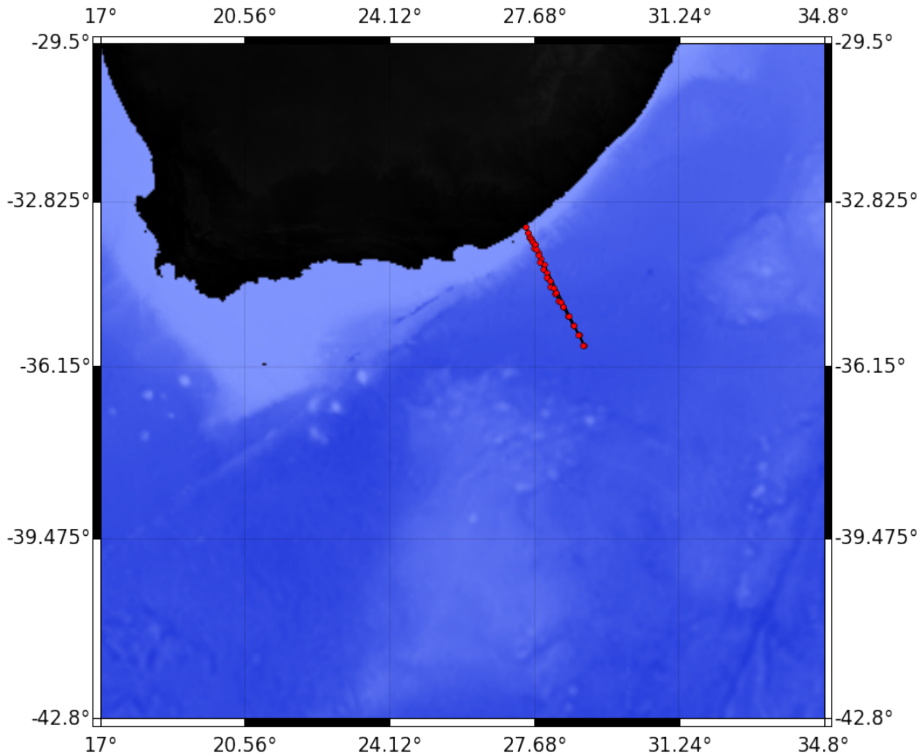
CRUISE REPORT: ACT2010

(Updated Nov 2014)



Highlights

Cruise Summary Information

Section Designation	**ACT2010**
Expedition designation (ExpoCodes)	**316N20100404**
Chief Scientists	**Dr. Lisa Beal / RSMAS**
Dates	2010 Apr 04 - 2010 Apr 23
Ship	R/V *Knorr*
Ports of call	Cape Town, South Africa - Cape Town, South Africa
Geographic Boundaries	33° 20' 45" S 27° 28' 34" E 28° 54' 47" E 35° 43' 14" S
Stations	40
Floats and drifters deployed	0
Moorings deployed or recovered	0

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Links To Select Topics

Shaded sections are not relevant to this cruise or were not available when this report was compiled.

ACT0410

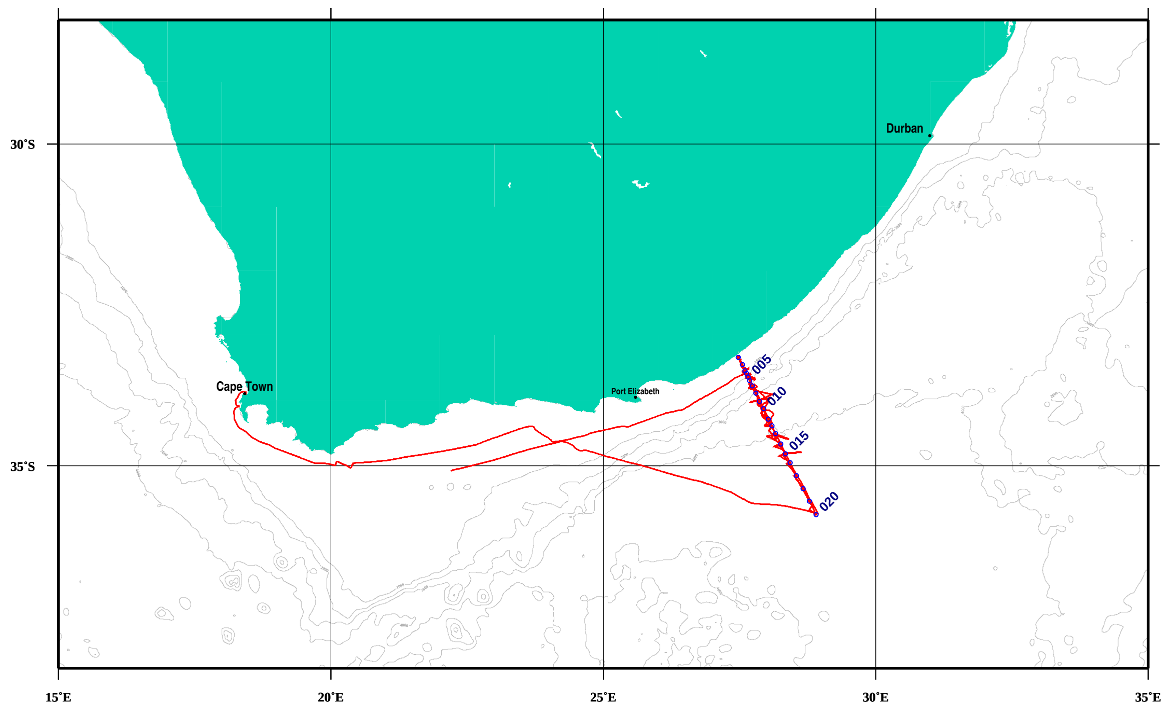
R/V Knorr, KN197-6

4 April 2010 to 23 April 2010

Cape Town, South Africa - Cape Town, South Africa

Chief Scientist: Dr. Lisa Beal

Rosenstiel School of Marine and Atmospheric Science.



Cruise Report
23 April 2010

Data Submitted by:
Oceanographic Data Facility, Computing Resources and Research Technicians
Shipboard Technical Support/Scripps Institution of Oceanography
La Jolla, CA 92093-0214

Summary

A hydrographic survey consisting of Rosette/CTD/LADCP sections, underway shipboard ADCP and float deployments in the Agulhas was carried out early 2010. The R/V Knorr departed Cape Town, South Africa on 4 April 2010.

40 Rosette/CTD/LADCP casts were made. Water samples (up to 12) and CTD data were collected on each Rosette/CTD/LADCP cast, usually made to within 5-70 meters of the bottom. Salinity, dissolved oxygen samples were analyzed for up to 12 water samples from each cast of the principal Rosette/CTD/LADCP program. Concurrent temperature, conductivity, dissolved oxygen measurements were made at the time samples were taken.

The cruise ended in Cape Town, South Africa 23 April 2010.

Description of Measurement Techniques

1. CTD/Hydrographic Measurements

ACT2010 Hydrographic measurements consisted of salinity, dissolved oxygen water samples taken from most of the 40 Rosette casts. Pressure, temperature, conductivity/salinity, dissolved oxygen, data were recorded from CTD profiles. The distribution of samples is shown in the following 2 figures.

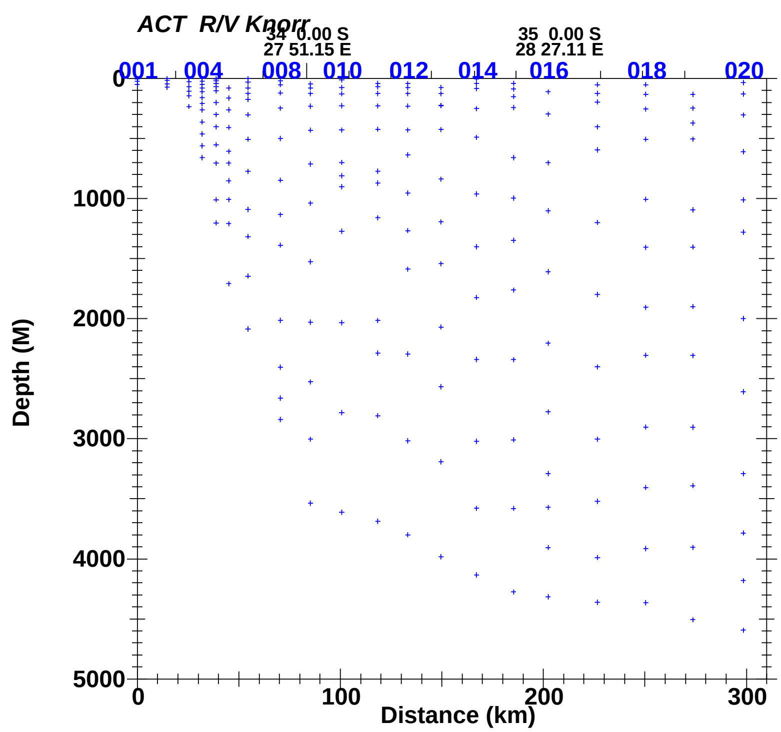


Figure 1.0 ACT0410 Sample distribution, stations 1-20.

