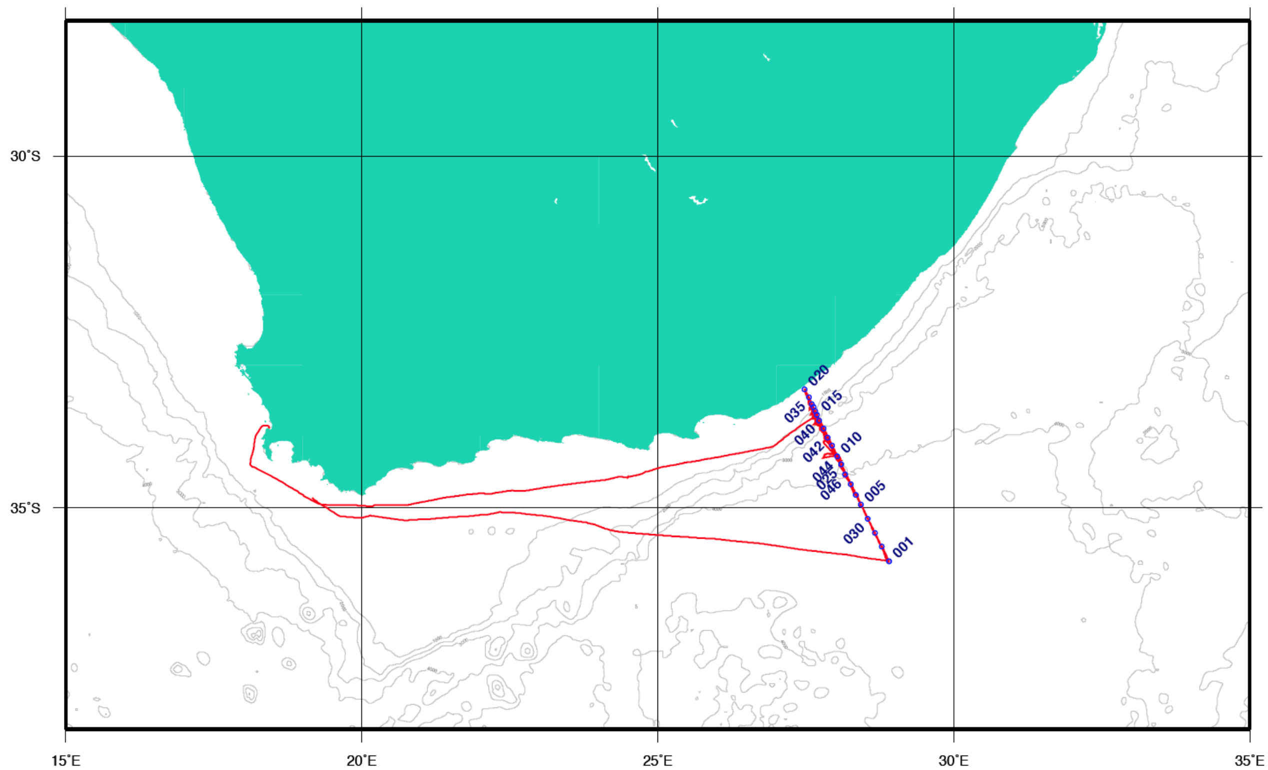
CRUISE REPORT: ACT2013

(Updated AUG 2017)



Highlights

Cruise Summary Information

WOCE Section Designation	**ACT2013**
Expedition designation (ExpoCodes)	**316N20130213**
Chief Scientists	**Dr. Lisa Beal / RSMAS**
Dates	**2013 FEB 13 - 2013 MAR 03**
Ship	**R/V *Knorr***
Ports of call	Cape Town, South Africa - Cape Town, South Africa
Geographic Boundaries	33° 20' 42" S 27° 28' 40" E 28° 53' 42" E 35° 43' 48" S
Stations	57
Floats and drifters deployed	0 deployed, 5 recovered
Moorings deployed or recovered	7 recovered

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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.

1 Overview

A full technical report for the CTD portion of the final Agulhas Current Time Series cruise (ACT0213) is available separately. Following a 1,000 m test cast (998/01), a total of 57 full-depth Rosette/CTD/LADCP casts were collected between 15 February 2013 and 28 February 2013. Figure 1 shows that these 57 stations were broken up into two synoptic sections, a time series, and a section that was broken up due to mooring recovery and a weather day. Each cast included water samples (up to 12), CTD (pressure, temperature, conductivity, dissolved oxygen) and LADCP (direct velocity) data to within 5 to 40 m off the bottom.

2 Instrumentation

The CTD package consisted of a 24-place carousel (Sea-Bird SBE32), with 12 10.0L Niskin bottles mounted on a 24-bottle rosette frame. Underwater CTD components included an SBE9plus CTD (S/N 830 for stations 1-9 and S/N 462 for stations 10-57) consisting of a Paroscientific Digiquartz pressure sensor (S/N 58952 for stations 1-9; S/N 99676 for stations 10-57), dual SBE3plus temperature sensors (S/N 03P-2333 and 03P-4532 for stations 1-9; S/N 03P-4360 and 03P-2774 for stations 10-57), dual SBE4C conductivity sensors (S/N 04-1744 and 04-2115 for stations 1-9; S/N 04-3042 and 04-3089 for stations 10-57), an SBE43 dissolved oxygen sensor (S/N 43-1136 for stations 1-9; S/N 43-0113 for stations 10-57), and one or two altimeters (Tritech 250m for station 1; Benthos 100m for stations 2-5; Tritech 250m for stations 5-9; Benthos 100m for stations 5-57). The CTD, altimeter(s) and LADCP battery pack were mounted horizontally at the bottom of the rosette frame. A downward-looking 150 kHz LADCP was mounted horizontally to one side of the bottom of the rosette frame, and an upward-looking 300 kHz LADCP was mounted horizontally along one edge of the top of the rosette frame. A UNOLS-standard three-conductor 0.322 electromechanical sea cable suspended the rosette package and frame. Each CTD cast was monitored using an SBE11 deck unit inside the ships main lab.

3 Operations

Preparation for each cast began 15-45 minutes prior to CTD deployment. Preparation included emptying and cocking the 12 Niskin bottles, closing all bottle valves, and removing any tubing. Once the bridge notified the deck watch that the ship was on station, the CTD rosette was brought out of the hangar using an air-powered cart and tracks and positioned below the squirt boom on the starboard deck. Once in position, the deck leader would alert the winch to pull up any slack in the wire. At this point, the console operator would turn on the SBE11 deck unit and turn on data acquisition. The deck watch would then string tag lines through the arms of the rosette frame and secure them to cleats located on the deck. Ratchet straps connecting the frame to the air-powered cart were then removed, and the deck leader would signal the winch operator to lift the CTD. As the boom extended, the deck watch reduced package swing by keeping the tag lines tight. Once the CTD was in the water, tag lines were removed and the package was brought to 10-m. Once the console operator determined that primary and secondary sensors were within reasonable agreement (± 0.001), he or she would instruct the winch operator to bring the package to the surface to zero the wire reading and then begin descent at 60 m min^{-1}.

During the last 100-m of the cast, determined using a combination of multibeam and Knudsen depths combined with the wire difference with depth, the console operator instructed the winch operator to slow to 30 m min^{-1}. If at 50-m above the bottom, the altimeter had yet to kick in (which was often the case), the console operator would instruct the winch to slow to 15 m/min. In most cases, the altimeter kicked in approximately 20-30 m of the bottom and would be used to get to a final depth of 10m off the bottom.

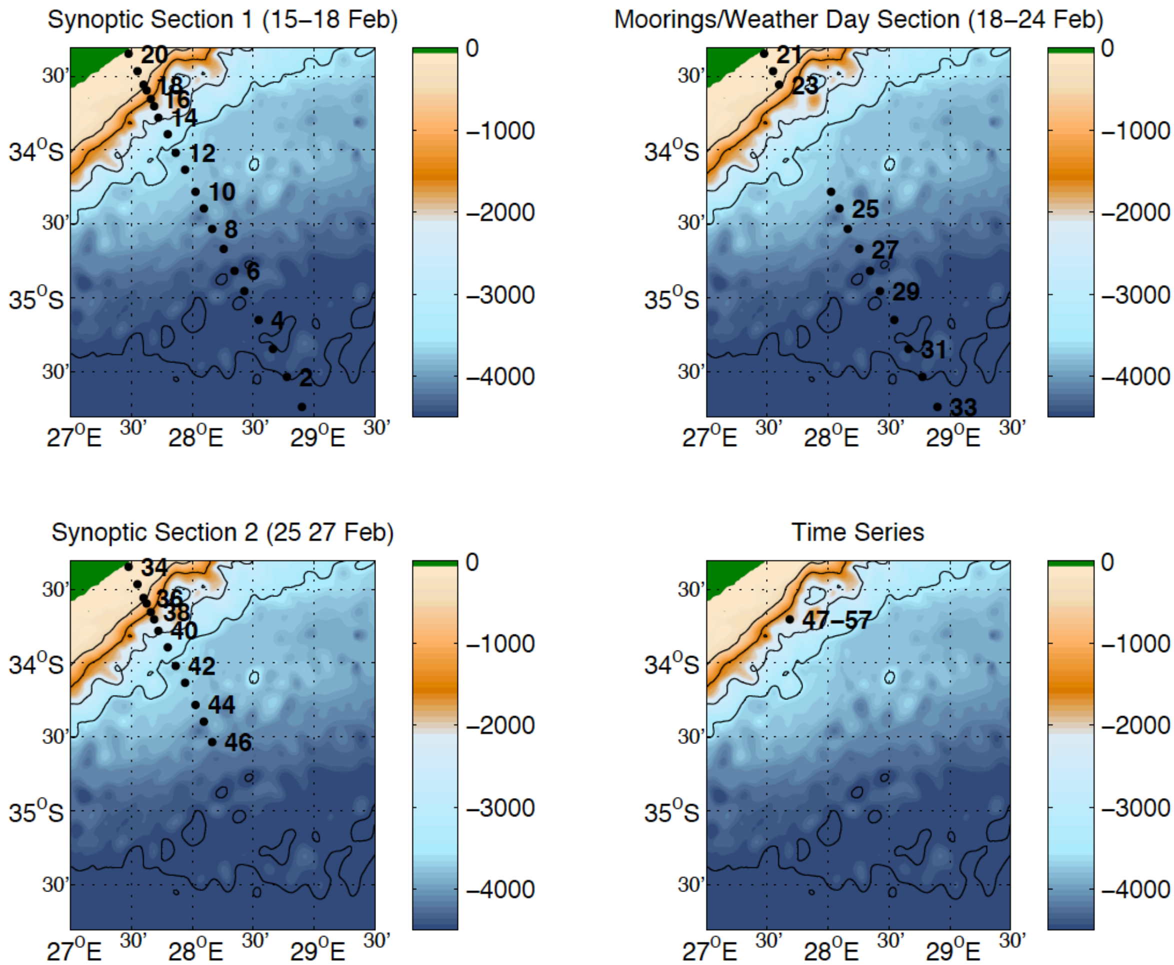


Figure 1: *Breakdown of station locations for February 2013 Agulhas Current Time Series cruise (ACT0213). Each panel gives the bathymetry in colors using the color bar on the right hand side, as well as station locations as black dots. Every other station is labeled in text next to its location. The top left panel shows the first synoptic section (station 1-20); the top right panel shows the cross-section broken up in time by mooring recoveries and in space by a weather day (stations 21-33); the bottom left panel shows the second synoptic section (stations 34-46); and the bottom right panel shows the location of the time series (stations 47-57).*

During the upcast, between 3 and 12 bottle samples were collected. Note that all 12 bottles were tripped during each cast to ensure even weight distribution of the rosette upon recovery, but that not all 12 were sampled. The first bottle was always tripped at the bottom, and last was tripped within 30-m of the surface. In between, bottles were tripped at staggered depths between each cast. Prior to tripping the bottle, the console operator waited at least 30 s to make sure that the rosette's shed wake had dissipated. After tripping, the console operator waited at least 10 s to ensure adequate time for the SBE35 to take a reading.

After all bottles had been tripped, the console operator would instruct the winch to bring the rosette to the surface and that the package was ready for recovery. At this point, the control would be given to the deck watch and the winch operator. The deck watch would set up poles and snap hooks attached to tag lines. The deck leader would instruct the winch operator to bring the package out of the water. The deck watch would then hook the frame and use tuggers to take the slack out of the tag lines as the rosette was lowered onto the air-powered cart. Once on deck, the console operator would stop data acquisition. The package was then secured to the cart using ratchet straps, and the cart was moved into the hangar where the deck watch would proceed to draw salinity and oxygen samples.

4 Data Acquisition and Processing

The data acquisition setup included three PCs running Linux. One of these PCs, designated the console, was connected to the deck unit. The console was used to observe incoming data using graphical displays, as well as to trigger bottles. During each cast, shipboard CTD data processing and backups were performed automatically. The automatic data processing consisted of applying laboratory calibrations for pressure, temperature and conductivity. Upon completion of any one cast, a series of data processing steps took place manually. This included checking the 0.5 s time series data for calibration shifts and consistency (comparing the primary and secondary sensors). Then, a 2-db pressure series was created from the down cast only. Salinity and Oxygen data was compared along isopycnal surfaces between up and down casts as well as with adjacent stations. Vertical cross-sections of temperature, salinity, and oxygen were plotted and checked for consistency. Both the 2-db pressure series and the 0.5 s time series were then placed on the shipboard cruise website.

5 Issues Affecting Data Quality

Prior to beginning the test cast (998/01), the 12-place carousel that was installed on the CTD package was replaced with a 24-hook carousel (S/N 3231095-0450) so that the lanyard lines did not interfere with the LADCP signal. In order to change the carousel, a new cable was spliced to work with the 24-hook configuration. During the test cast, there were several bugs in the CTD acquisition software, which were fixed after the cast was completed. Once the rosette was back on deck it was noted that almost all of the spigots were not closed completely.

During bottom station 001/01 bottom approach, the altimeter (Tritech 250m S/N 221666) did not work. During the upcast when bottle 6 was fired (wire out: 3180), the system froze. It was observed that the Reset button on the CTD box was pushed accidentally. The computer was restarted and the remaining upcast was saved as 001/02. Following the cast, the Tritech altimeter was switched out for a Benthos altimeter (S/N: 1182). During the next casts bottom approach (002/01), the altimeter worked o↲ and on, ultimately kicking in around 50 m off the bottom. The signal was still noisy so that a plot of the altimeter was necessary to gauge distance off the bottom. At the bottom of the cast, bottles 1 and 2 were both fired (2 fired accidentally by operator). For stations 003/01 and 004/01 the altimeter worked off and on, but for station 005/01 it appeared as though the altimeter was not kicking in at all and so the cast was stopped 25 m above the bottom. After the cast, it was realized that the Knudsen depth was not sound speed corrected and was probably giving a depth about 20 m shallower than the actual depth. However, the altimeter was switched out for a second Benthos altimeter (S/N 41631), and the Tritech (S/N 221666) was added back on as a secondary altimeter sensor. During station 006/01 bottom approach, the Tritech again didn't work. The Benthos kicked in at 20-m off the (sound-speed corrected) bottom. It was decided that we should slow down to 15 m/min descent rate close to the bottom to allow the altimeter to kick in.

During station 008/01 upcast, bottles 22-24 did not trip. Though the operator pushed the trip button, the bottles were still cocked upon recovery. It was noted that on the bottle trip screen, bottles 22-24 showed a negative confirmation. During station 009/01 upcast, bottles 18-24 did not trip. Initially, the problem was believed to be a software issue because the program was not closing the bottles. It was eventually discovered that one of the wire ties connecting the new altimeters cable to the package was close to the splice in the manufactured cable, and was probably interrupting the signal. During station 010/01, a trial bottle trip at 10-m did not work so the CTD was recovered and the CTD replaced with one from WHOI (S/N 462). The WHOI CTD was configured for a 24-hook rosette and do did not need the spliced cable. However, it lacked a cable for the SBE 35. During the cast, a new cable to connect the SBE 35 was being manufactured. Therefore, there was no SBE 35 for cast 010/01. The WHOI rosette also did not allow for two altimeters so the Tritech (S/N 221666) was removed. During 010/01, temperature 1 and 2, and conductivity 1 and 2 both differed from each other by about 0.1. After the cast, it was realized that a tube was left on the rosette and connected to the oxygen sensor, meaning that the oxygen data collected was corrupted. This tube also corrupted both primary sensors (temperature and conductivity), so that all viable temperature and conductivity data for 010/01 comes from the secondary sensors only. Following this diagnosis, the sensors were flushed. During cast 011/01, the cable to reconnect the SBE35 was still not ready, but it was reconnected for cast 012/01.