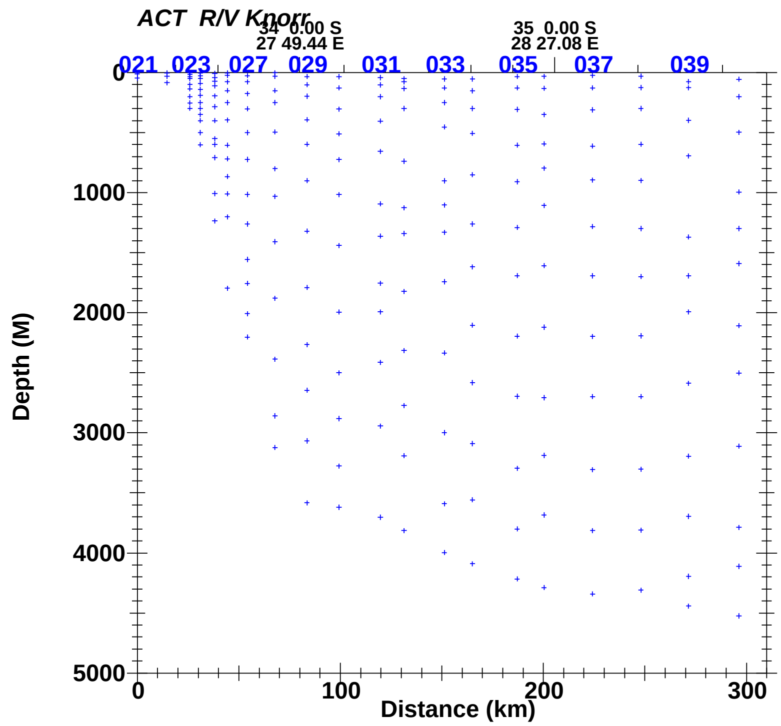


Figure 1.0 ACT0410 Sample distribution, stations 21-40.

1.1. Water Sampling Package

Rosette/CTD/LADCP casts were performed with a package consisting of a 12-bottle rosette frame (SIO/STS), a 12-place carousel (SBE32) and 12 10.0L Niskin bottles (SIO/STS). Underwater electronic components consisted of a Sea-Bird Electronics SBE9*plus* CTD (SIO/STS #796) with dual pumps (SBE5), dual temperature (SBE3*plus*), dual conductivity (SBE4C), dissolved oxygen (SBE43), altimeter (Benthos 100m).

The CTD was mounted horizontally in an SBE CTD cage attached to the bottom of the rosette frame and located to one side of the carousel. The SBE4C conductivity, SBE3*plus* temperature and SBE43 dissolved oxygen sensors and their respective pumps and tubing were mounted in the CTD cage, as recommended by SBE. Pump exhausts were attached to the sensor bracket on the side opposite from the sensors. The altimeter was mounted on the inside of the bottom frame ring. The 300 KHz LADCP (RDI) was mounted vertically on one side of the frame between the bottles and the CTD as well as above the CTD. Its battery pack was located on the opposite side of the frame, mounted on the bottom of the frame. Table 1.1.0 shows height of the sensors referenced to the bottom of the frame.

Instrument	Height in cm
Temperature sensors	11
SBE35	11
Altimeter	4
Transmissometer	8
CDOM Fluorometer	49
Pressure sensor	28
Inner bottle midline	112
Outer bottle midline	119
BB LADCP XDCR Face midline	11
Zero tape	180

Table 1.1.0 Heights referenced to bottom of rosette frame.

The rosette system was suspended from a UNOLS-standard three-conductor 0.322" electro-mechanical sea cable. The sea cable was terminated at the beginning of ACT. Reterminations were performed prior to station 30 when a kink was found in the winch wire 2 ft above termination. Kink was from an unknown source. Technician also performed a total retermination after 14 kinks were found in about 50 meters of wire above termination. These kinks were determind to be from CTD touching bottom. The CTD package was found in good condtion after recovery and the data was not at all affected. The R/V Knorr's DESH-6 winch was used for all casts.

The deck watch prepared the rosette 10-30 minutes prior to each cast. The bottles were cocked and all valves, vents and lanyards were checked for proper orientation. Once stopped on station, the rosette was moved out from the forward hanger to the deployment location under the squirt boom using an air-powered cart and tracks. The CTD was powered-up and the data acquisition system started from the computer lab. The rosette was unstrapped from the air-powered cart. Tag lines were threaded through the rosette frame and syringes were removed from CTD intake ports. The winch operator was directed by the deck watch leader to raise the package. The A-frame and rosette were extended outboard and the package was quickly lowered into the water. Tag lines were removed and the package was lowered to 10 meters, until the console operator determined that the sensor pumps had turned on and the sensors were stable. The winch operator was then directed to bring the package back to the surface, re-zero the wire-out reading, and begin the descent.

Most rosette casts were lowered to within 5-70 meters of the bottom, using the altimeter, winch wire-out, CTD depth and echosounder depth to determine the distance.

For each up cast, the winch operator was directed to stop the winch between 3-12 standard sampling depths. These depths were staggered every station. To insure package shed wake had dissipated, the CTD console operator waited 30 seconds prior to tripping sample bottles. An additional 10 seconds elapsed before moving to the next consecutive trip depth, to allow the SBE35RT time to take its readings.

Recovering the package at the end of the deployment was essentially the reverse of launching, with the additional use of poles and snap-hooks to attach tag lines. The rosette was secured on the cart and moved into the aft hanger for sampling. The bottles and rosette were examined before samples were taken, and anything unusual was noted on the sample log.

Each bottle on the rosette had a unique serial number, independent of the bottle position on the rosette. Sampling for specific programs was outlined on sample log sheets prior to cast recovery or at the time of collection.

Routine CTD maintenance included soaking the conductivity and oxygen sensors in fresh water between casts to maintain sensor stability.

1.2. Navigation and Bathymetry Data Acquisition

Navigation data was acquired at 1-second intervals from the ship's GP90 GPS receiver by a Linux system beginning April 6 2010.

The bottom depths reported in the data transmittal files were recorded on the Console Logs during acquisition, and later input manually into the postgreSQL database. Knudsen depths were typically reported, unless depth data were not available.

1.3. Underwater Electronics

An SBE35RT reference temperature sensor was connected to the SBE32 carousel and recorded a temperature for each bottle closure. These temperatures were used as additional CTD calibration checks.

Instrument/Sensor	Mfr./Model	Serial Number	A/D Channel	Stations Used
Carousel Water Sampler	Sea-Bird SBE32 (12-Pl.)	3231807-0487	n/a	1-40
CTD	Sea-Bird SBE9*plus*	381	n/a	1-40
Pressure	Paroscientific Digiquartz	58952	n/a	1-40
Primary Temperature (T1)	Sea-Bird SBE3*plus*	03P-4924	n/a	1-40
Primary Conductivity (C1a)	Sea-Bird SBE4C	04-3399	n/a	1-40
Dissolved Oxygen	Sea-Bird SBE43	43-0275	Aux4/V6	1-40
Primary Pump	Sea-Bird SBE5T	05-1799	n/a	1-40
Secondary Temperature (T2)	Sea-Bird SBE3*plus*	03P-4588	n/a	1-40
Secondary Conductivity (C2)	Sea-Bird SBE4C	04-2765	n/a	1-40
Secondary Pump	Sea-Bird SBE5T	05-3245	n/a	1-40
Altimeter	Benthos, 100m	1182	Aux3/V4	1-40
Reference Temperature	Sea-Bird SBE35	35-0011	n/a	1-40
LADCP	RDI WHM300-I-UG50	13330	n/a	1-40
Deck Unit (in lab)	Sea-Bird SBE11	11P21561-0518	n/a	1-40

Table 1.3.0 ACT0410 Rosette Underwater Electronics.

The SBE9*plus* CTD was connected to the SBE32 12-place carousel providing for single-conductor sea cable operation. The sea cable armor was used for ground (return). Power to the SBE9*plus* CTD (and sensors), SBE32 carousel and Benthos 100 altimeter was provided, but not operating correctly.

1.4. CTD Data Acquisition and Rosette Operation

The CTD data acquisition system consisted of an SBE-11*plus* (V2) deck unit and three networked generic PC workstations running CentOS-5.4 Linux. Each PC workstation was configured with a color graphics display, keyboard, trackball and DVD+RW drive. One system had a Comtrol Rocketport PCI multiple port serial controller providing 8 additional RS-232 ports. The systems were interconnected through the ship's network. These systems were available for real-time operational and CTD data displays, and provided for CTD and hydrographic data management.

One of the workstations was designated the CTD console and was connected to the CTD deck unit via RS-232. The CTD console provided an interface and operational displays for controlling and monitoring a CTD deployment and closing bottles on the rosette. The website and database server and maintain the hydrographic database for ACT. Redundant backups were managed automatically.

Once the deck watch had deployed the rosette, the winch operator lowered it to 10 meters. The CTD sensor pumps were configured with an 5-second startup delay after detecting seawater conductivities. The console operator checked the CTD data for proper sensor operation and waited for sensors to stabilize, then instructed the winch operator to bring the package to the surface and descend to a specified target depth (wire-out). The profiling rate was no more than 60m/min depending on sea cable tension and sea state.

The progress of the deployment and CTD data quality were monitored through interactive graphics and operational displays. Bottle trip locations were transcribed onto the console and sample logs. The sample log was used later as an inventory of samples drawn from the bottles. The altimeter channel, CTD depth, winch wire-out and bathymetric depth were all monitored to determine the distance of the package from the bottom, allowing a safe approach at depth.

Bottles were closed on the up cast by operating an on-screen control. The winch operator was given a target wire-out for the bottle stop, proceeded to that depth and stopped.

After the last bottle was closed, the console operator directed the deck watch to bring the rosette on deck. Once the rosette was on deck, the console operator terminated the data acquisition, turned off the deck unit and assisted with rosette sampling.

1.5. CTD Data Processing

Shipboard CTD data processing was performed automatically during each Rosette/CTD/LADCP deployment, and at the end of each Trace Metals rosette deployment using SIO/ODF CTD processing software. The Trace Metals rosette contained its own CTD and carousel. These data were acquired using SBE SeaSave software, then copied to a Linux workstation for further processing.

Processing was performed during data acquisition for Rosette/CTD/LADCP deployments. The raw CTD data were converted to engineering units, filtered, response-corrected, calibrated and decimated to a more manageable 0.5-second time series. The laboratory calibrations for pressure, temperature and conductivity were applied at this time. The 0.5-second time series data were used for real-time graphics during deployments, and were the source for CTD pressure and temperature associated with each rosette bottle. Both the raw 24 Hz data and the 0.5-second time series were stored for subsequent processing. During the deployment, the data were backed up to another Linux workstation.

At the completion of a deployment a sequence of processing steps were performed automatically. The 0.5-second time series data were checked for consistency, clean sensor response and calibration shifts. A 2-decibar pressure series was then generated from the down cast. Both the 2-decibar pressure series and 0.5-second time series data were made available for downloading, plotting and reporting on the shipboard cruise website.

Rosette/CTD/LADCP data were routinely examined for sensor problems, calibration shifts and deployment or operational problems. The primary and secondary temperature sensors (SBE3*plus*) were compared to each other and to the SBE35 temperature sensor. CTD conductivity sensors (SBE4C) were compared to each other, then calibrated by examining differences between CTD and check sample conductivity values. The CTD dissolved oxygen sensor data were calibrated to check sample data. Additional Salinity and O_2 comparisons were made with respect to isopycnal surfaces between down and up casts as well as with adjacent deployments. Vertical sections were made of the various properties derived from sensor data and checked for consistency.

The primary temperature and conductivity sensors were used for reported CTD temperatures and conductivities.

1.6. CTD Acquisition and Data Processing Problems

ODF acquisition software was not functioning properly for the first cast. The frame length and modulo count had changed between the test cast and the first cast. This led to the appearance of a 20 db pressure offset. Acquisition was performed with SBE software for station 1-3, then reverted back to ODF acquisition prior to station 4.

Salinity for stations 1-3 were erratic. It was found the deck unit settings were not set to SBE specifications and were corrected prior to station 4. Timing offsets were applied in processing to 1-3 and corrected for salinity.

Station 30, the CTD package was laid on its side on the sea floor. The ship was repositioned on shift change at the same time as CTD approached the bottom of the cast. The relative surface current was 4 knots. The current structure indicated bi-directional flow split at mid-depth. There was about 700 m of winch-wire in excess of the relative depth. Some moments after ship was repositioned, the CTD package reached the bottom and was laid on its side. The sensors were facing the opposite direction of the seafloor. The sensors did not register any sea floor sediment or material interference in the signal, thus the incident was not reported until the CTD was brought back to surface. The data appeared intact. Subsequent data checks have shown data to be good. Approximately 50 m of winch-wire was kinked in 14 places, indicating the package was still falling in the water column for the first several bottle stops.

1.7. CTD Sensor Laboratory Calibrations

Laboratory calibrations of the CTD pressure, temperature, conductivity and dissolved oxygen sensors were performed prior to ACT0410. The calibration dates are listed in table 1.7.0.

Sensor	S/N	Calibration Date	Calibration Facility
Paroscientific Digiquartz Pressure	58952	16 Dec 2009	SIO/STS
Sea-Bird SBE3*plus* T1 Temperature	03P-4924	11 Dec 2009	SIO/STS
Sea-Bird SBE3*plus* T2 Temperature	03P-4588	11 Dec 2009	SIO/STS
Sea-Bird SBE4C C1 Conductivity	04-3399	10 Feb 2010	SBE
Sea-Bird SBE4C C2 Conductivity	04-2765	10 Feb 2010	SBE
Sea-Bird SBE43 Dissolved Oxygen	43-0275	1 July 2009	SBE
Sea-Bird SBE35 Reference Temperature	35-0011	07 Feb 2010	SBE

Table 1.7.0 ACT0410 CTD sensor laboratory calibrations.

ODF typically calibrates sensors about two months before an expedition.

1.8. CTD Shipboard Calibration Procedures

CTD 381 was used for all Rosette/CTD/LADCP casts during ACT. The primary temperature sensor (T1/03P-4924) and conductivity sensors (C1/04-3399) were used for all reported CTD data for stations 1-40.

The SBE35RT Digital Reversing Thermometer (S/N 3528706-0011) served as an independent calibration check for T1 and T2. *In-situ* salinity and dissolved O_2 check samples collected during each cast were used to calibrate the conductivity and dissolved O_2 sensors.

1.8.1. CTD Pressure

The Paroscientific Digiquartz pressure transducer (S/N 58952) was calibrated in Dec 2009 at the STS/ODF Calibration Facility. The calibration coefficients provided on the report were used to convert frequencies to pressure; then the calibration correction slope and offset were applied to the converted pressures during each cast. Pre- and post-cast on-deck/out-of-water pressure offsets varied from -0.1 to +0.5db before and after the aborted test cast. An additional -0.2db correction was applied during data acquisition/block-averaging starting with station 1.

1.8.2. CTD Temperature

The same primary (T1/03P-4924) and secondary (T2/03P-4588) temperature sensors were used for all 40 stations. Calibration coefficients derived from the pre-cruise calibrations, plus shipboard temperature corrections determined during the cruise, were applied to raw primary and secondary sensor data during each cast.

A single SBE35RT was used as a tertiary temperature check. It was located equidistant between T1 and T2 with the sensing element aligned in a plane with the T1 and T2 sensing elements. The SBE35RT Digital Reversing Thermometer is an internally-recording temperature sensor that operates independently of the CTD. It is triggered by the SBE32 carousel in response to a bottle closure. According to the manufacturer's specifications, the typical stability is 0.001°C/yr. The SBE35RT on ACT was set to internally average over an 8 second period.