During cast 014/01, the wire difference with depth was 180 m so the down cast was terminated 20 m o↵ the bottom. During 016/01 and 032/01, Bottle 24 was not fired due to operator error. During 041/01 bottom approach, the screen showing wire out, tension, etc. flashed off and on, the altimeter did not kick in, the Knudsen depth was unreliable, and the multibeam depth was fluctuating between 3125 and 3210 m. Therefore, there was no way to know distance off the bottom. Final uncorrected depth was 3014-m (showing 3380 at cast bottom), and maximum rosette depth was 3157-m. Similarly, during bottom approach of cast 054/01, there was a large wire angle and more than 300 m excess wire let out (wire out of 2030 for depth of 1693). Final distance above bottom was 40 m. Again, during bottom approach of cast 049/01, wire difference with depth was growing exponentially. Over 50-m of wire was let out and the rosette dropped less than 10-m. Cast bottom uncorrected depth was 1667, and the rosette maximum depth was 1679 m. Altimeter was working but was probably angled due to excess wire, and final distance above bottom was 19-m.

During the down cast of 048/01, the winch stopped at 119 wire out at a depth of 116- m. The ship repositioned to change its heading and speed to correct a large wire angle. Cast resumed at 9:56 GMT. During the cast 049/01 upcast, the bridge asked the winch to slow to 20 m/min because the winch block was bouncing up and down. After slowing, the block slowly stopped jumping but the wire angle became large. After correcting for the wire angle, the winch increased speed and the block began to jump again. After slowing again to stop the jumping, the cast resumed normally. After recovery on deck, it was noted that the wire was beginning to separate and it was switched out for a second wire. Shortly after deployment for cast 056/01, it was noticed that the winch block was jumping again. The winch was stopped at 591 m wire out until the vibrations stopped.

After restarting, the jumping started up again and the winch stopped at 638 m wire out until the vibrations stopped. Again, as soon as the winch started up again, the block began to jump. The block bounced o↵ and on with a large wire angle. The bridge instructed the winch to slow to 40 m min^{-1} to try and correct the jumping. By 1000 m wire out, the jumping was mostly gone and the remainder of the downcast was taken at 40 m min^{-1}. There were no issues during the upcast and winch speed was 60 m min^{-1} throughout the up cast.

6 Preliminary Results

Figures 2 through 4 show temperature, salinity and oxygen respectively for both synoptic lines. These lines were sampled continuously and give a synoptic view of water mass properties across the Agulhas Current. Figure 5 shows temperature and salinity for the time series data (stations 47-57).

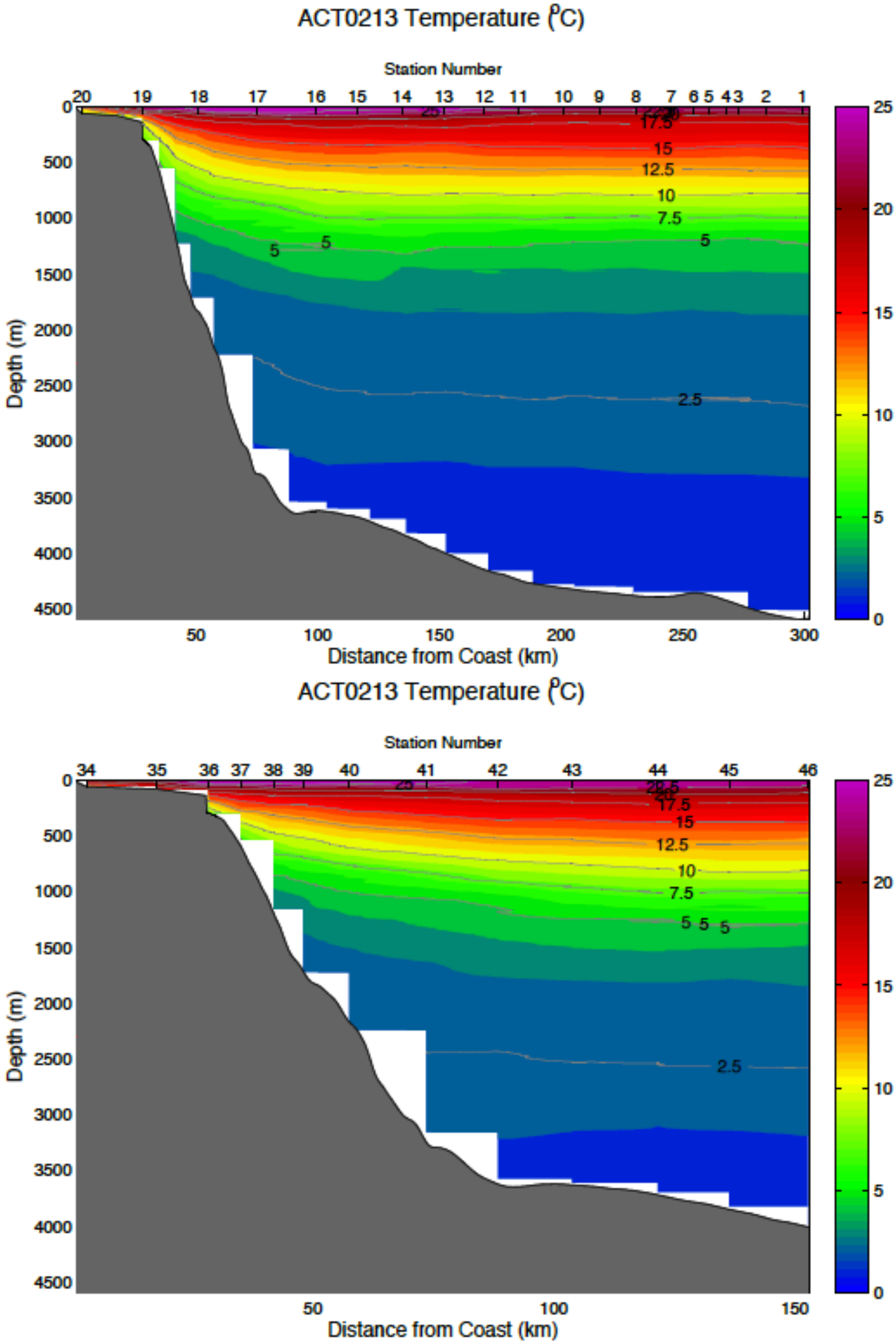


Figure 2: *Temperature cross-sections for stations 1-20 (top) and stations 34-46 (bottom) of the first and second synoptic sections from ACT0213. Colors show temperature in "C using the color bar on the right.*

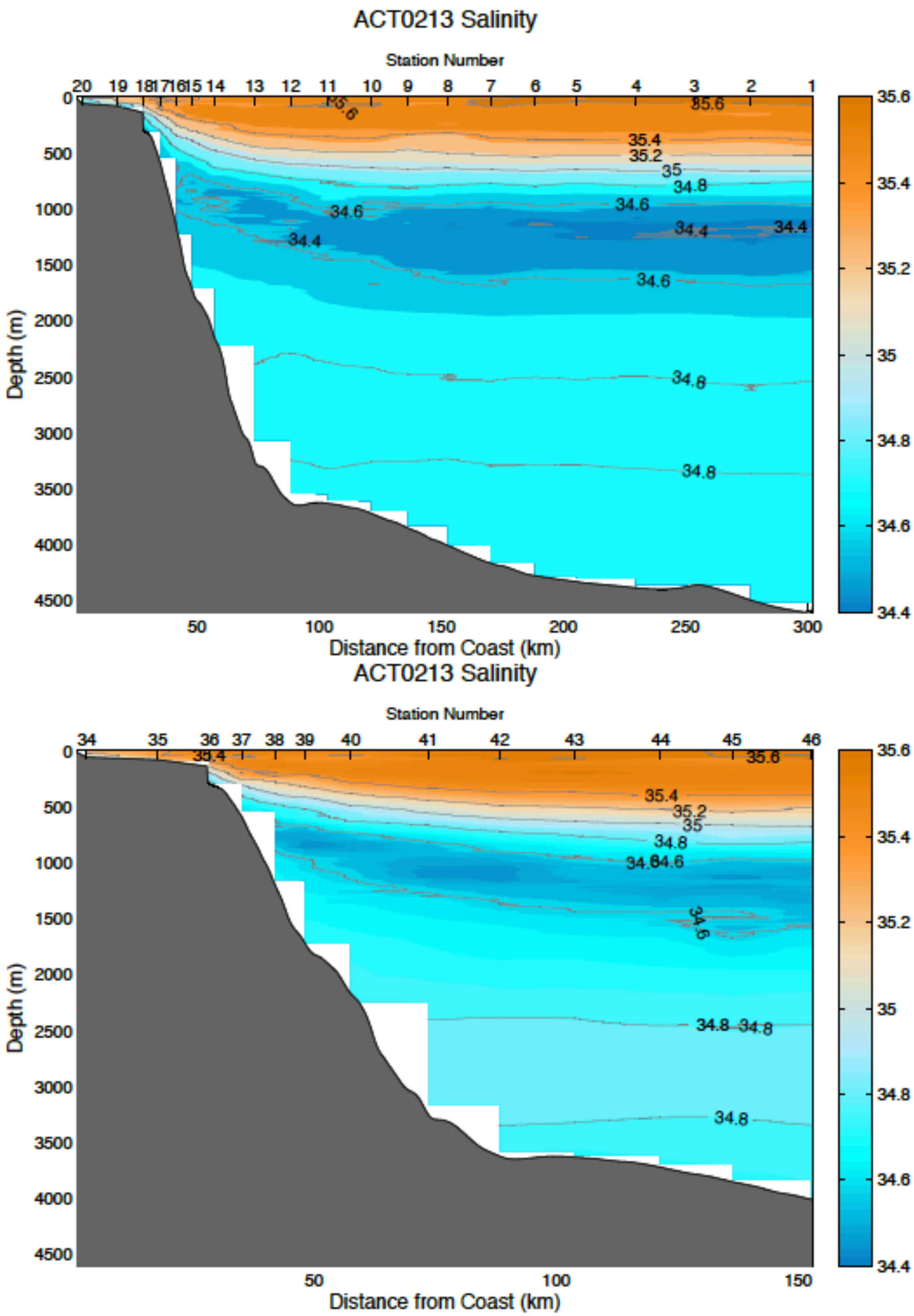


Figure 3: *Salinity cross-sections for stations 1-20 (top) and stations 34-46 (bottom) of the first and second synoptic sections from ACT0213. Colors show salinity using the color bar on the right.*

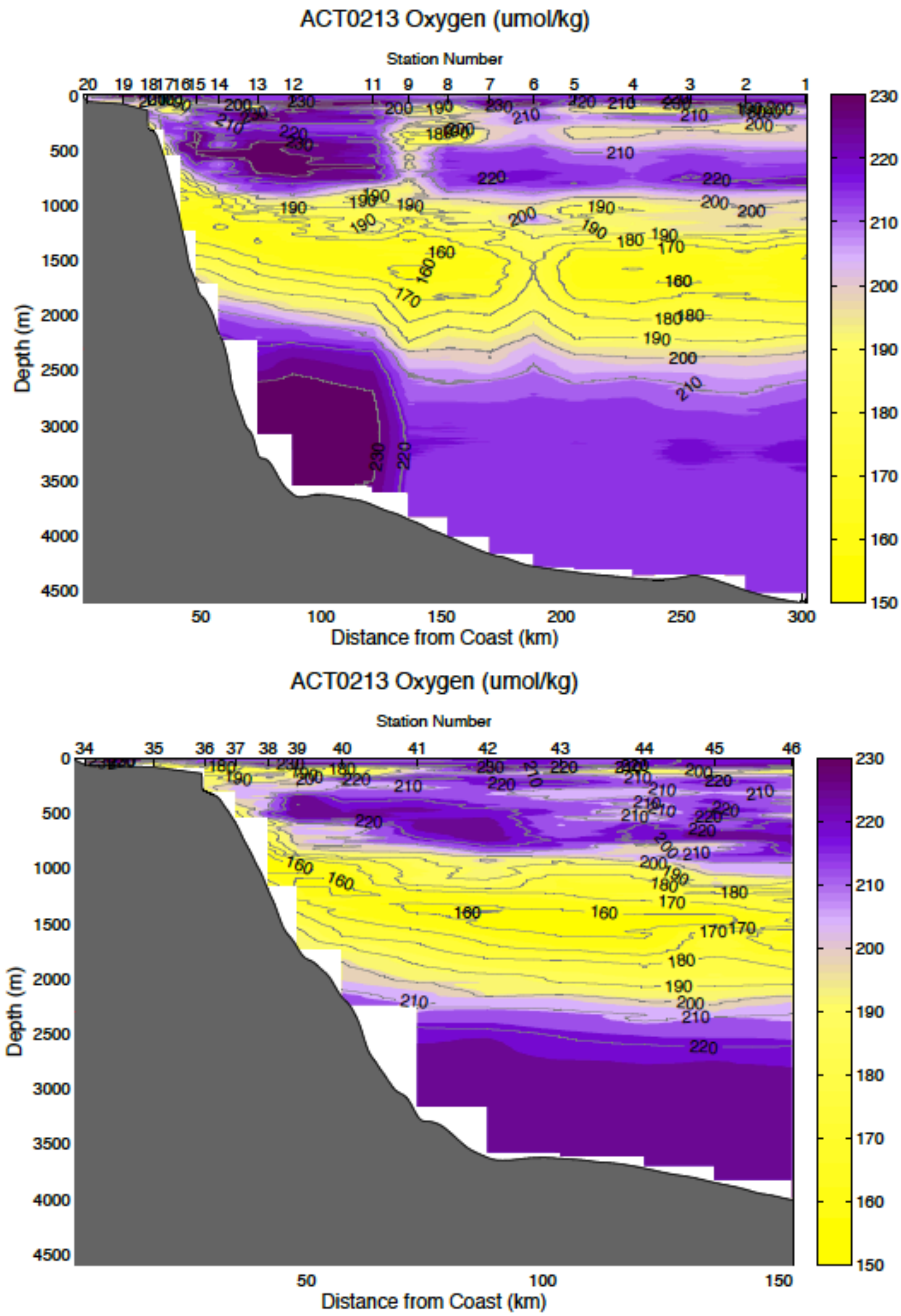


Figure 4: *Oxygen cross-sections for stations 1-20 (top) and stations 34-46 (bottom) of the first and second synoptic sections from ACT0213. Colors show oxygen in µmol/kg using the color bar on the right.*