Two independent metrics of calibration accuracy were examined. At each bottle closure, the primary and secondary temperature were compared with each other and with the SBE35RT temperatures.

The primary temperature sensor exhibited a second-order pressure response, and the secondary sensor did as well when compared to the SBE35RT.

All corrections made to CTD temperatures had the form:

$$T_{cor} = T + tp_2 P^2 + tp_1 P + t_0$$

Residual temperature differences after correction are shown in figures 1.8.2.0 through 1.8.2.1.

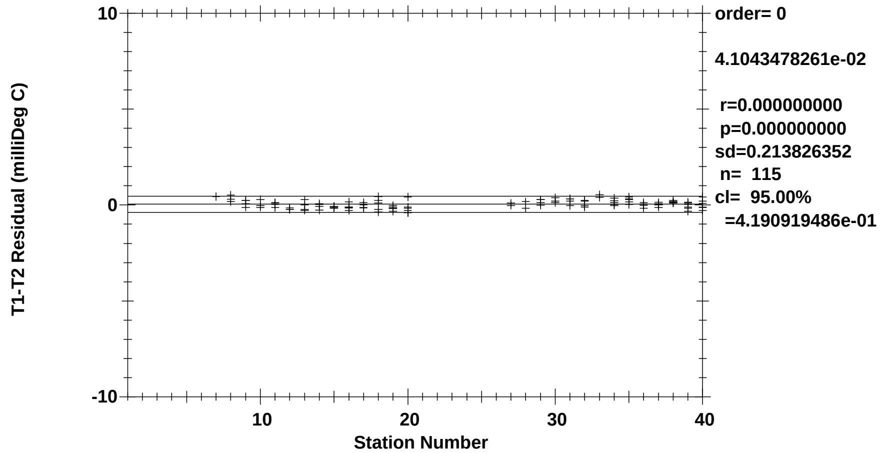


Figure 1.8.2.0 T1-T2 by station ($-0.01°C \leq T1 - T2 \leq 0.01°C$).

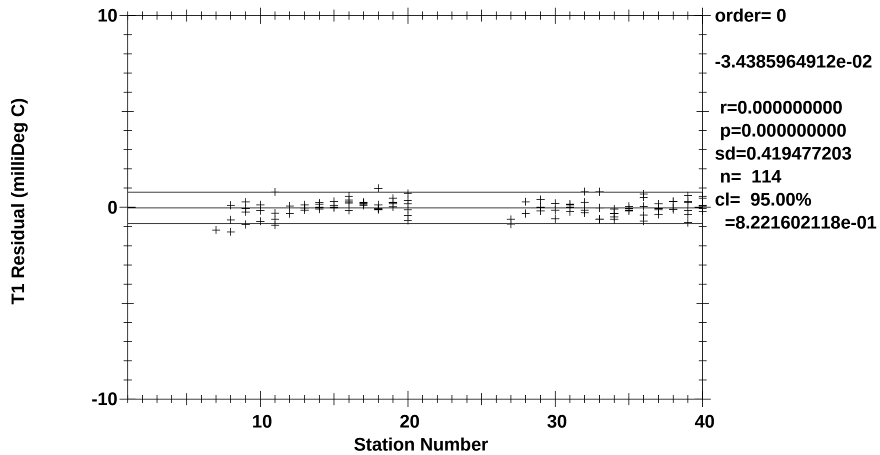


Figure 1.8.2.1 SBE35RT-T1 by station ($-0.01°C \leq T1 - T2 \leq 0.01°C$).

1.8.3. CTD Conductivity

Primary conductivity sensor SBE4C-3399 and secondary conductivity sensor SBE4C-2765 were used for all 40 stations. Calibration coefficients derived from the pre-cruise calibrations were applied to convert raw frequencies to conductivity. Shipboard conductivity corrections, determined during the cruise, were applied to primary and secondary conductivity data for each cast.

Corrections for both CTD temperature sensors were finalized before analyzing conductivity differences. Two independent metrics of calibration accuracy were examined. At each bottle closure, the primary and secondary conductivity were compared with each other. Each sensor was also compared to conductivity calculated from check sample salinities using CTD pressure and temperature.

The differences between primary and secondary temperature sensors were used as filtering criteria to reduce the contamination of conductivity comparisons by package wake. The coherence of this relationship is shown in figure 1.8.3.0.

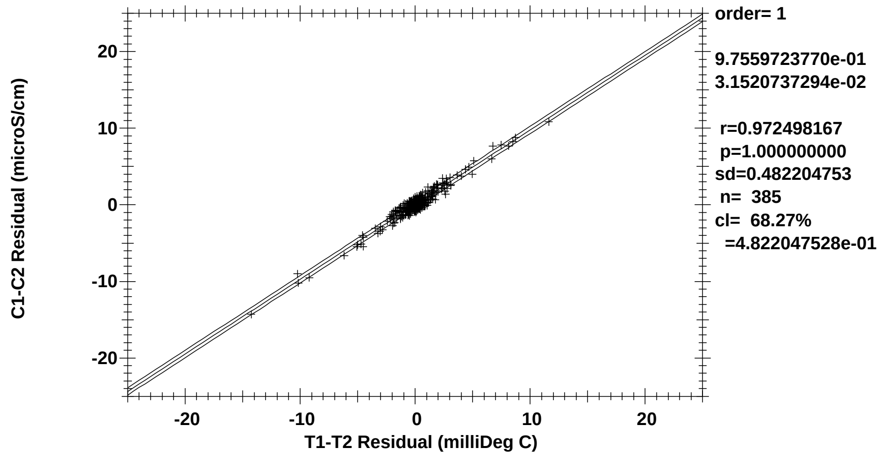


Figure 1.8.3.0 Coherence of conductivity differences as a function of temperature differences.

Uncorrected conductivity comparisons are shown in figures 1.8.3.1 through 1.8.3.3.

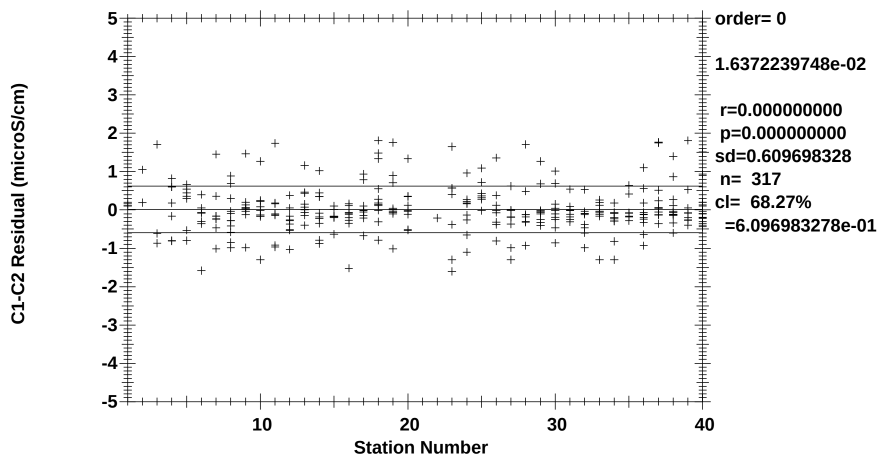


Figure 1.8.3.1 Uncorrected $C1 - C2$ by station (-0.01°C $\leq T1 - T2 \leq$ 0.01°C).

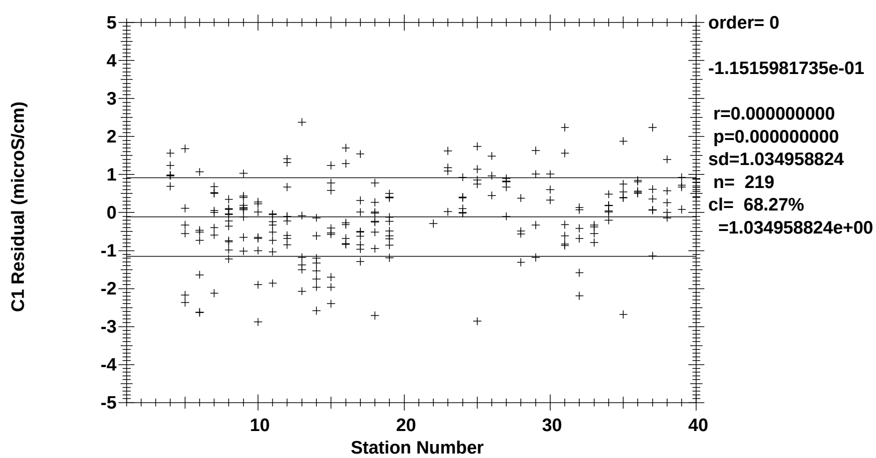


Figure 1.8.3.2 Uncorrected $C_{Bottle} - C1$ by station (-0.01°C $\leq T1 - T2 \leq$ 0.01°C).

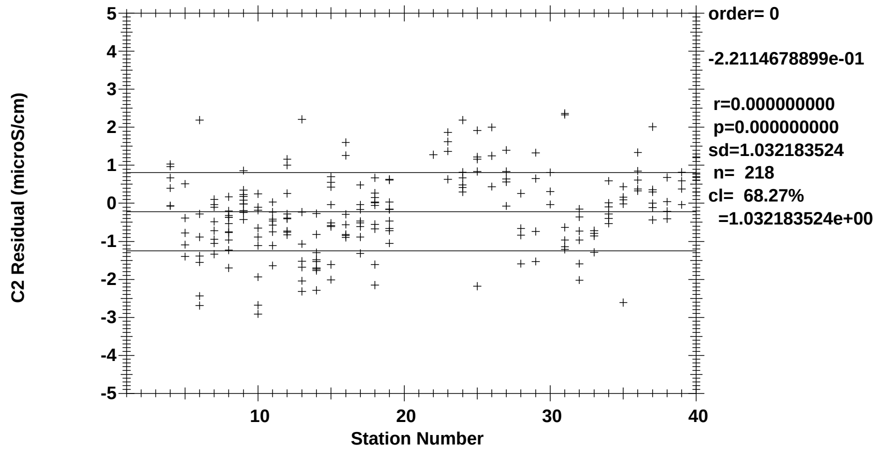


Figure 1.8.3.3 Uncorrected $C_{Bottle} - C2$ by station (-0.01°C ≤T1-T2≤0.01°C).

First-order time-dependent drift corrections (changing conductivity offset with time) were determined for each sensor. After applying the drift corrections, second-order pressure responses were evident for each conductivity sensor.

$C_{Bottle} - C_{CTD}$ differences were then evaluated for response to temperature and/or conductivity, which typically shifts between pre- and post-cruise SBE laboratory calibrations. Temperature and conductivity responses essentially showed the same picture, so each sensor was fit to conductivity response. Both C1 and C2 required a second-order correction.

After conductivity responses were corrected, the pressure-dependent correction for C1 required a minor adjustment to flatten out the deep end.

The residual differences after correction are shown in figures 1.8.3.4 through 1.8.3.12.

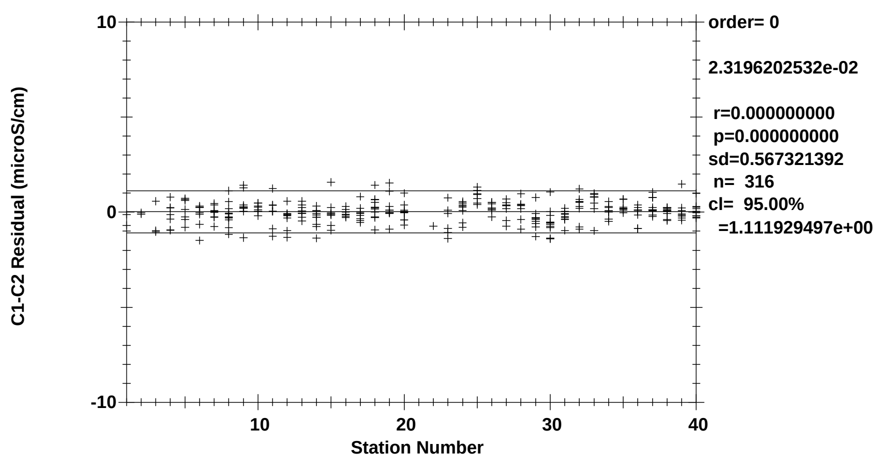


Figure 1.8.3.4 Corrected $C1 - C2$ by station (-0.01°C ≤T1-T2≤0.01°C).

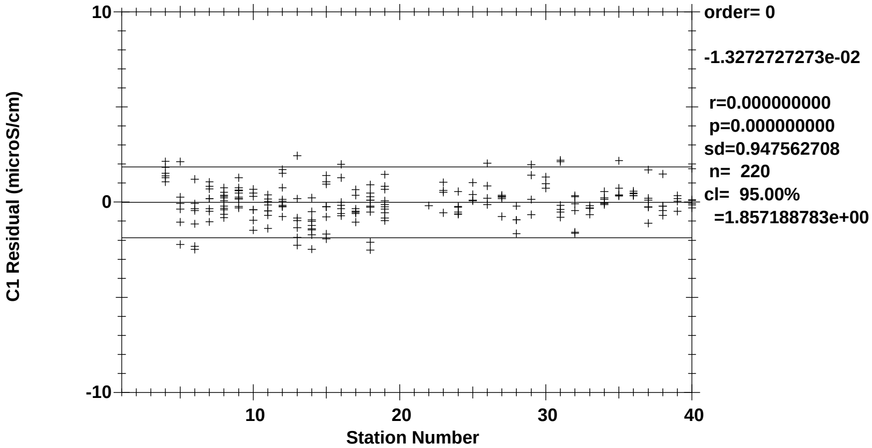


Figure 1.8.3.5 Corrected $C_{Bottle} - C1$ by station (-0.01°C ≤T1-T2≤0.01°C).

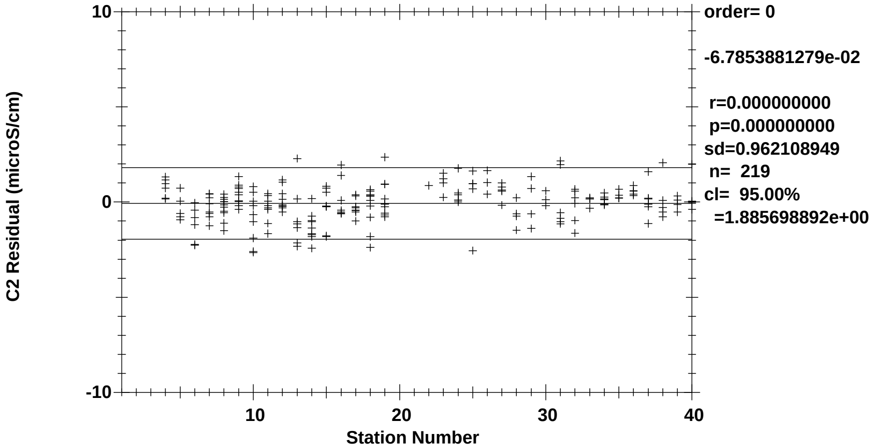


Figure 1.8.3.6 Corrected $C_{Bottle} - C2$ by station (-0.01°C ≤T1-T2≤0.01°C).

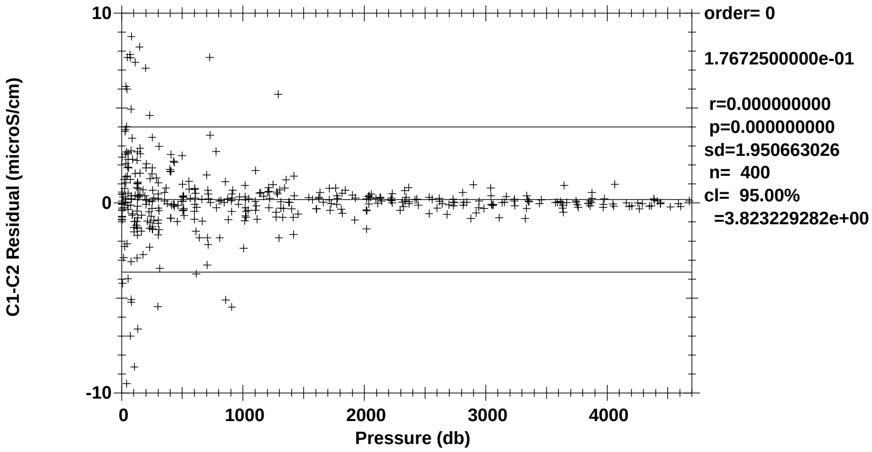


Figure 1.8.3.7 Corrected $C1 - C2$ by pressure (-0.01°C ≤T1-T2≤0.01°C).