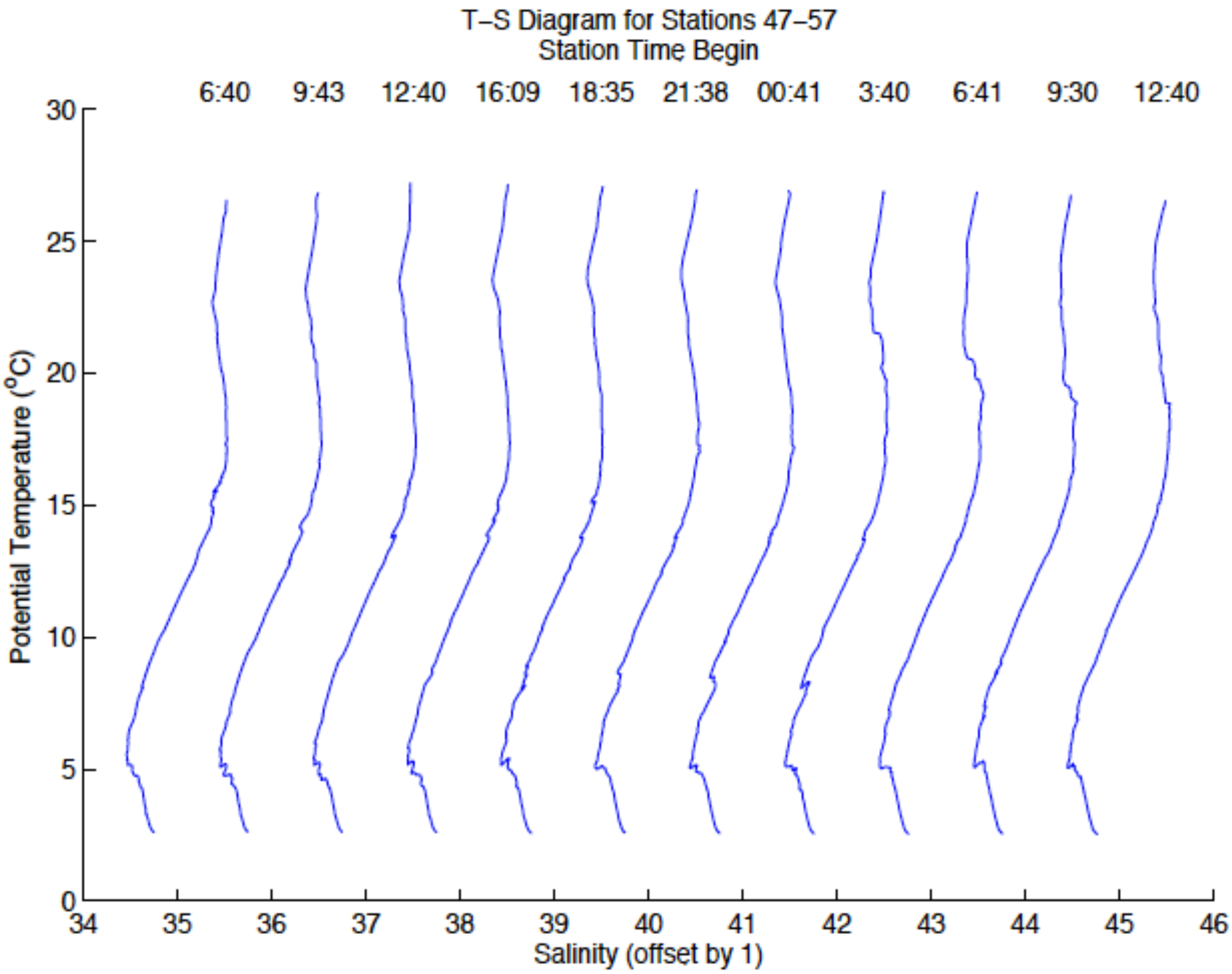
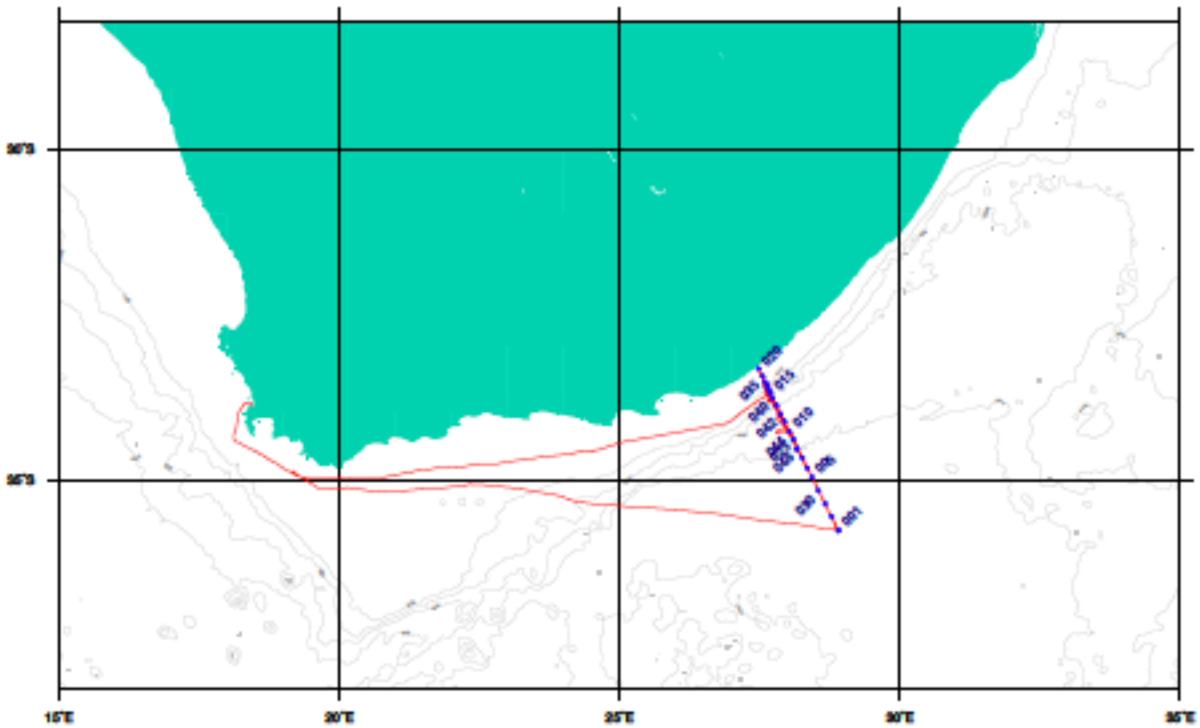


Figure 5: *Temperature and Salinity (offset by 1) for stations 47 through 57 from left to right. Start time for each cast is given by the top axis starting on 27 February 2013 and ending on 28 February 2013.*

R/V *Knorr*, KN197-6

13 February 2013 to 03 March 2013
Cape Town, South Africa - Cape Town, South Africa
Chief Scientist: Dr. Lisa Beal
Rosenstiel School of Marine and Atmospheric Science.



Cruise Report

02 March 2013
Data Submitted by:
Oceanographic Data Facility, Computing Resources and Research Technicians
Shipboard Technical Support/Scr ipps Institution of Oceanography
La Jolla, CA 92093-0214

Summary

A hydrographic survey consisting of Rosette/CTD/LADCP sections, underway shipboard ADCP in the Agulhas was carried out early 2013. The R/V *Knorr* departed Cape Town, South Africa on 13 February 2013.

57 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 5-40 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 03 March 2013.

Description of Measurement Techniques

1. CTD/Hydrographic Measurements

ACT0213 Hydrographic measurements consisted of salinity, dissolved oxygen water samples taken from most of the 57 Rosette casts. Pressure, temperature, conductivity/salinity, dissolved oxygen, data were recorded from CTD profiles. The distribution of samples is shown in the following 4 figures.

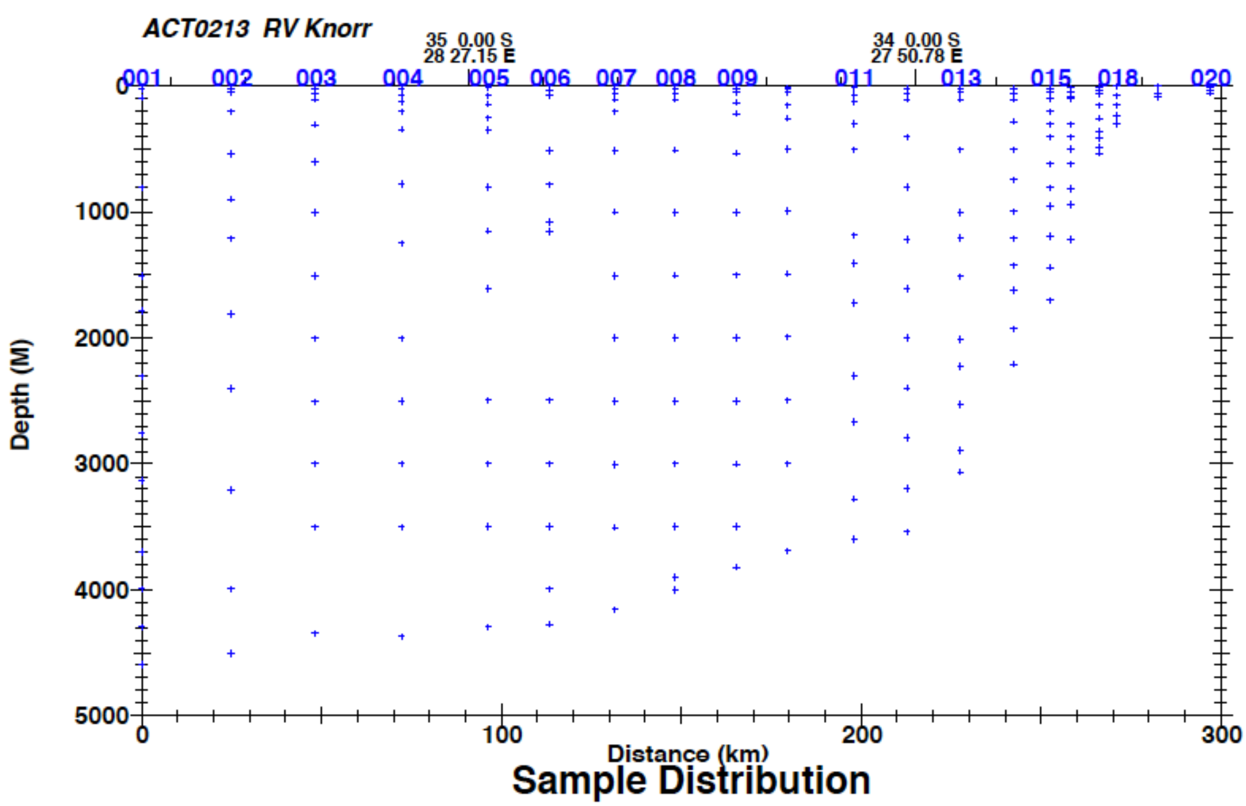


Figure 1.0 *ACT0213 Sample distribution, stations 1-20.*

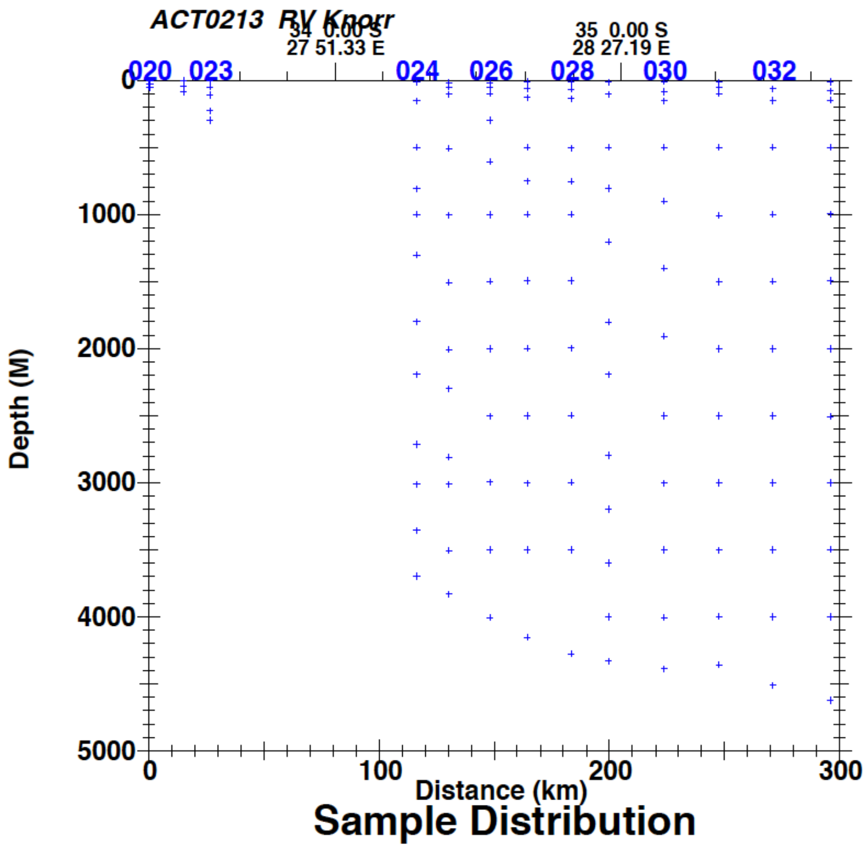


Figure 1.0: *ACT0213 Sample distribution, stations 21-33.*

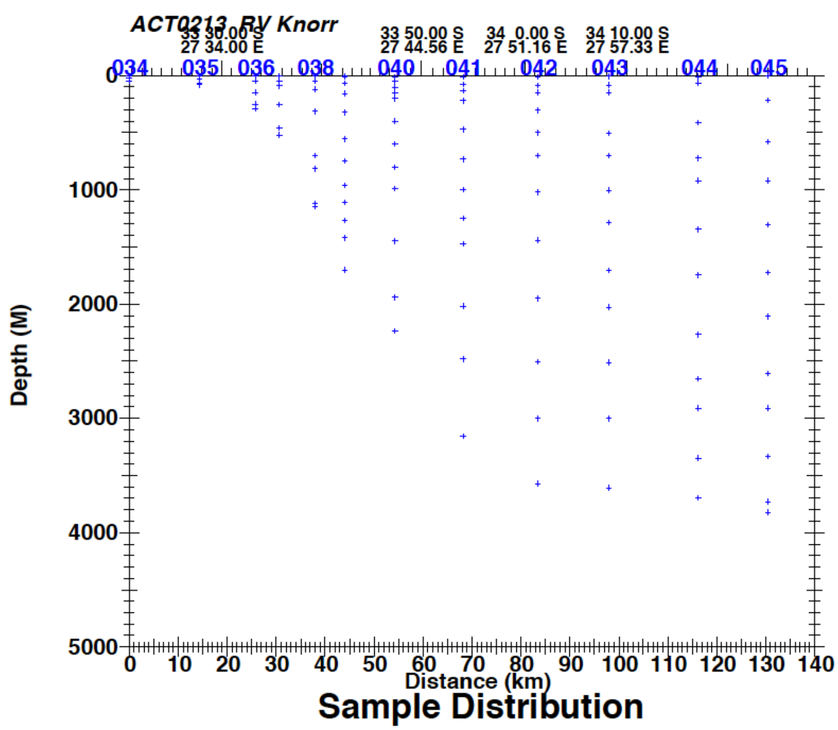


Figure 1.0 *ACT0213 Sample distribution, stations 34-46*

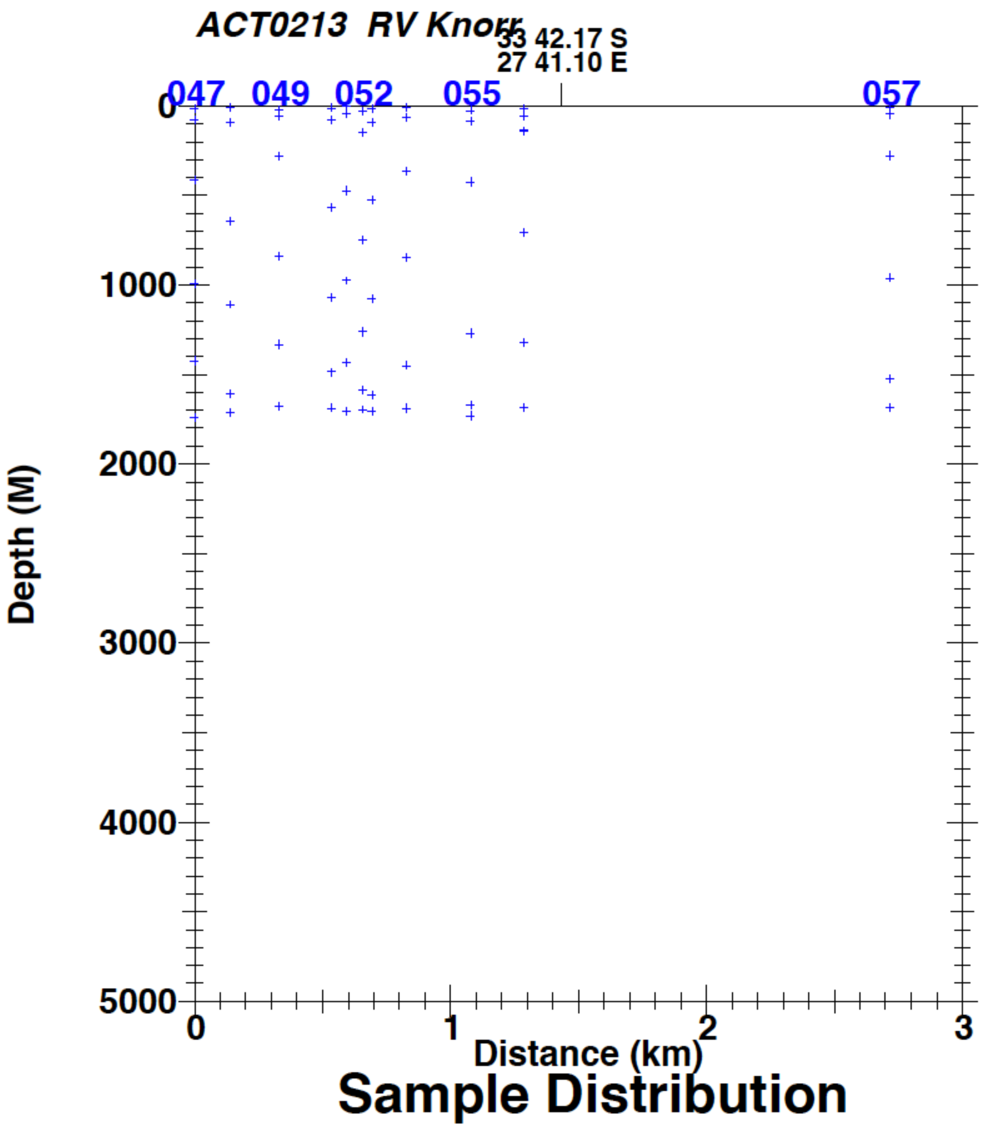


Figure 1.0 *ACT0213 Sample distribution, stations 47-57*

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 SBE9plus CTD with dual pumps (SBE5), dual temperature (SBE3plus), single dual conductivity (SBE4C), dissolved oxygen (SBE43), altimeter.

The CTD was mounted vertically in an SBE CTD cage attached to the bottom of the rosette frame and located to one side of the carousel. The SBE4C conductivity, SBE3plus 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 mounted on the bottom of the 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 just above termination. Kink was from an unknown source. 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 airpowered 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 squirt-boom 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 5-40 meters of the bottom, using the altimeter, winch pay-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 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 February 13, 2013.