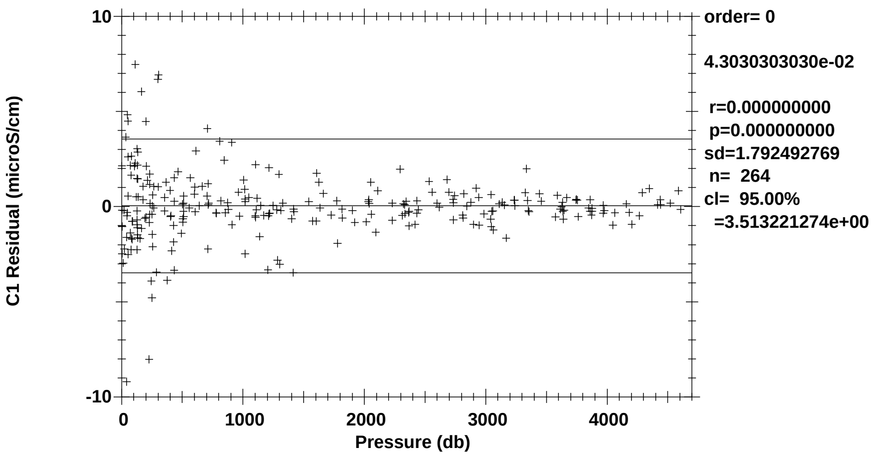


Figure 1.8.3.8 Corrected $C_{Bottle} - C1$ by pressure (-0.01°C ≤T1-T2≤0.01°C).

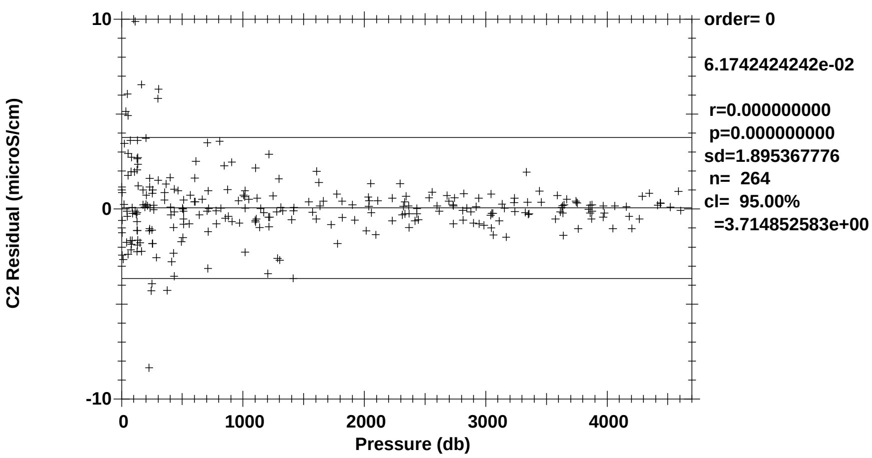


Figure 1.8.3.9 Corrected $C_{Bottle} - C2$ by pressure (-0.01°C ≤T1-T2≤0.01°C).

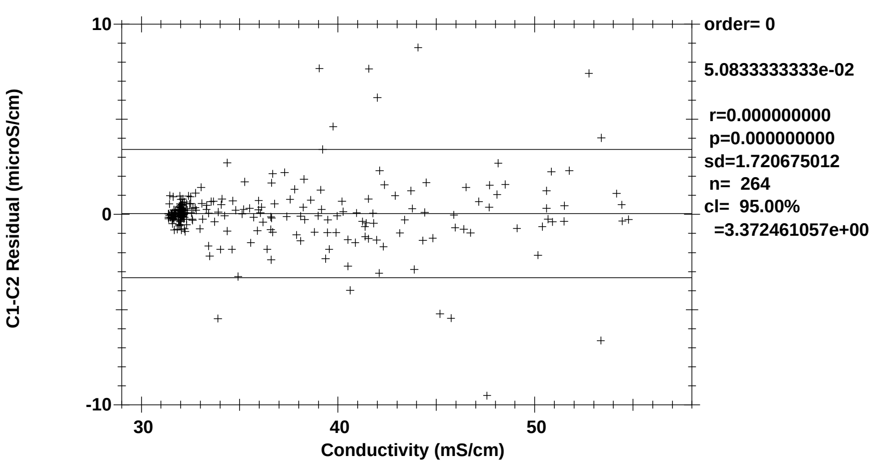


Figure 1.8.3.10 Corrected $C1 - C2$ by conductivity (-0.01°C ≤T1-T2≤0.01°C).

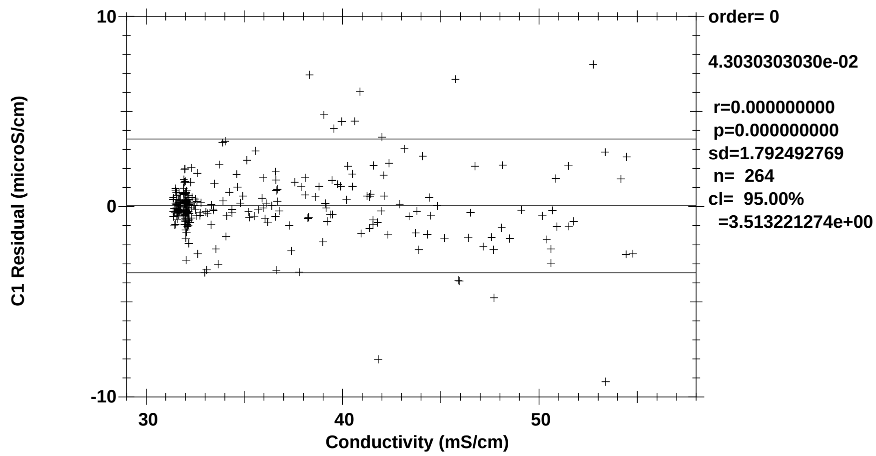


Figure 1.8.3.11 Corrected $C_{Bottle} - C1$ by conductivity (-0.01°C ≤T1-T2≤0.01°C).

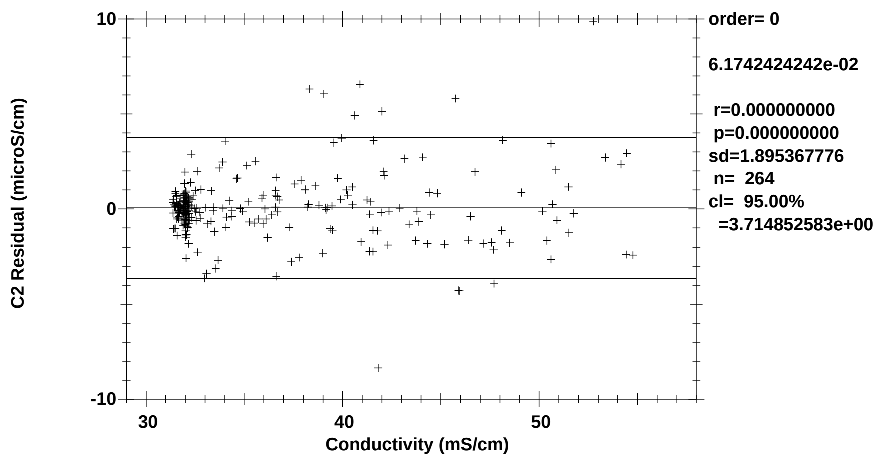


Figure 1.8.3.12 Corrected $C_{Bottle} - C2$ by conductivity (-0.01°C ≤T1-T2≤0.01°C).

Corrections made to all conductivity sensors had the form:

$$C_{cor} = C + cp_2P^2 + cp_1P + cp_0C^2 + c_2C^2 + c_1 + c_0$$

Only CTD and bottle salinity data with "acceptable" quality codes are included in the differences.