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.

The SBE9plus CTD was connected to the SBE32 24-place carousel providing for single-conductor sea cable operation. The sea cable armor was used for ground (return). Power to the SBE9plus CTD (and sensors), SBE32 carousel, Benthos PSA-916 100m altimeter and Tritech 250m altimeter.

Table 1.3.0 *ACT0213 Rosette Underwater Electronics.*

Instrument/Sensor	Mfr./Model	Serial Number	A/D Channel	Stations Used
Carousel Water Sampler	Sea-Bird SBE32 (24-Pl.)	3231095-0450	n/a	1-57
CTD	Sea-Bird SBE9plus	830	n/a	1-9
Pressure	Paroscientific Digiquartz	58952	n/a	1-9
CTD	Sea-Bird SBE9plus	462	n/a	10-57
Pressure	Paroscientific Digiquartz	99676	n/a	1-9
Primary Temperature (T1)	Sea-Bird SBE3plus	03P-2333	n/a	1-9
Primary Temperature (T1)	Sea-Bird SBE3plus	03P-4360	n/a	10-57
Primary Conductivity (C1)	Sea-Bird SBE4C	04-1744	n/a	1-9
Primary Conductivity (C1)	Sea-Bird SBE4C	04-3042	n/a	10-57
Dissolved Oxygen	Sea-Bird SBE43	43-1136	Aux4/V6	1-9
Dissolved Oxygen	Sea-Bird SBE43	43-0113	Aux3/V5	10-57
Primary Pump	Sea-BirdSBE5T	05-3245	n/a	1-9
Primary Pump	Sea-BirdSBE5T	05-5284	n/a	10-57
Secondary Temperature (T2)	Sea-Bird SBE3plus	03P-4532	n/a	1-9
Secondary Temperature (T2)	Sea-Bird SBE3plus	03P-2774	n/a	10-57
Secondary Conductivity (C2)	Sea-Bird SBE4C	04-2115	n/a	1-9
Secondary Conductivity (C2)	Sea-Bird SBE4C	04-3089	n/a	10-57
Secondary Pump	Sea-Bird SBE5T	05-2788	n/a	1-9
Secondary Pump	Sea-Bird SBE5T	05-3107	n/a	10-57
Altimeter	Tritech, 250m	221666	Aux3/V4	1
Altimeter	Benthos, 100m	1182	Aux3/V4	2-5
Altimeter	Benthos, 100m	1247	Aux3/V4	5-57
Altimeter	Tritech, 250m	221666	Aux2/V2	5-9
Reference Temperature	Sea-Bird SBE35	35-0034	n/a 1-8	12-57
Deck Unit (in lab)	Sea-Bird SBE11	11P-0384	n/a	1-57

1.4. CTD Data Acquisition and Rosette Operation

The CTD data acquisition system consisted of an SBE-11plus (V2) deck unit and two networked generic PC workstations running CentOS-5.8 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 manually.

Once the deck watch had deployed the rosette, the winch operator lowered it to 10 meters. The CTD sensor pumps were configured with a 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 (pay-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 inventor y of samples drawn from the bottles. The altimeter channel, CTD depth, winch pay-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 pay-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 CTD/rosette/LADCP deployment using SIO/ODF CTD processing software during data acquisition for CTD/rosette/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 was 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.

CTD/rosette data were routinely examined for sensor problems, calibration shifts and deployment or operational problems. The primary and secondary temperature sensors (SBE3plus) 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 proper ties 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

Station 001/01 was reset midway through up-cast at 3175m on a 4700m cast after the fourth bottle had been triggered. The cast was restarted and the two resulting data files were concatenated and a 9-minute lag was removed from the meta data files. The 4 initial bottles triggered for the restart cast were omitted along with 9min lag for reporting and fitting purposes but preserved in backup data files. The reset continued to be problematic for bottle data alignment against the CTD values at same depth. The low gradient region bottles were coded questionable and omitted from fitting routine.

The Tritech altimeter was used on cast 001/01 and again from casts 005/01-009/01. It held a steady 5V signal throughout casts without typical noise disruption. It is believed the signal was not recognized by the acquisition software. 3 Benthos model 916s were employed on all casts. Benthos S/N 1182 was used 002/01-005/01, S/N 41631 for casts 005/01-009/01. Benthos 1182 responded at depths < 30m above bottom. It is believed that casts were reaching depths > 30m off bottom due to a large error in Knudsen system settings thus the initial S/N 1182 had not performed consistently.

After station 009/01 cable communications failed to the carousel on the eighth consecutive bottle trigger. After review of casts 008/01 it was found a similar communications failure had been noted by console operator for trips 11 and 12 and miss reported as lanyard misalignment by deck technicians. In the interest of saving time a back-up CTD was used for the remainder of the cruise, casts 010/01-057/01. After 009/01 SBE35RT was returned to use on cast 0012/01 once an adapter cable could be constructed for the alternate CTD/carousel unit.

After the alternate CTD was put in use it was found that the primary plumb line had not been connected through SBE43 to SBE5T. Initially it was believed the software configuration files were incorrect. Secondary temperature and conductivity were sound fit and reported. Dissolved oxygen was not reported for cast 010/01.

Numerous miss-trips were noted on console logs and omitted from fitting routine.

1.7. CTD Sensor Laboratory Calibrations

Laboratory calibrations of the CTD pressure, temperature, conductivity and dissolved oxygen sensors were performed prior to ACT0213. The calibration dates are listed in table 1.7.0.

Table 1.7.0: *ACT0213 CTD sensor laboratory calibrations.*

Sensor	S/N	Calibration Date	Calibration Facility
Paroscientific Digiquartz Pressure	830/99686	15 Nov 2012	STS/ODF
Sea-Bird SBE3plus T1 Temperature	03P-2333	08 Nov 2012	STS/ODF
Sea-Bird SBE3plus T2 Temperature	03P-4532	06 Nov 2012	STS/ODF
Sea-Bird SBE4C C1 Conductivity	04-1744	07 Dec 2012	SBE
Sea-Bird SBE4C C2 Conductivity	04-2115	07 Dec 2012	SBE

Sea-Bird SBE43 Dissolved Oxygen	43-1136	06 Dec 2012	SBE
Sea-Bird SBE35 Reference Temperature	35-0034	12 Dec 2012	STS/ODF
Paroscientific Digiquartz Pressure	462/58952	15 Mar 2012	SBE
Sea-Bird SBE3plus T1 Temperature	03P-4532	21 Dec 2012	SBE
Sea-Bird SBE3plus T2 Temperature	03P-2774	21 Dec 2012	SBE
Sea-Bird SBE4C C1 Conductivity	04-3042	29 Nov 2012	SBE
Sea-Bird SBE4C C2 Conductivity	04-3089	29 Nov 2012	SBE
Sea-Bird SBE43 Dissolved Oxygen	43-0113	18 Dec 2012	SBE
Sea-Bird SBE35 Reference Temperature	35-0034	12 Dec 2012	STS/ODF

1.8. CTD Shipboard Calibration Procedures

During ACT CTD set up 830 was used for CTD/rosette/LADCP casts 1-9, and CTD set up 462 for stations 10-57

The SBE35RT Digital Reversing Thermometer (S/N 3528706-0034) served as an independent calibration check for T1 and T2 on stations 1-9 and 12-57 In-situ salinity and dissolved O2 check samples collected dur ing each cast were used to calibrate the conductivity and dissolved O2 sensors.

Rapid variability in the environment observed on many of the deployments in sensor and check sample comparisons. An additional metric of typical variability was inferred from comparing primary and secondary temperature data. This metric was used to filter check sample comparisons for calibration purposes.

1.8.1. CTD Pressure

The Paroscientific Digiquartz pressure transducer (S/N ?????) was calibrated in ??? 20?? at the STS/ODF Calibration Facility.

Conversion coefficients for both Paroscientific Digiquarts pressure transducers provided with-in calibrations reports were used to convert frequencies to pressure. Calibration correction slope and offset were then applied to pressures during each cast. Pre- and post-cast on-deck/out-of-water pressure offsets varied from -0.1 to -0.3db for 830 CTD setup (stations 1-9). Pre- and post-cast on-deck/out-of water pressure offsets varied from -1.3 to +3.5db for the 462 CTD setup (stations 10-57).

1.8.2. CTD Temperature

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.

Note that a temperature slope of 0.00024 was applied to each sensor to convert from the ITS-90 calibration to IPTS-68. Reported sensor data have been converted to ITS-90.

Due to alternate CTD configuration, temperature calibrations for 1-9 were applied independent of calibration for stations 10-57.

All corrections made to CTD temperatures had the form:

$$T_{cor} = T + tp_2P^2 + tp_1P + t_0$$

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

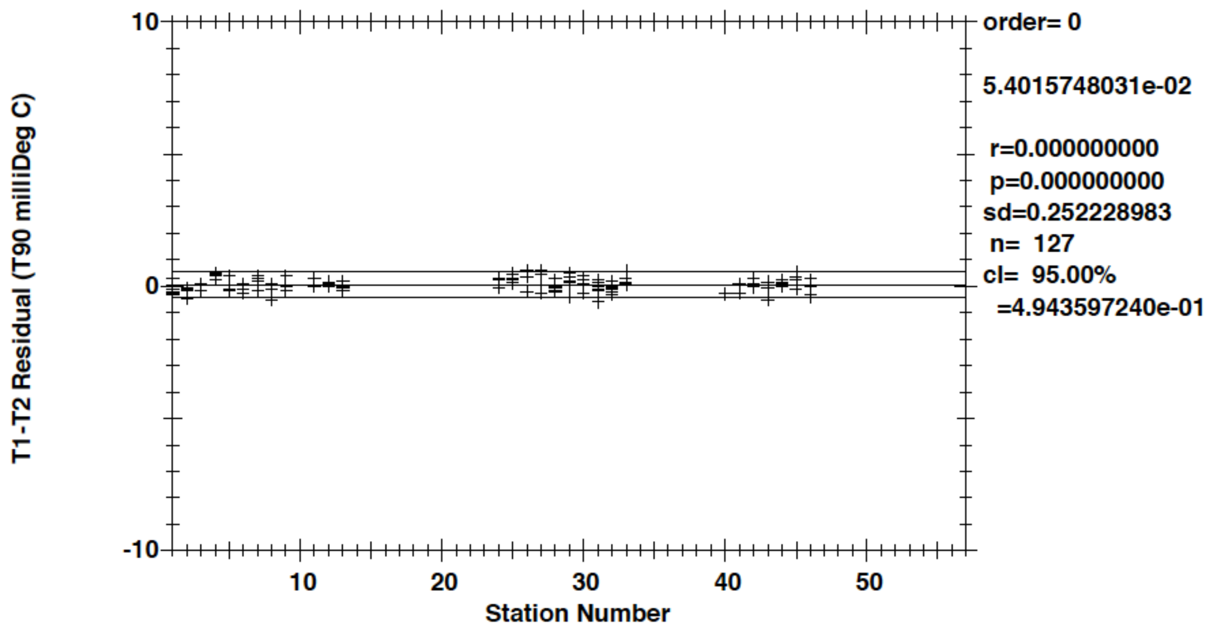


Figure 1.8.2.0: *T1-T2 by station (-0.01°C ≤ T1 -T2 ≤ 0.01°C).*

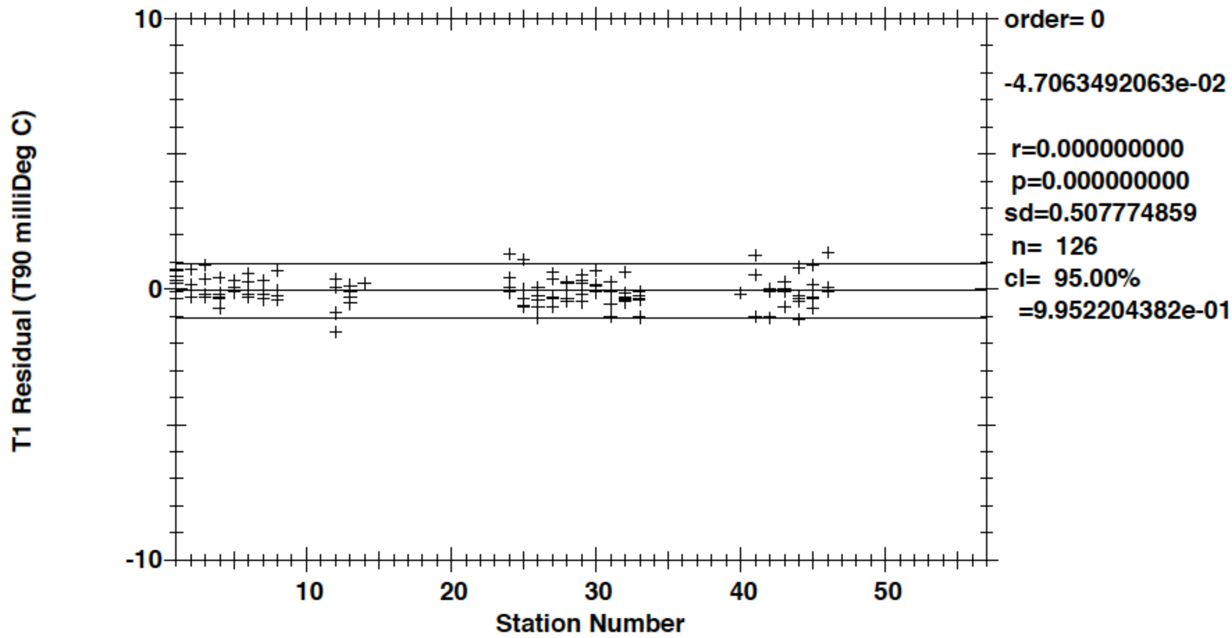


Figure 1.8.2.1: *SBE35RT-T1 by station (-0.01°C ≤ T1 -T2 ≤ 0.01°C).*

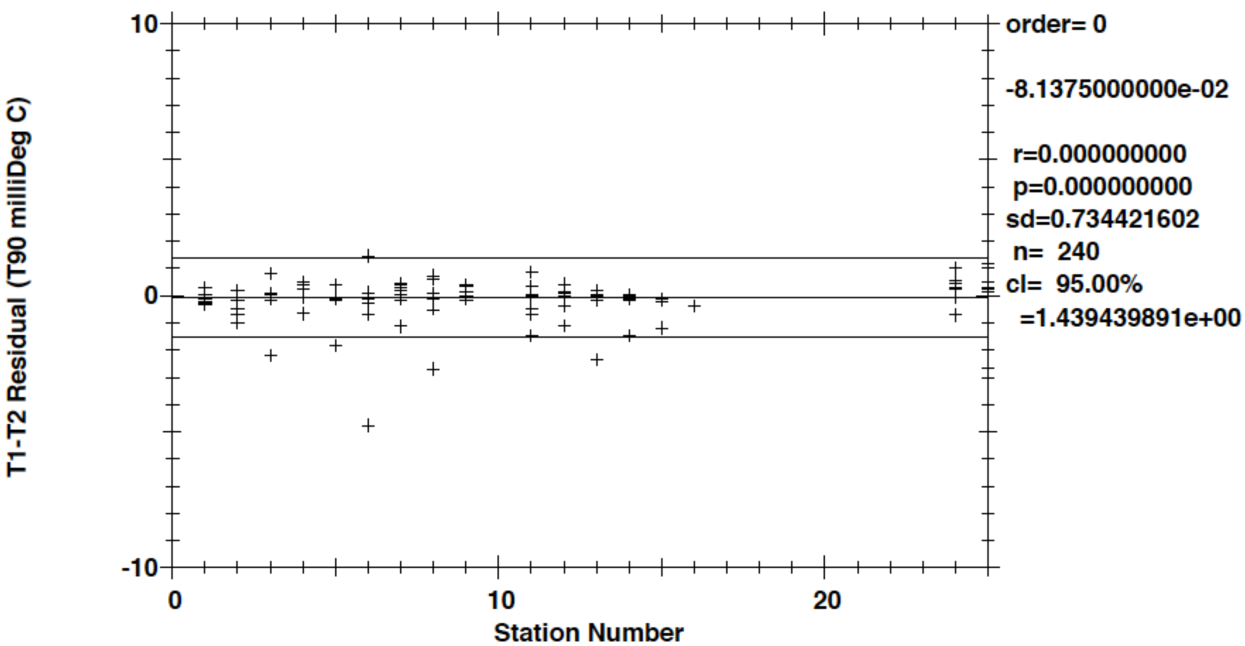


Figure 1.8.2.2: *Deep T1-T2 by station (Pressure > 1000dbar).*

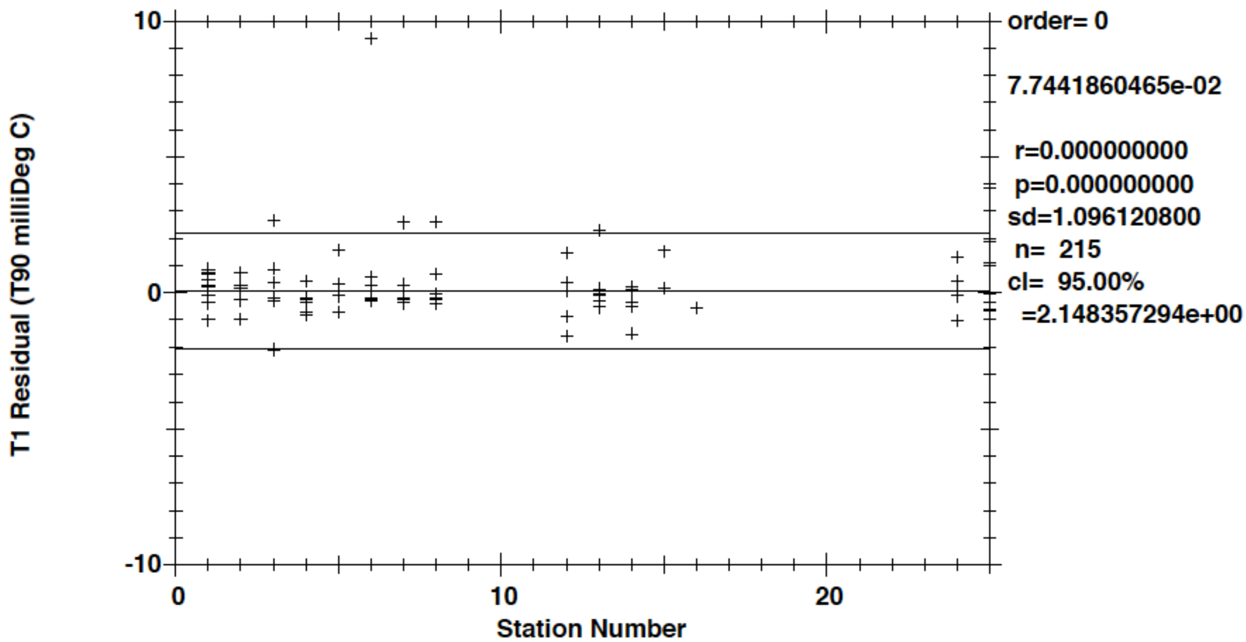


Figure 1.8.2.3: *Deep SBE35RT-T1 by station (Pressure > 1000dbar).*

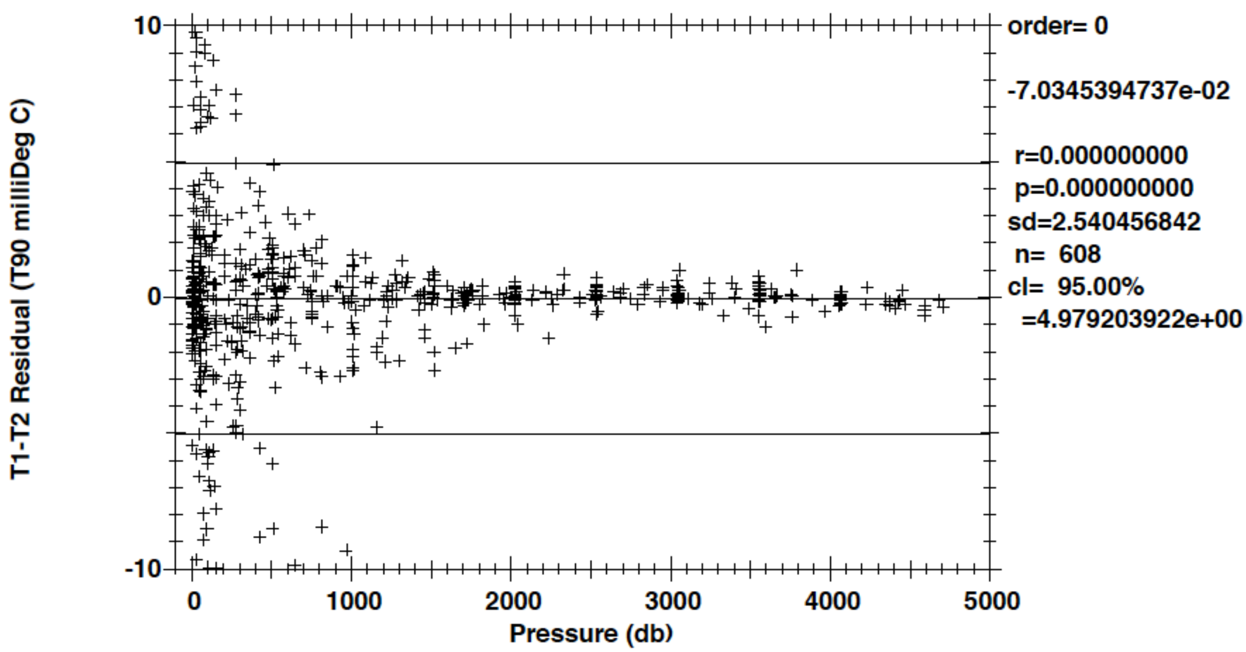


Figure 1.8.2.4: *T1-T2 by pressure (-0.01°C ≤ T1 -T2 ≤ 0.01°C).*

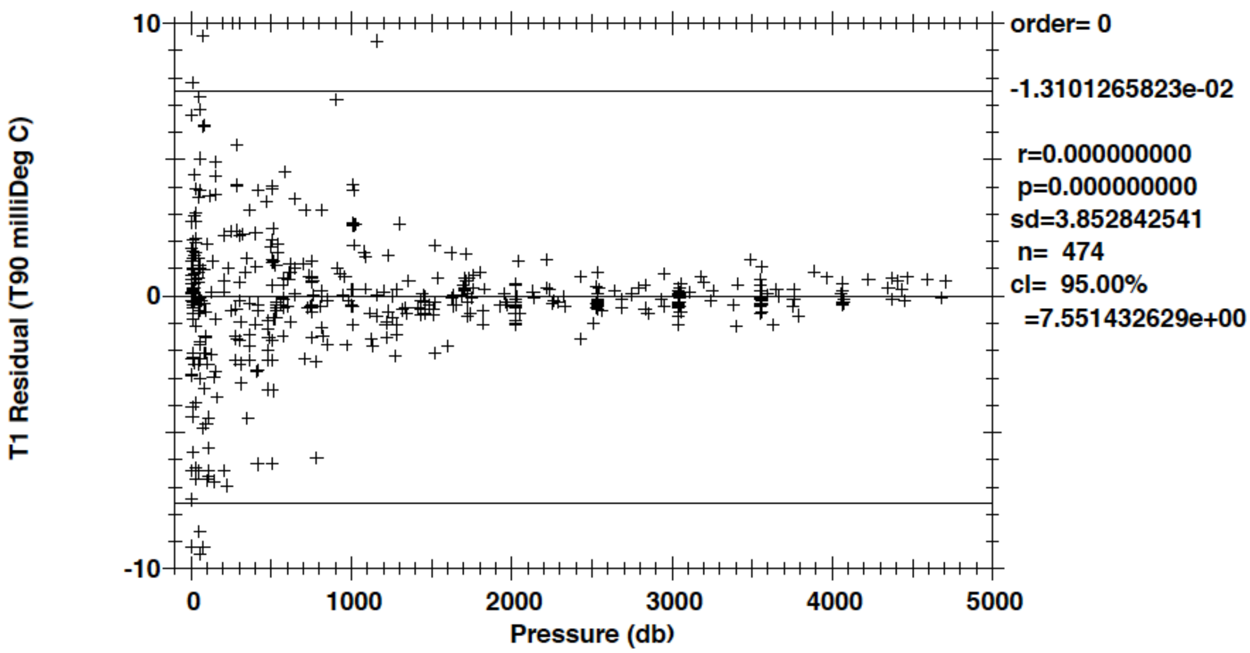


Figure 1.8.2.5: *SBE35RT-T1 by pressure (-0.01°C ≤ T1 -T2 ≤ 0.01°C).*

The 95% confidence limits for the mean low-gradient (typically pressure > 1000dbar) bottle differences are ± 0.000494°C for T1-T2, ± 0.000995°C for SBE35R T-T1.

1.8.3. CTD Conductivity

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 primar y 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.

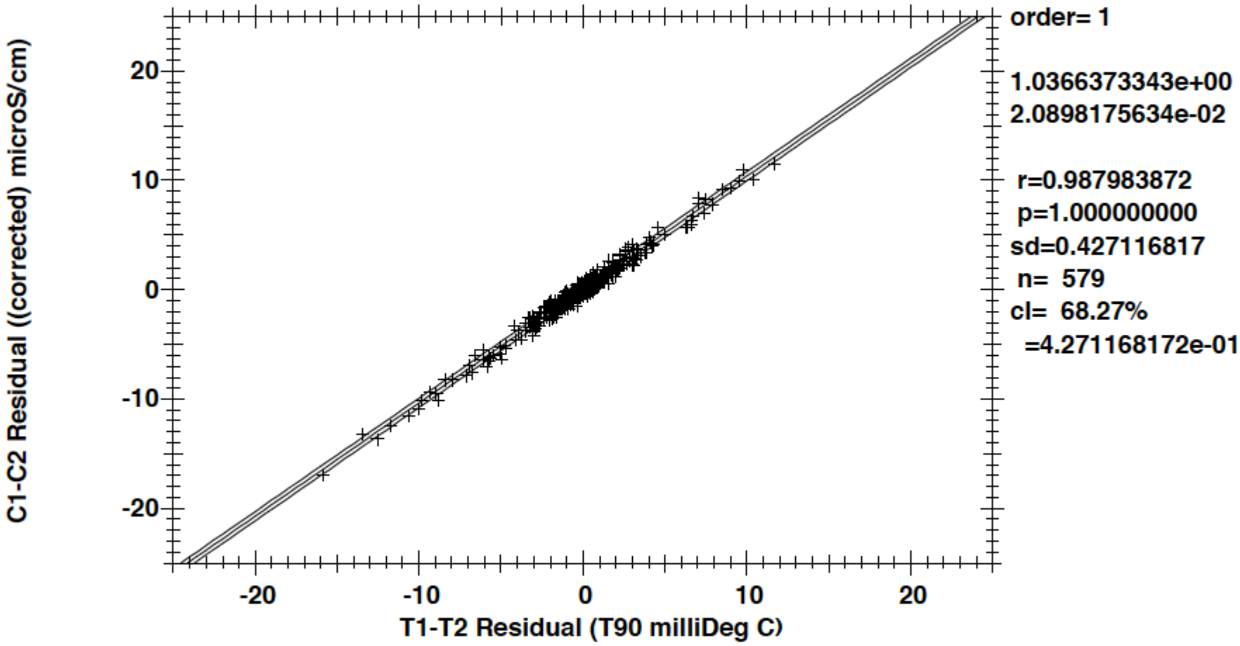


Figure 1.8.3.0: *Coherence of conductivity differences as a function of temperature differences.*

Uncorrected conductivity comparisons are shown in figures 1.8.3.1 through 1.8.3.3.

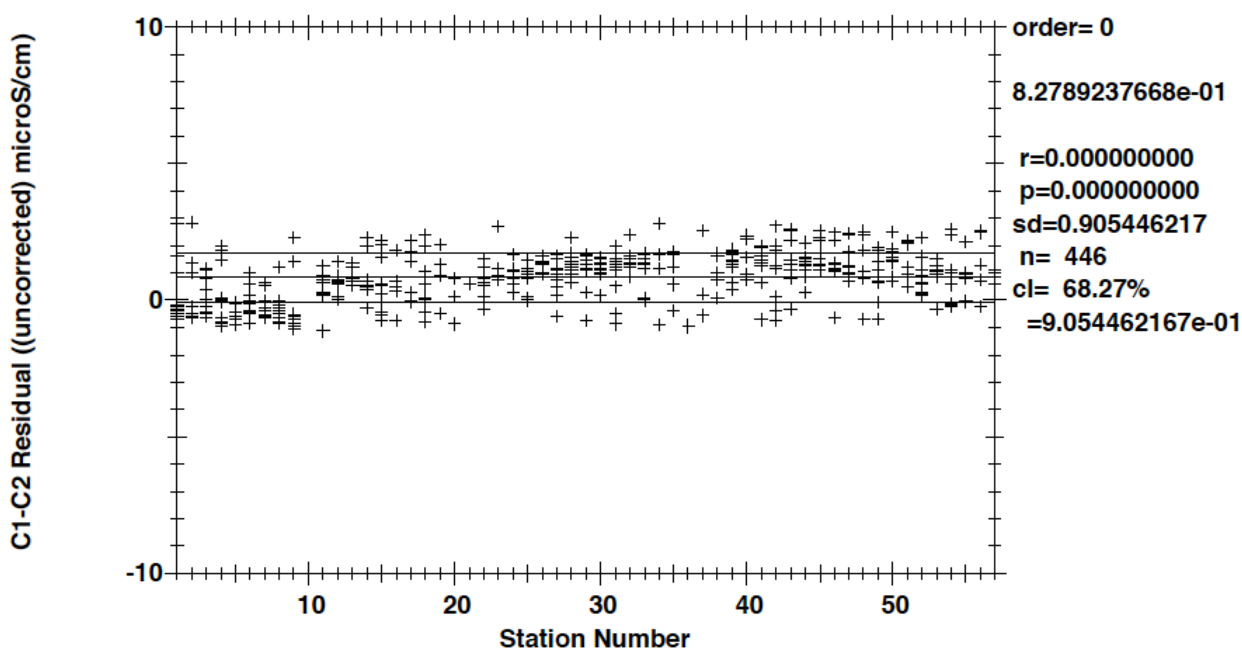


Figure 1.8.3.1: *Uncorrected C1 -C2 by station (-0.01°C ≤ T1 -T2 ≤ 0.01°C).*

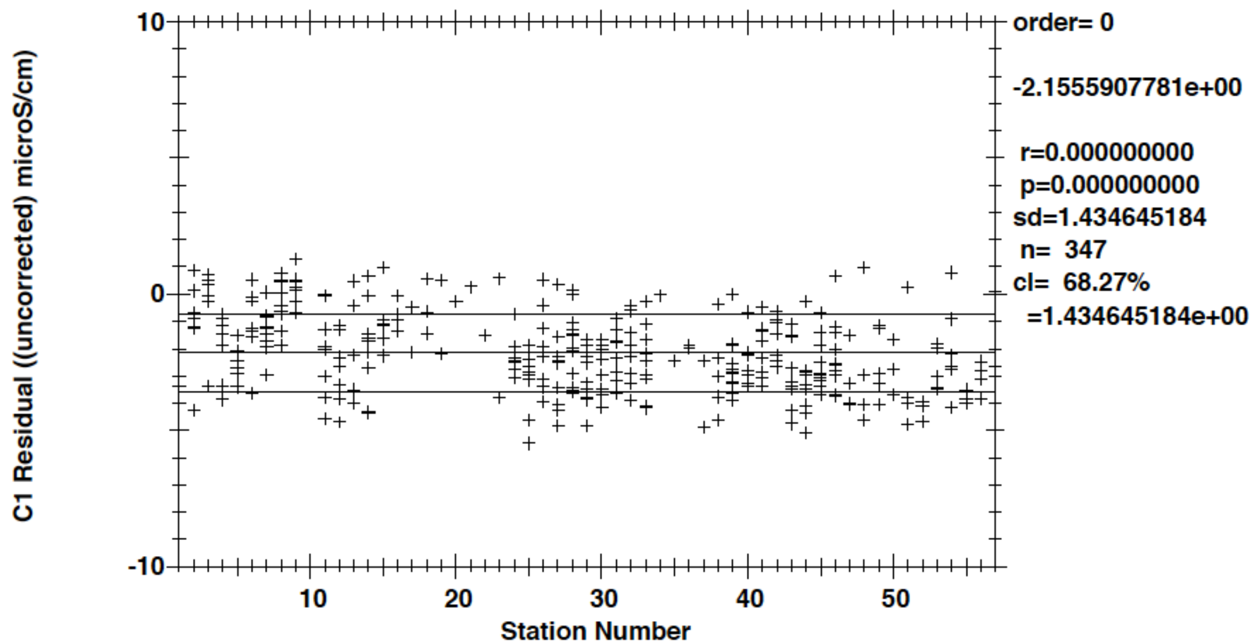


Figure 1.8.3.2: *Uncorrected C_{Bottle} -C1 by station (-0.01°C ≤ T 1 -T 2 ≤ 0.01°C).*

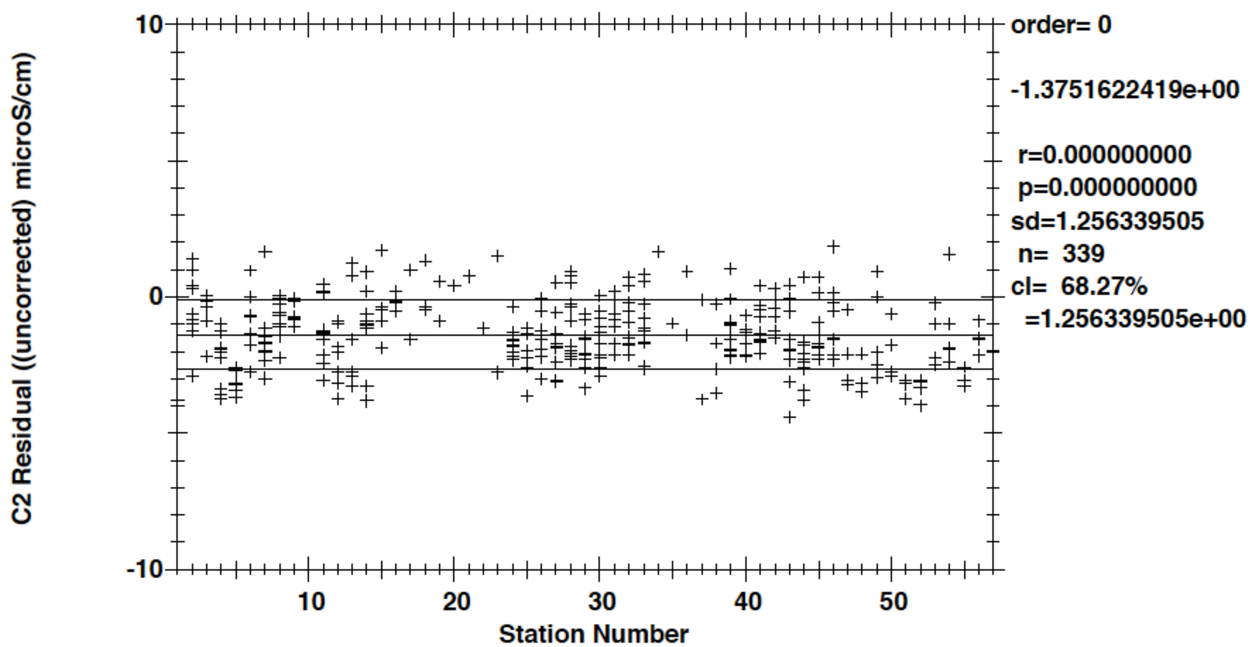


Figure 1.8.3.3: *Uncorrected C_{Bottle} -C2 by station (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

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} - CCTD 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.

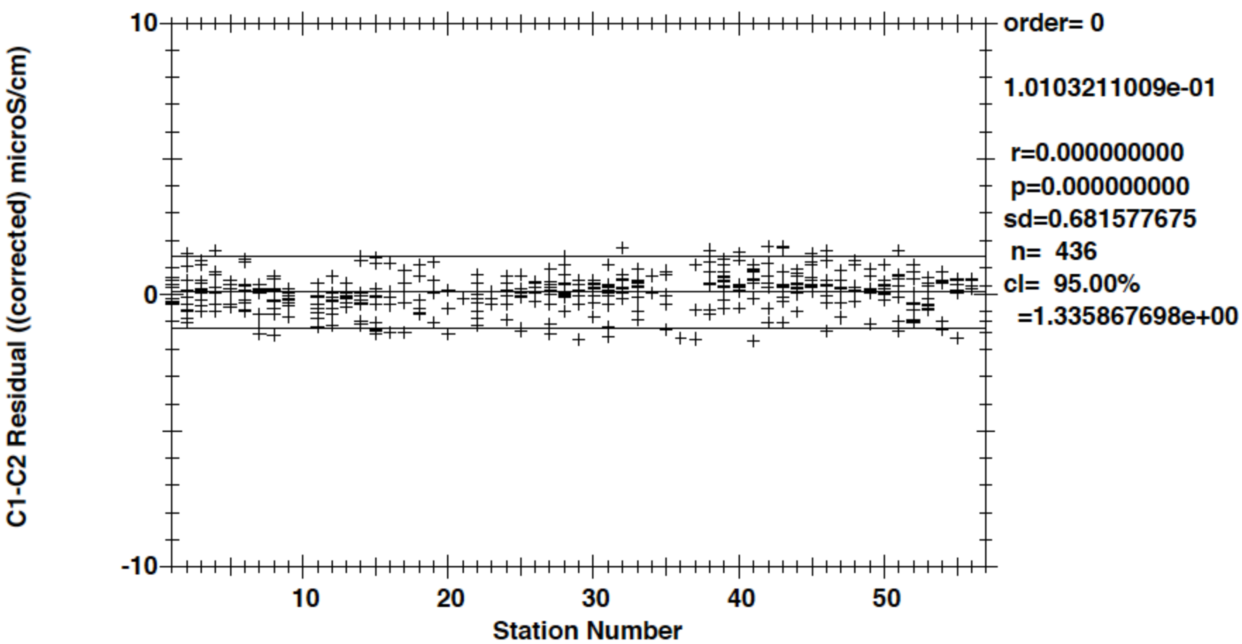


Figure 1.8.3.4: *Corrected C1 - C2 by station (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

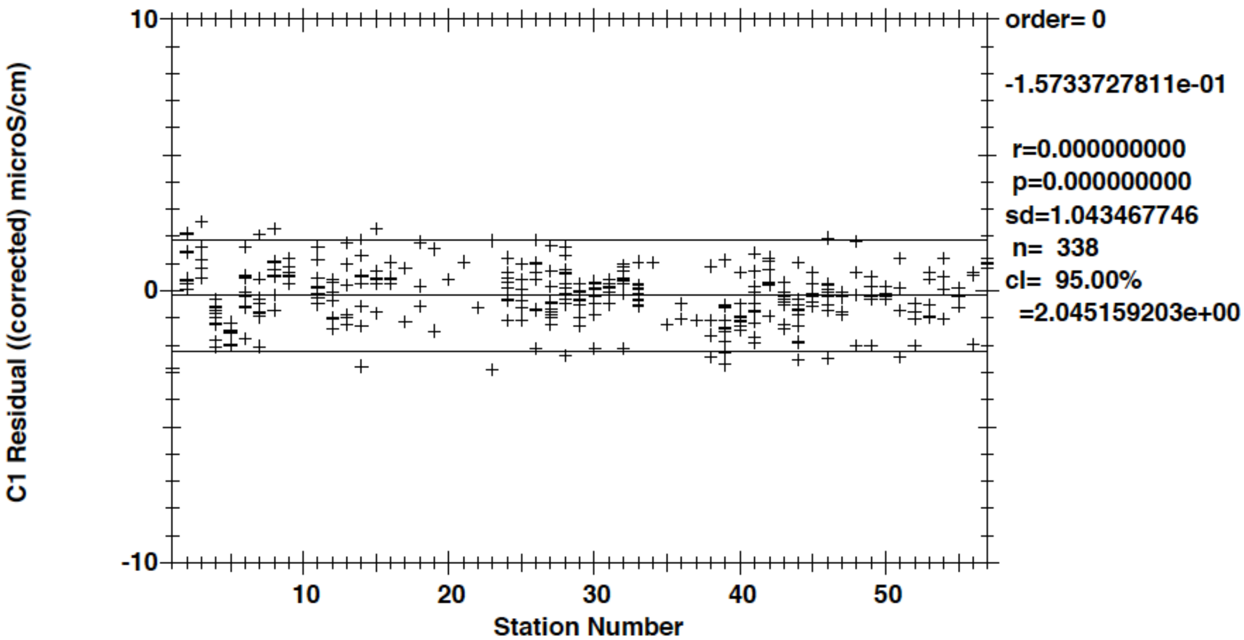


Figure 1.8.3.5: *Corrected C_{Bottle} - C1 by station (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

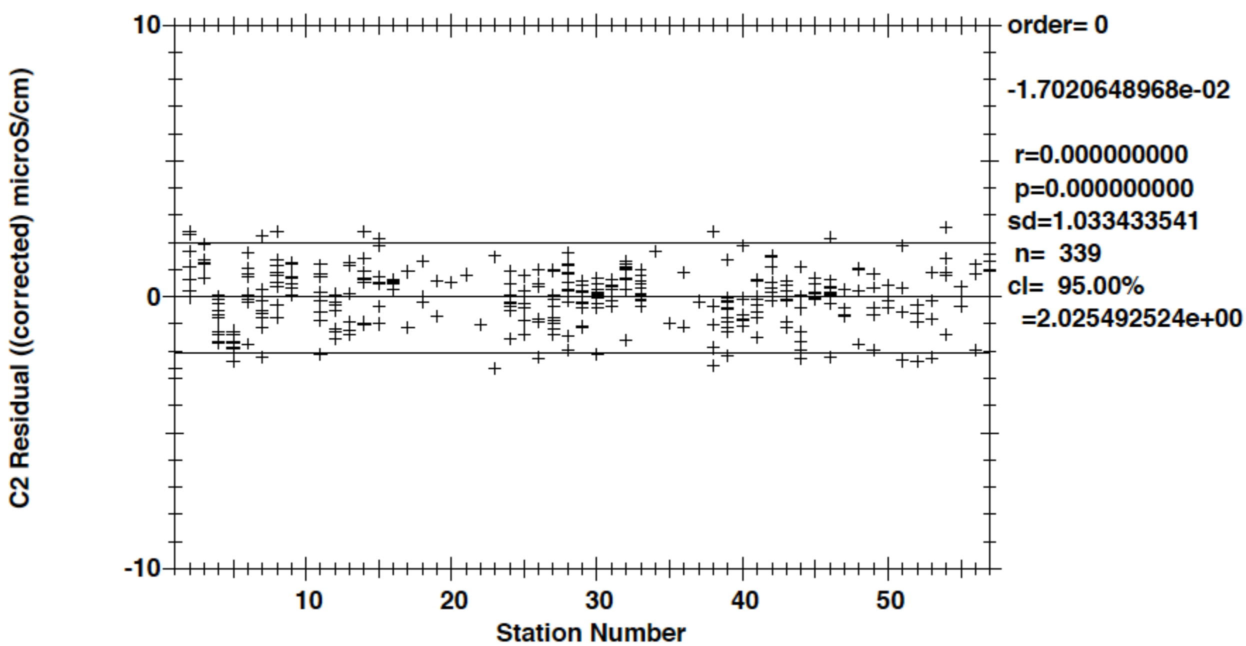


Figure 1.8.3.6: *Corrected C_{Bottle} - C2 by station (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

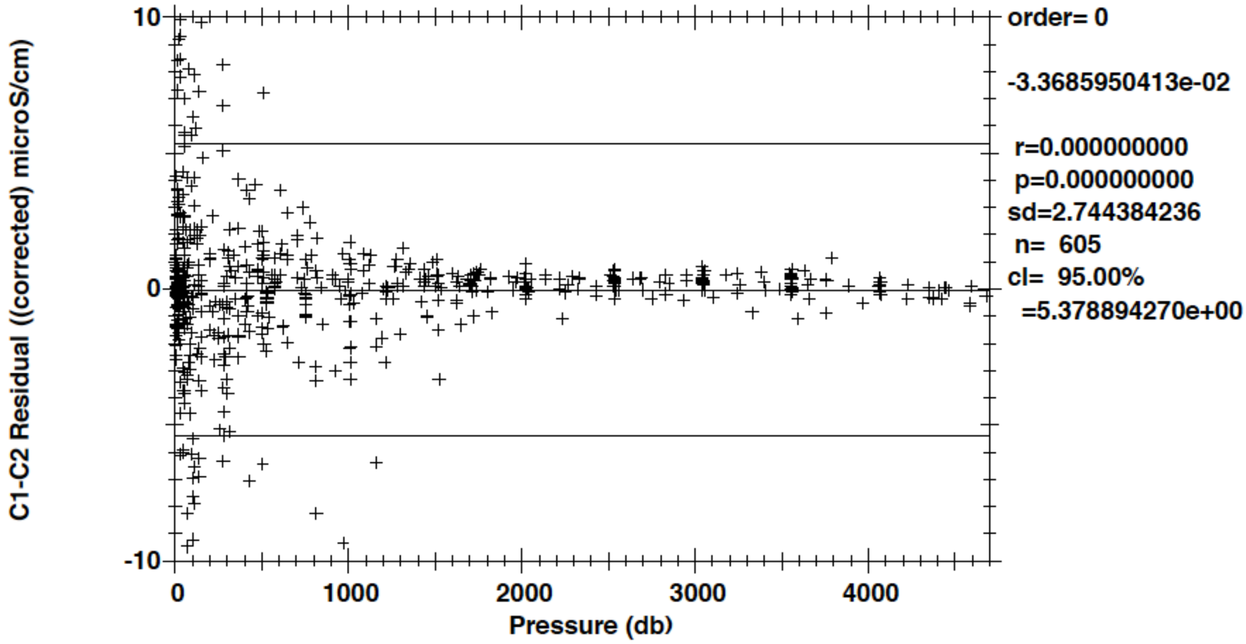


Figure 1.8.3.7: *Corrected C1 - C2 by pressure (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

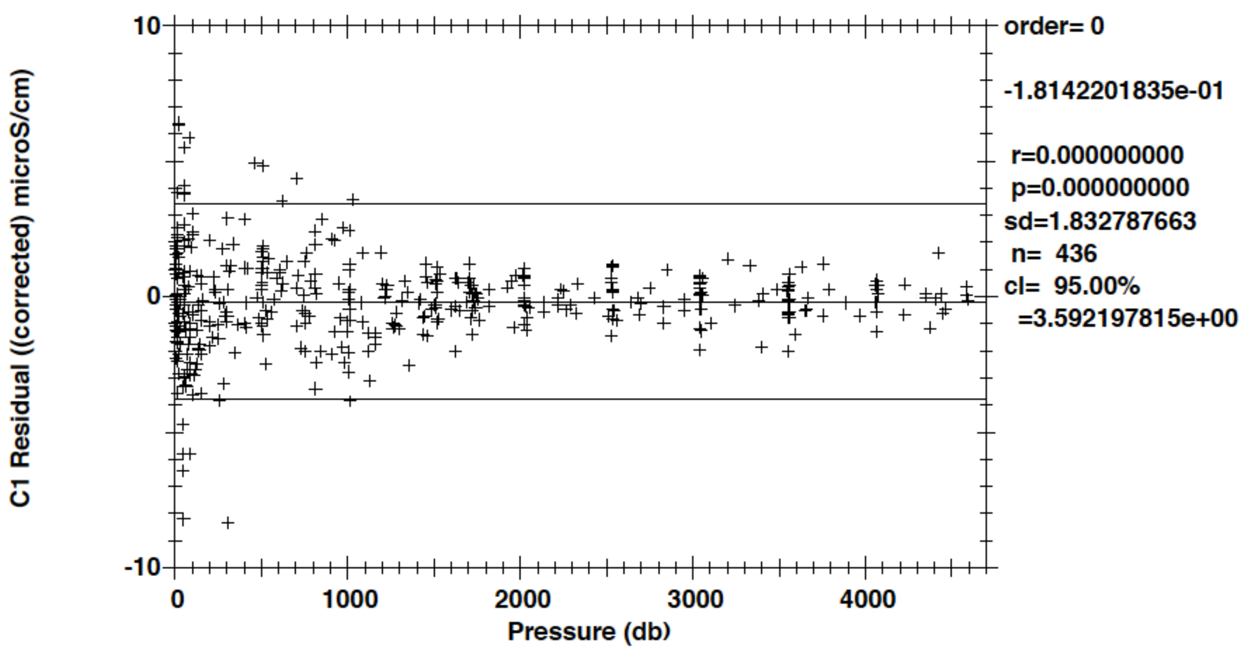


Figure 1.8.3.8: *Corrected C_{Bottle} - C1 by pressure (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

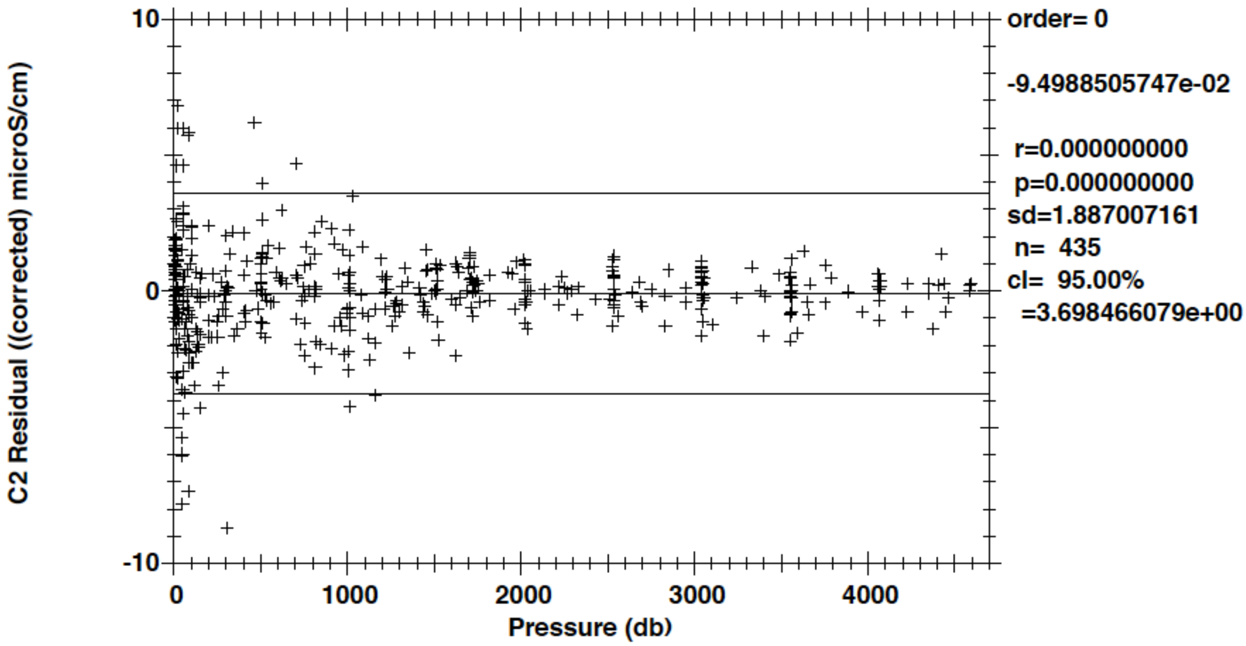


Figure 1.8.3.9: *Corrected C_{Bottle} - C2 by pressure (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