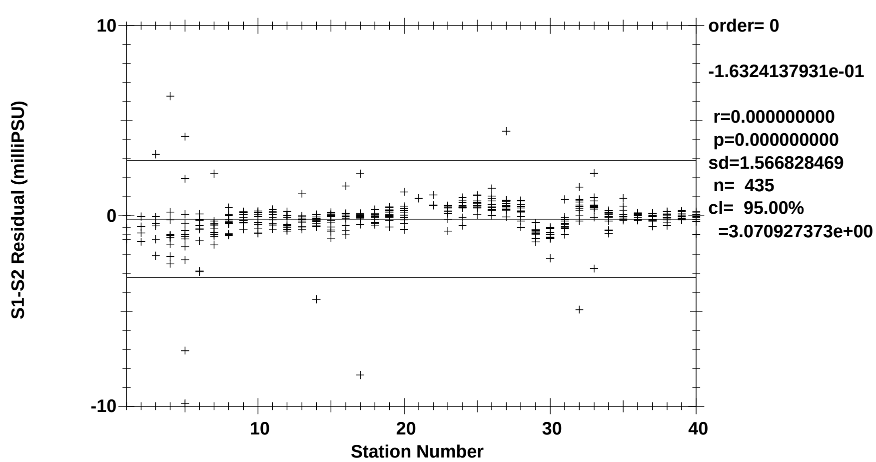


Figure 1.8.3.13 Salinity residuals by station (-0.01°C ≤T1-T2≤0.01°C).

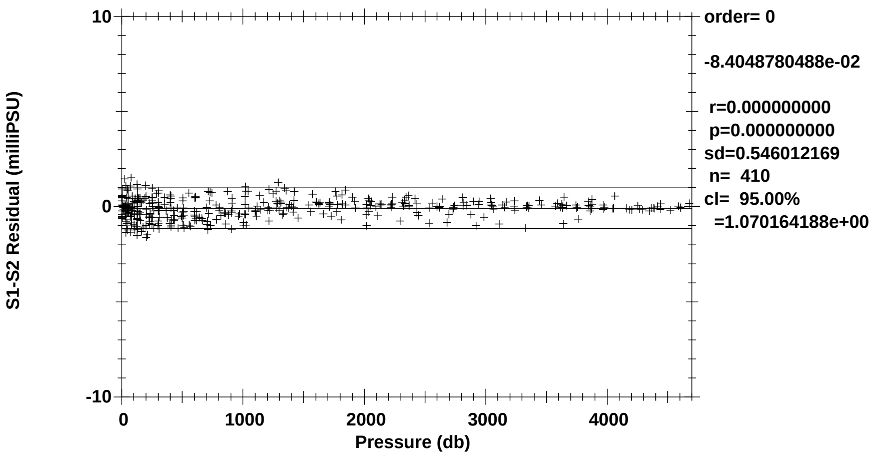


Figure 1.8.3.14 Salinity residuals by pressure (-0.01°C ≤T1-T2≤0.01°C).

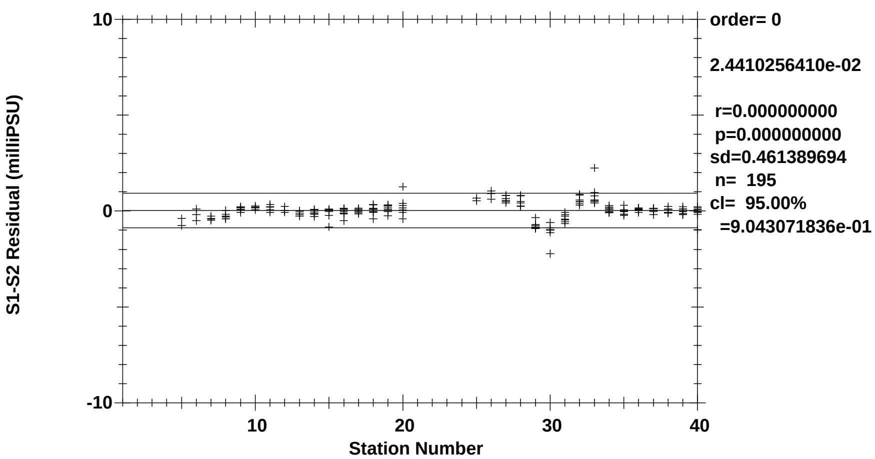


Figure 1.8.3.15 Salinity residuals by station (Pressure>2000db)

Figures 1.8.3.14 and 1.8.3.15 represent estimates of the deep salinity accuracy of ACT0410. The 95% confidence limits are ±0.000904 PSU relative to bottle salinities for deep salinities, and ±0.00307 PSU relative to bottle salinities for all salinities where T1-T2 is within ±0.01°C.

1.8.4. CTD Dissolved Oxygen

A single SBE43 dissolved O_2 sensor (DO/43-0275) was used during this leg. The sensor was plumbed into the primary T1/C1 pump circuit after C1.

The DO sensor was calibrated to dissolved O_2 check samples taken at bottle stops by matching the down cast CTD data to the up cast trip locations on isopycnal surfaces, then calculating CTD dissolved O_2 using a DO sensor response model and minimizing the residual differences from the check samples. A non-linear least-squares fitting procedure was used to minimize the residuals and to determine sensor model coefficients, and was accomplished in three stages.

The time constants for the lagged terms in the model were first determined for the sensor. These time constants are sensor-specific but applicable to an entire cruise. Next, casts were fit individually to check sample data. Consecutive casts were checked on plots of Theta vs O_2 to check for consistency.

Standard and blank values for check sample oxygen titration data were smoothed, and the oxygen values recalculated, prior to the final fitting of CTD oxygen.

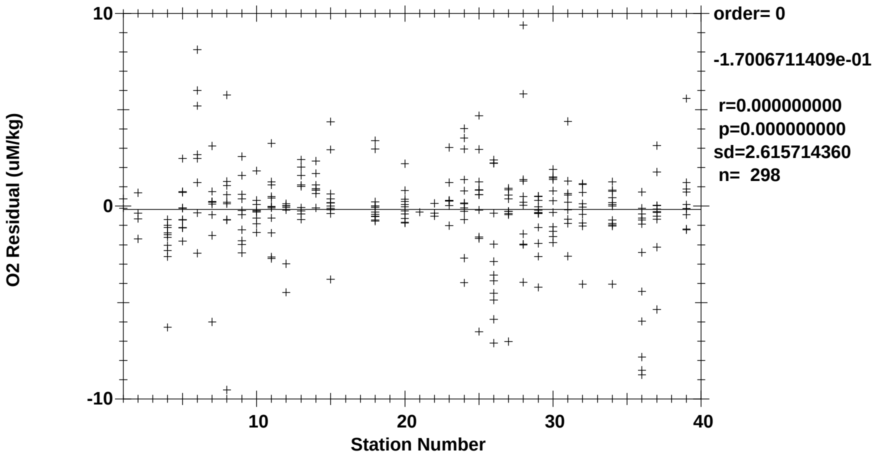


Figure 1.8.4.0 O_2 residuals by station (-0.01°C ≤T1-T2≤0.01°C).

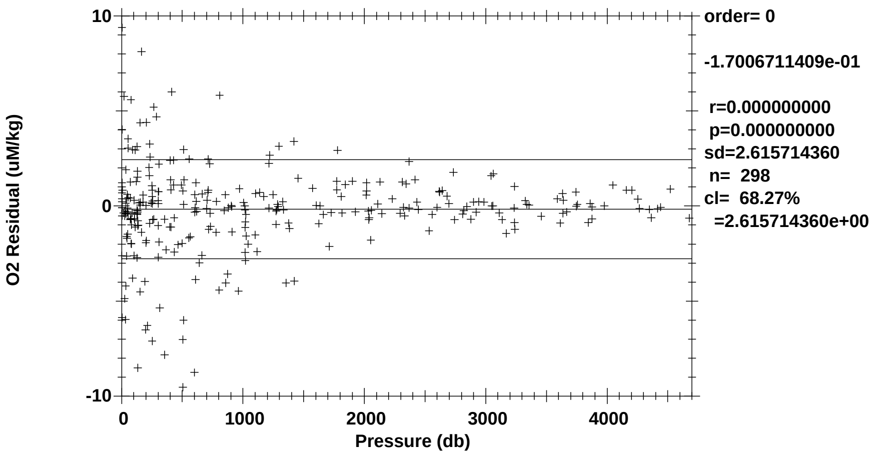


Figure 1.8.4.1 O_2 residuals by pressure (-0.01°C ≤T1-T2≤0.01°C).

The standard deviations of 3.04 μmol/kg for all oxygens and 0.76 μmol/kg for deep oxygens are only presented as general indicators of goodness of fit. ODF makes no claims regarding the precision or accuracy of CTD dissolved O_2 data.