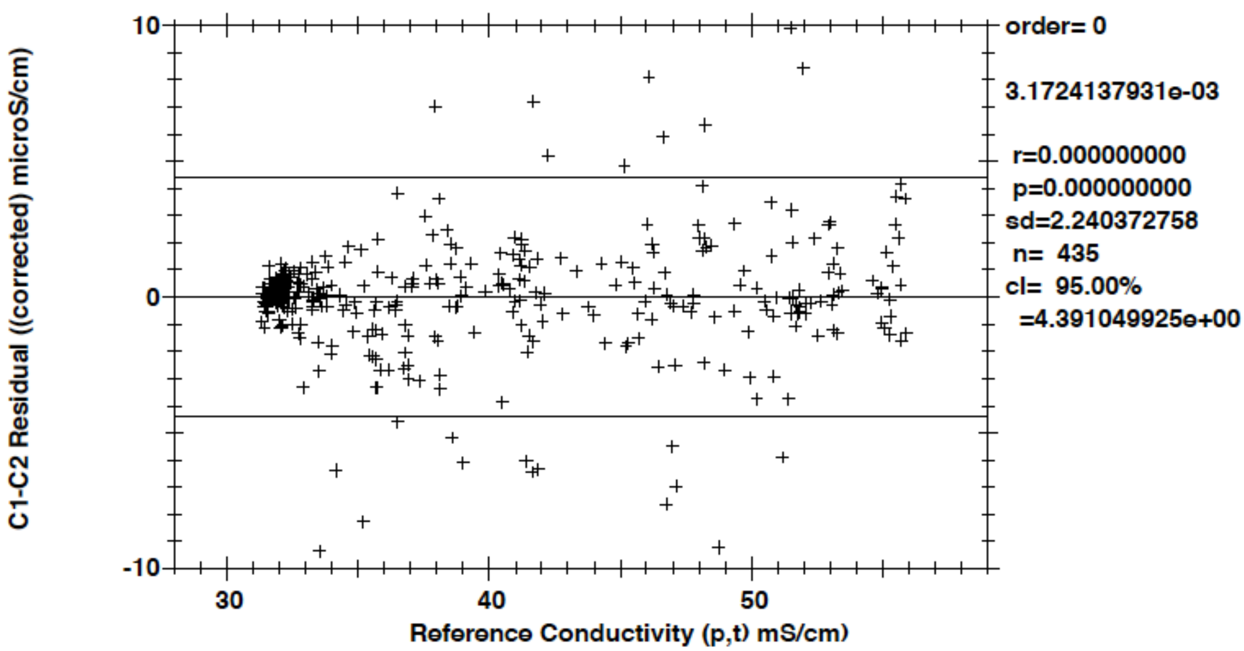


Figure 1.8.3.10: *Corrected C1 - C2 by conductivity (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

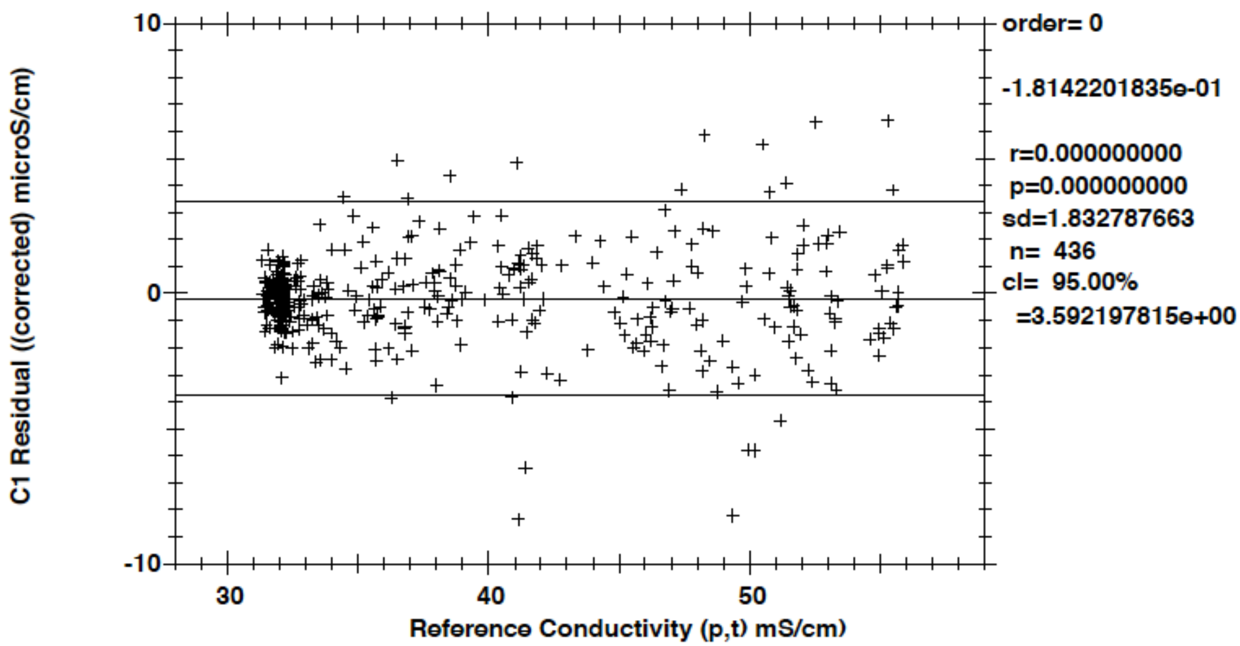


Figure 1.8.3.11: *Corrected C_{Bottle} - C1 by conductivity (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

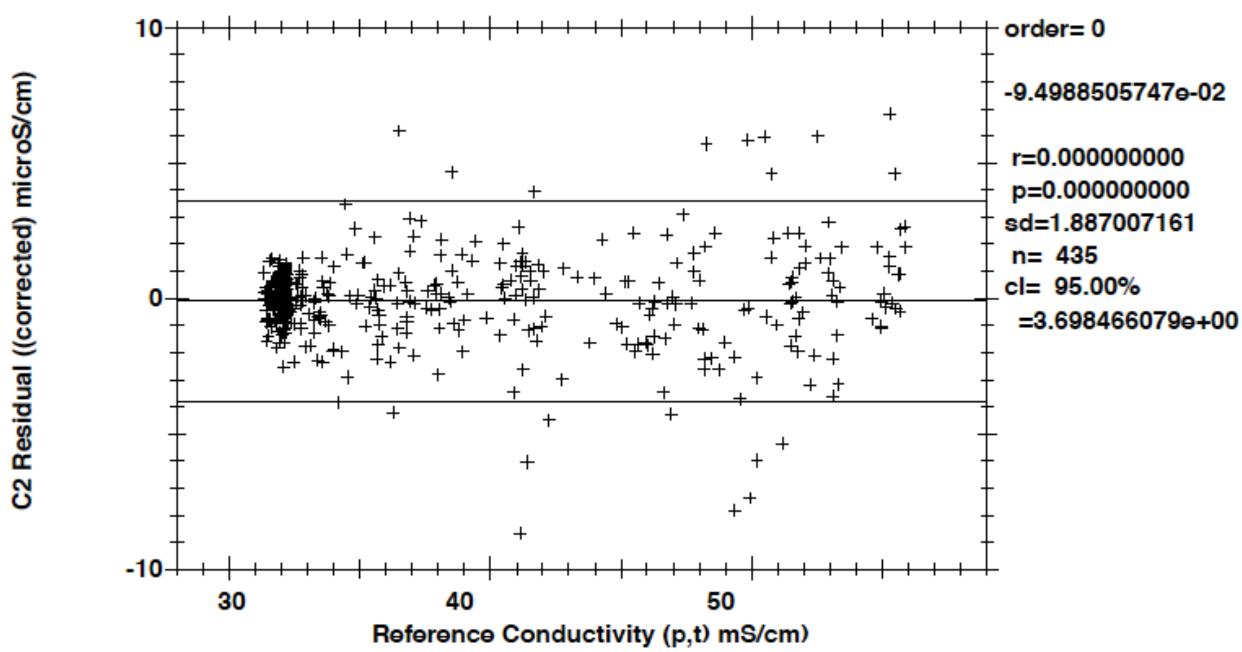


Figure 1.8.3.12: *Corrected C_{Bottle} - C2 by conductivity (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

Corrections made to all conductivity sensors had the form:

$$C_{cor} = C + cp_2P2 + cp_1P + cp_0C^2 + c_2C^2 + c_1 + c_0$$

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

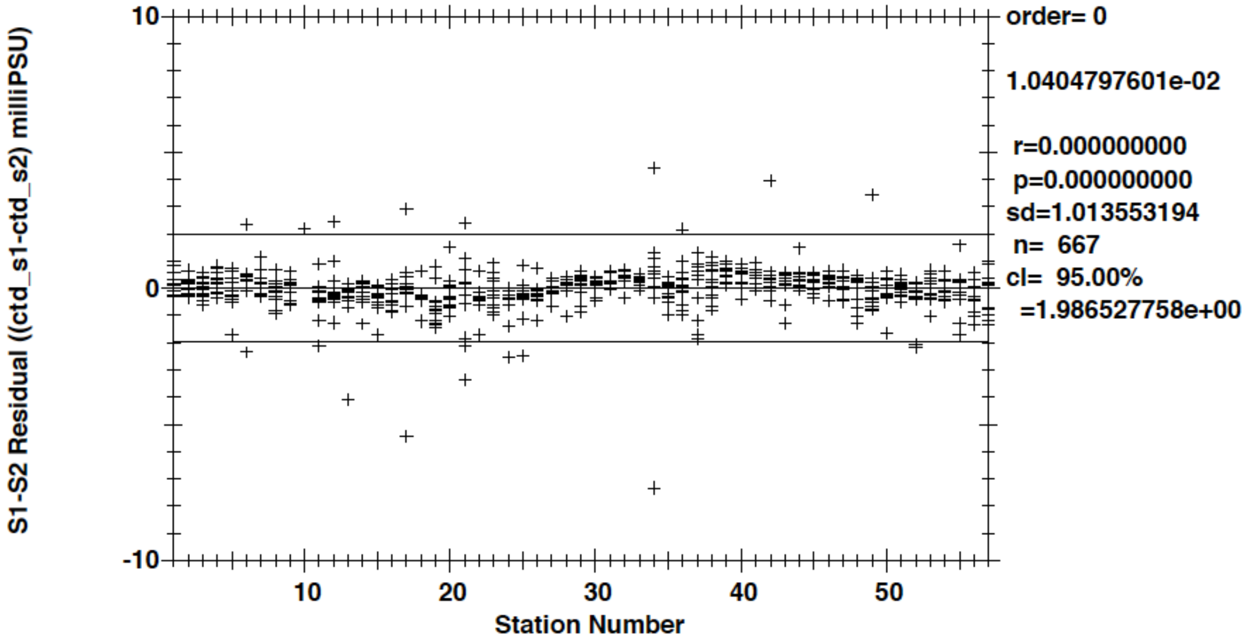


Figure 1.8.3.13: *Salinity residuals by station (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

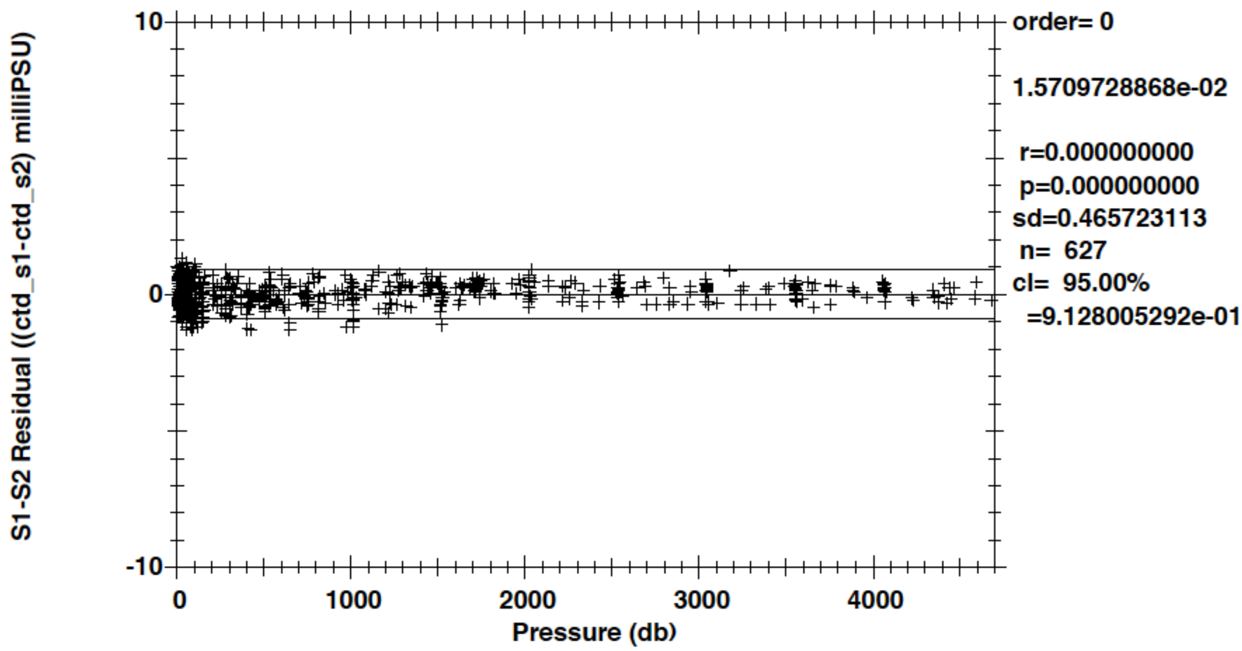


Figure 1.8.3.14: *Salinity residuals by pressure (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

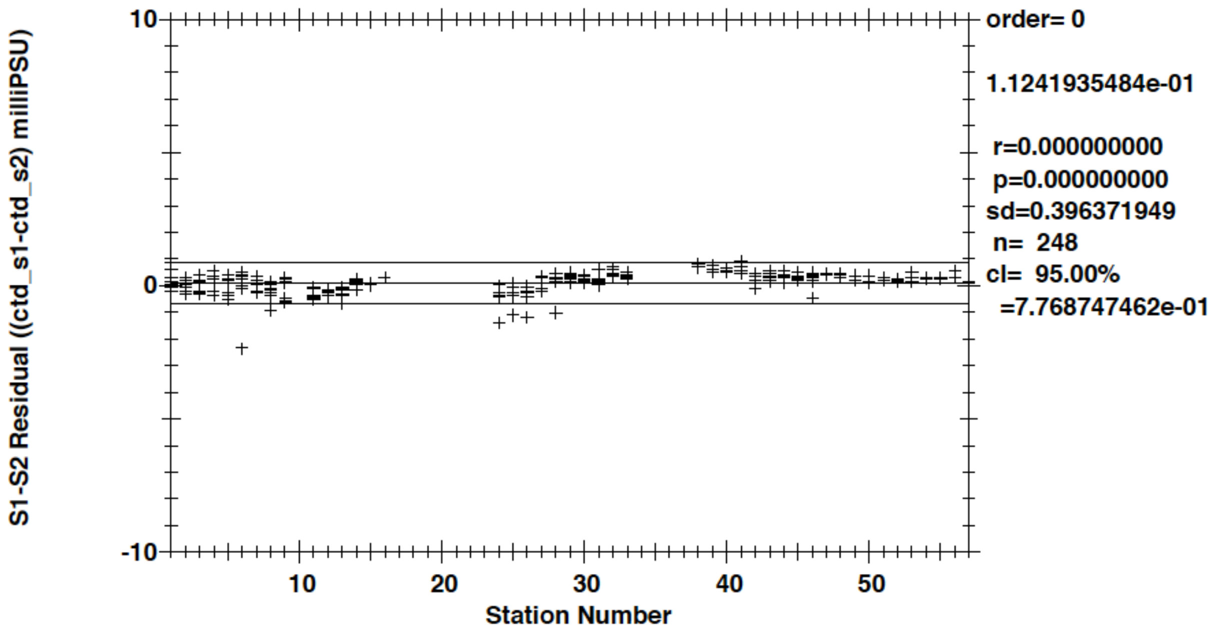


Figure 1.8.3.15: *Salinity residuals by station (Pressure > 2000db)*

Figures 1.8.3.14 and 1.8.3.15 represent estimates of the deep salinity accuracy of ACT0213. The 95% confidence limits are ± 0.000777 PSU relative to deep bottle salinities, and ± 0.000913 PSU relative to all bottle salinities where T1-T2 is within ± 0.01°C.