The general form of the ODF DO sensor response model equation for Clark cells follows Brown and Morrison [Brow78], and Millard [Mill82], [Owen85]. ODF models DO sensor secondary responses with lagged CTD data. *In-situ* pressure and temperature are filtered to match the sensor responses. Time constants for the pressure response τ_p, a slow (τ_{Tf}) and fast (τ_{Ts}) thermal response, package velocity (τ_{dP}), thermal diffusion (τ_{dT}) and pressure hysteresis (τ_h) are fitting parameters. Once determined for a given sensor, these time constants typically remain constant for a cruise. The thermal diffusion term is derived by low-pass filtering the difference between the fast response (T_s) and slow response (T_l) temperatures. This term is intended to correct non-linearities in sensor response introduced by inappropriate analog thermal compensation. Package velocity is approximated by low-pass filtering 1st-order pressure differences, and is intended to correct flow-dependent response. Dissolved O_2 concentration is then calculated:

$$O_2ml/l = [C_1 V_{DO} e^{(C_2 \frac{P_h}{5000})} + C_3] \cdot f_{sat}(T,P) \cdot e^{(C_4 T_l + C_5 T_s + C_7 P_l + C_6 \frac{dO_c}{dt} + C_8 \frac{dP}{dt} + C_9 dT)}$$

where:

O_2ml/l	Dissolved O_2 concentration in ml/l
V_{DO}	Raw sensor output
C_1	Sensor slope
C_2	Hysteresis response coefficient
C_3	Sensor offset
$f_{sat}(T,P)$	O_2 saturation at T,P (ml/l)
T	*insitu* temperature (°C)
P	*insitu* pressure (decibars)
P_h	Low-pass filtered hysteresis pressure (decibars)
T_l	Long-response low-pass filtered temperature (°C)
T_s	Short-response low-pass filtered temperature (°C)
P_l	Low-pass filtered pressure (decibars)
$\frac{dO_c}{dt}$	Sensor current gradient (μamps/sec)
$\frac{dP}{dt}$	Filtered package velocity (db/sec)
dT	low-pass filtered thermal diffusion estimate (T_s - T_l)
$C_4 - C_8$	Response coefficients

1.9. Bottle Sampling

At the end of each rosette deployment water samples were drawn from the bottles in the following order:

- O_2
- Salinity

The correspondence between individual sample containers and the rosette bottle position (1-12) from which the sample was drawn was recorded on the sample log for the cast. This log also included any comments or anomalous conditions noted about the rosette and bottles. One member of the sampling team was designated the *sample cop*, whose sole responsibility was to maintain this log and ensure that sampling progressed in the proper drawing order.

Normal sampling practice included opening the drain valve and then the air vent on the bottle, indicating an air leak if water escaped. This observation together with other diagnostic comments (e.g., "lanyard caught in lid", "valve left open") that might later prove useful in determining sample integrity were routinely noted on the sample log. Drawing oxygen samples also involved taking the sample draw temperature from the bottle. The temperature was noted on the sample log and was sometimes useful in determining leaking or mis-tripped bottles.

Once individual samples had been drawn and properly prepared, they were distributed for analysis. Oxygen and salinity analyses were performed on computer-assisted (PC) analytical equipment networked to the data processing computer for centralized data management.

1.10. Bottle Data Processing

Water samples collected and properties analyzed shipboard were centrally managed in a relational database (PostgreSQL 8.1.11) running on a Linux system. A web service (OpenACS 5.3.2 and AOLServer 4.5.0) front-end provided ship-wide access to CTD and water sample data. Web-based facilities included on-demand arbitrary property-property plots and vertical sections as well as data uploads and downloads.

The sample log (and any diagnostic comments) was entered into the database once sampling was completed. Quality flags associated with sampled properties were set to indicate that the property had been sampled, and sample container identifications were noted where applicable (e.g., oxygen flask number).

Analytical results were provided on a regular basis by the various analytical groups and incorporated into the database. These results included a quality code associated with each measured value and followed the coding scheme developed for the World Ocean Circulation Experiment Hydrographic Programme (WHP) [Joyc94].

Table 1.10.0 shows the number of samples drawn and the number of times each WHP sample quality flag was assigned for each basic hydrographic property:

Rosette Samples Stations 1- 40								
	Reported levels	WHP Quality Codes 1	2	3	4	5	7	9
Bottle	436	0	432	0	0	0	0	4
CTD Salt	436	0	435	1	0	0	0	0
CTD Oxy	425	0	425	0	0	0	0	11
Salinity	300	15	287	13	0	12	0	109
Oxygen	429	3	409	20	0	0	0	4

Table 1.10.0 Frequency of WHP quality flag assignments.

Various consistency checks and detailed examination of the data continued throughout the cruise.

CCHDO Data Processing Notes

2014-10-15	BTL	Submitted	data update, to go online

Courtney Schatzman

Changes:
1) Updated BTLNBR from bottle serial numbers to positional numbers.
2) Removed depth field
3) Corrected missing salinity and oxygen samples.
4) Fixed uncalibrated flags "1" in file.

2014-10-14	BTL	Submitted	Bottle data file fixed

Courtney Schatzman

2014-10-14	BTL	Website Update	Available under 'Files as received'

CCHDO Staff

The following files are now available online under 'Files as received', unprocessed by the CCHDO. act_hy1.csv

2014-08-13	Map	Website Update	Maps online

Rox Lee

316N20100404 processing - Maps
2014-08-13
R Lee

Contents

Process

Changes

- Map created from 316N20100404_hy1.csv

Directories

working directory:

/data/co2clivar/indian/act/316N20100404/original/2014.08.13_Map_RJL

cruise directory:

/data/co2clivar/indian/act/316N20100404

Updated Files Manifest

file	stamp
316N20100404_trk.gif	
316N20100404_trk.jpg	

2014-08-12	BTL	Website Update	Exchange and netCDF files online

Roxanne Lee

ACT2010 2010 316N20100404 processing - BTL/CTD
2014-08-12
R Lee

Contents

Submission

filename	submitted by	date	data type	id
act2010.tar.gz	Frank Delahoyde	2014-04-21	CrsRpt/BTL/CTD	1160

Parameters

act_hy1.csv

- CTDPRS
- CTDTMP
- CTDSAL [1]
- SALNTY [1]
- CTDOXY [1]
- OXYGEN [1]
- SILCAT [1] [2]
- NITRAT [1] [2]
- NITRIT [1] [2]
- PHSPHT [1] [2]
- BTL_LAT [3]
- BTL_LON [3]
- REFTMP [1] [3]

316N20100404_ct1.zip

- CTDPRS [1]
- CTDTMP [1]
- CTDSAL [1]

- CTDOXY [1]
- CTDNOBS [3]
- CTDETIME [3]

[1] (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13) parameter has quality flag column

[2] (1, 2, 3, 4) parameter only has fill values/no reported measured data

[3] (1, 2, 3, 4, 5) not in WOCE bottle file

[4] merged

Process

Changes

act_hy1.csv

- Change CTDPRS unit from DBARS to DBAR
- Change REFTEMP to REFTMP

316N20100404_ct1.zip

- Rename CTD files

Conversion

file	converted from	software
316N20100404_nc_hyd.zip	316N20100404_hy1.csv	hydro 0.8.2-11-g372a577
316N20100404_nc_ctd.zip	316N20100404_ct1.zip	hydro 0.8.2-26-g20de094

All converted files opened in JOA with no apparent problems.

Directories

working directory:

/data/co2clivar/indian/act/316N20100404/original/2014.08.12_BTL_CBG

cruise directory:

/data/co2clivar/indian/act/316N20100404

Updated Files Manifest

file	stamp
316N20100404_nc_hyd.zip	20140724SIOCCHRJL
316N20100404_hy1.csv	20140724SIOCCHRJL
316N20100404_ct1.zip	20110803ODF
316N20100404_nc_ctd.zip	20110803ODF

2014-04-22	CrsRpt/BTL/CTD	Website Update	Available under 'Files as received'
CCHDO Staff	The following files are now available online under 'Files as received', unprocessed by the CCHDO. act2010.tar.gz		
2014-10-29	CrsRpt	Website Update	PDF version online
Kappa, Jerry	I've placed a new PDF version of the cruise report: 316N20100404_do.pdf into the directory: http://cchdo.ucsd.edu/data/b/c36647/ It includes all the reports provided by the cruise PIs, summary pages and CCHDO data processing notes, as well as a linked Table of Contents and links to figures, tables and appendices.		