1.8.4. CTD Dissolved Oxygen

The DO sensors were 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.

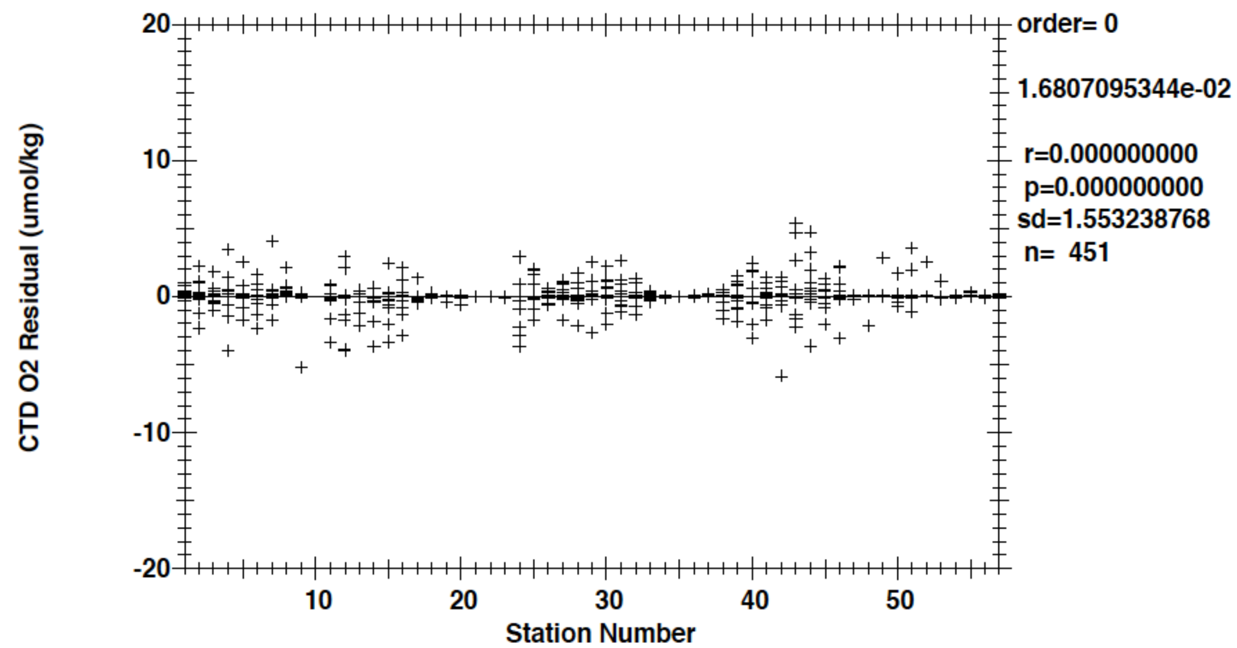


Figure 1.8.4.0: *O_2 residuals by station (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

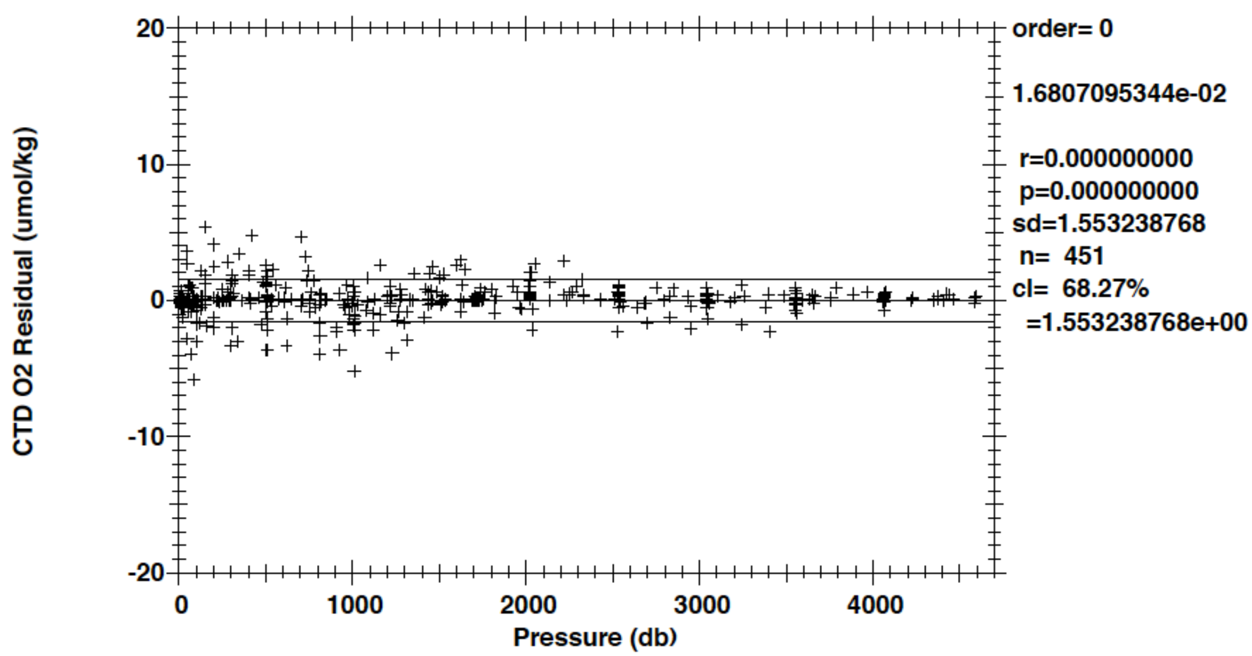


Figure 1.8.4.1: *O_2 residuals by pressure (-0.01°C ≤ T1-T2 ≤ 0.01°C).*

A standard deviation of 1.55 umol/kg for low gradient deep CTD oxygen residuals is an indication of consistent dependable dissolved oxygen 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	Shor t-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:

- O2
- 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 8.1.23) running on a Linux system. A web service (OpenACS 5.5.0 and AOLServer 4.5.1) front-end provided ship-wide access to CTD and water sample data. Web-based facilities included on-demand arbitrary proper ty-proper ty 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:

Table 1.10.0: *Frequency of WHP quality flag assignments.*

Rosette Samples Stations - 57								
	Reported levels	WHP Quality Codes						
		1	2	3	4	5	7	9
Bottle	683	0	523	0	0	0	0	159
CTD Salt	683	0	679	3	0	0	0	0
CTD Oxy	522	0	489	27	5	2	0	159
Salinity	522	0	489	27	5	2	0	159
Oxygen	509	0	508	0	0	0	0	174

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

Lowered ADCP Operations

Joni Lum
28 February 2013

Instrument Set Up:

Full depth velocity profiles were captured during the 2013 ACT cruise using a hybrid 150kHz/300kHz LADCP Workhorse configuration. The 150kHz instrument (s/n # 18144) was provided by the Rosenstiel School for Marine and Atmospheric Science at the University of Miami, while the 300kHz instrument (s/n # 4897) was provided by Dan Torres of Woods Hole Oceanographic Institute. Two backup instruments (150kHz and 300kHz), cables, mounting brackets, and three custom-made 48V deep-sea batteries, were also provided by WHOI. The upward looking Workhorse ADCP was mounted off center of the 12-bottle rosette, just above the upper rim. The downward looking ADCP was mounted off center of the frame with the face of the transducer just above the deck. The battery was mounted adjacent to the downward looking ADCP and rested on two beams mounted to the bottom of the frame and secured with a ratchet strap. Both instruments were connected to the single battery pack using a star cable.

The upward looking ADCP was configured for 20 8-meter bins with an 8-meter blanking distance. The downward looking ADCP was configured for 16 16-meter bins with a 10-meter blanking distance. Both instruments were configured for an ambiguity velocity of 350 cm/s and staggered single-ping ensembles. The upward looking ADCP was running version 50.40 firmware and set for 1 second ensembles. The downward looking ADCP was running version 51.40 firmware and set to burst-sample every 2 seconds, with 0.8 s between pings.

Data Acquisition Set Up:

Inside the main lab of the *Knorr*, two computers were set up for data acquisition and processing. The primary data acquisition computer ran Ubuntu and had two built-in serial ports, while the data processing computer ran Windows 7. The data acquisition computer ran a python-based dual terminal window. The initial battery charger was an American Reliance Inc. LPS-305 programmable power supply. It was programmed to output 58V and was plugged into one of the long power/communication cables that ran from the acquisition computer to the ADCP while the rosette was on deck. After the second cast, the battery charger was swapped out for a Soneil 4808SRF because the initial charger maintained a slightly high current (0.4A to 0.6A) after 1.5 hours of charging. After checking the voltage before and after charging, it was determined that neither the battery nor the charger were malfunctioning. Nevertheless, the charger was swapped out for the Soneil, which was used without issues on the previous ACT cruise in 2011. When using the Soneil, the battery charger reported a 'green' or fully charged light almost immediately after connecting to the instruments, even on the longer casts.

Deployment and Recovery:

On 13 February 2013, a damaged cable connecting the battery to the instruments was found during an initial inspection of the rosette. A 1 cm piece of the wire's rubber jacket was missing. It appeared to have been shaved by a blade, exposing the cable shielding. The wire itself looked undamaged but the cable was replaced.

On 14 February, lowered ADCP operations began with a test cast. The blanking distance of the downward looking ADCP was initially set to 0 to test the effect of zero blanking on data quality. The effects were unclear and the blanking distance was set at 8 meters. There were no operational problems with the ADCP during the test cast. On 15 Feb 2013 at 12:10 GMT the first cast was done at deepest station in 4613 m of water. The three LADCP operators familiarized themselves with the setup and the typical deployment proceeded as follows:

- About 10 min prior to station arrival, the operator sets the station number in the box in the upper right hand corner of the window. Starting with the upward looking instrument, it is woken up by choosing 'Deployment Initialization' from the dropdown menu. The time is recorded and the LADCP's clock is checked against the ships GPS.
- The instrument voltage is checked and recorded by typing 'PT4'.
- Memory is erased by selecting 'Erase Memory Now' under the Command drop down menu.
- If the LADCP clock is more than 2 seconds off of the ships GPS, the clock is reset by selecting the option under the Deployment menu.
- The above steps are repeated for the downward looking instrument.
- The appropriate Command file is loaded for the instruments, starting with the upward looking instrument by selecting 'Send Setup' under the Deployment tab. The operator is careful to choose the file that has 'no_comments' in the name. The output of this file is captured in a log file with the appropriate station number.
- Time of the start of pinging is recorded, and the computer is disconnected from the instruments by selecting 'Disconnect' from the drop down menu under Deployment.
- Cables are disconnected, battery cap is replaced, dummy plugs are inserted.
- In situ time is recorded after deployment.

At the bottom of the cast the time, latitude, longitude, CTD maximum depth, and height off the bottom are recorded. When the rosette is secured on deck, the operator dries and connects the cables, removes the battery cap, and begins the recovery procedure:

- The operator sends a 'break' command to the upward looking instrument by selecting 'Recovery Initialization' under the Recover tab, halting data collection and closing the data file.
- Voltage is checked and recorded by typing PT4.
- The two steps above are repeated for the downward looking instrument.
- The battery charger is switched on.
- Data is downloaded by selecting 'Download' from the Recover drop down menu. The latest data file is selected (if there is more than one file) and downloaded to a xxx.dat file, where xxx represents the station number. The file size is also recorded. When download is complete, the instruments are automatically powered down.
- The new files are copied to the data processing computer via the ship's shared network where the file is renamed to 'act0213_up_xxx.000' or 'act0213_dn_xxx.000'., where xxx represents the station number.

Four lines of CTD casts were completed during the cruise. They continued as follows:

	Station (Location)	Date (2013)	Time
Synoptic Line	CTD 001 (P5)	15 Feb.	12:10 GMT
	CTD 020 (P1)	18 Feb.	13:51 GMT
Mooring Operations	CTD 021 (P1)	18 Feb.	23:45 GMT
(skipped CTD stations between mooring sites A-E)	CTD 033 (P5)	24 Feb.	09:00 GMT
Synoptic Line across Current only	CTD 034 (P1)	25 Feb.	14:47 GMT
	CTD 046 (F) 27 Feb. 08:01 GMT		
Time Series	CTD 047 (B-C)	27 Feb.	09:43 GMT
	CTD 057 (B-C)	28 Feb.	14:00 GMT

There were two casts where CTD malfunctions affected the LADCP. On 17 Feb., three attempts were made at CTD 010, resulting in two aborted casts and a final successful cast. The LADCP began pinging and was stopped on both failed casts; however, data was not collected. Before the third cast at this station, the SBE-9 was swapped out for a spare one and the third cast, 010/03, was completed successfully. On 26 Feb., shortly after the beginning of cast 040, the CTD's pressure sensors malfunctioned, aborting the cast. Redeployment occurred just five minutes later, and there was no need to stop/restart the LADCP.

Unusual behavior of the LADCP occurred at the start of pinging on several of the early casts. On casts 1, 3, 4, 5, 7, 8, 9, and 12, the upward looking instrument would record an ensemble when it started pinging instead of waiting for a signal from downward looking ADCP. This resulted in an 'extra' ensemble in the data for the upward looking instrument that needed to be cut in order for the first-pass processing to begin. However, there was no consistency in the occurrence of this behavior, and later casts proceeded without any issues.

In the core of the current, the ADCP recorded high tilt levels due to high shear conditions. The rosette was strongly tilted up to 20 degrees during most of the time-series casts and casts 16, 17, 37, and 38. Normal cutoff limit in the processing software is 30 degrees. A 'bump' in the tilt often occurred immediately after the upcast began. During these high shear casts, bottom track velocities were also greatly offset from the profile.

There were large error velocities at the start of the upcast in most casts. This effect is likely due to the low scatter environment at depth coupled with the wake of the rising package. During Cast 13, the acceleration of the package before and after bottle stops was decreased to see if it would reduce the error, but there was no obvious improvement.

In shallow casts, the 150kHz workhorse did not produce reliable velocity measurements. Processing of the data from the 150kHz workhorse failed completely in cast 34. The downward looking ADCP seemed to have trouble distinguishing between reflection off the bottom and backscatter in the water column.

Data Processing:

The raw data files and logs were copied to the data processing computer and renamed. Navigation data were extracted from the half-second CTD time-series data. After the data were copied to the correct directories, 'first-pass' processing took place. Processing of the raw LADCP data used version 10.14 of the M. Visbeck & A. Thurnherr.

MATLAB toolbox. The toolbox was modified by G. Krahmann. The script copies, loads, and runs the shear and inverse methods, producing sixteen plots of useful diagnostics including a full depth velocity profile and maximum depth from the integrated vertical velocity. The processing scripts required some modification to ensure proper loading of GPS and ADCP data. Two small m-files were added: 'load_ctd_for nav.m' and 'load_ctd_for_prof.m'. Manual modifications to the scripts 'cruise_params.m' and 'prepare_cast.m' were also necessary prior to execution of each pass. The changes ensured that navigation data would be used, disabling bottom tracking during the first pass. When the first pass is complete, the operator makes note of the CTD maximum depth, the depth based on the integrated vertical velocity, and retains a hard copy for easy comparison.

Second-pass processing included both CTD time-series and pressure data. During the second pass, bottom tracking is turned on and the LADCP software becomes much more accurate at masking out the sea floor and determining bottom-track velocities. Once the first and second passes are complete, a third and final pass is done that incorporates the shipboard 75kHz ADCP data.

Summary:

Overall, the hybrid 150kHz/300kHz Workhorse LADCP performed well, without any major issues. After some initial confusion about the current draw of the American Reliance Inc. LPS- 305 programmable power supply, the charger was swapped out for the Soneil 4808SRF. The battery held up well over the 57 total casts and did not require a large amount of recharge time. Processing of the shallow water casts proved to be difficult due to the errors in bottom detection from the 150kHz instrument. Most stations had high error velocity in the downward looking instrument on the upcast, possibly due to the low scatter environment at depth coupled with the wake of the package. Second pass processing shows a high offset of the bottom track velocities from the full velocity profile during casts in strong current.

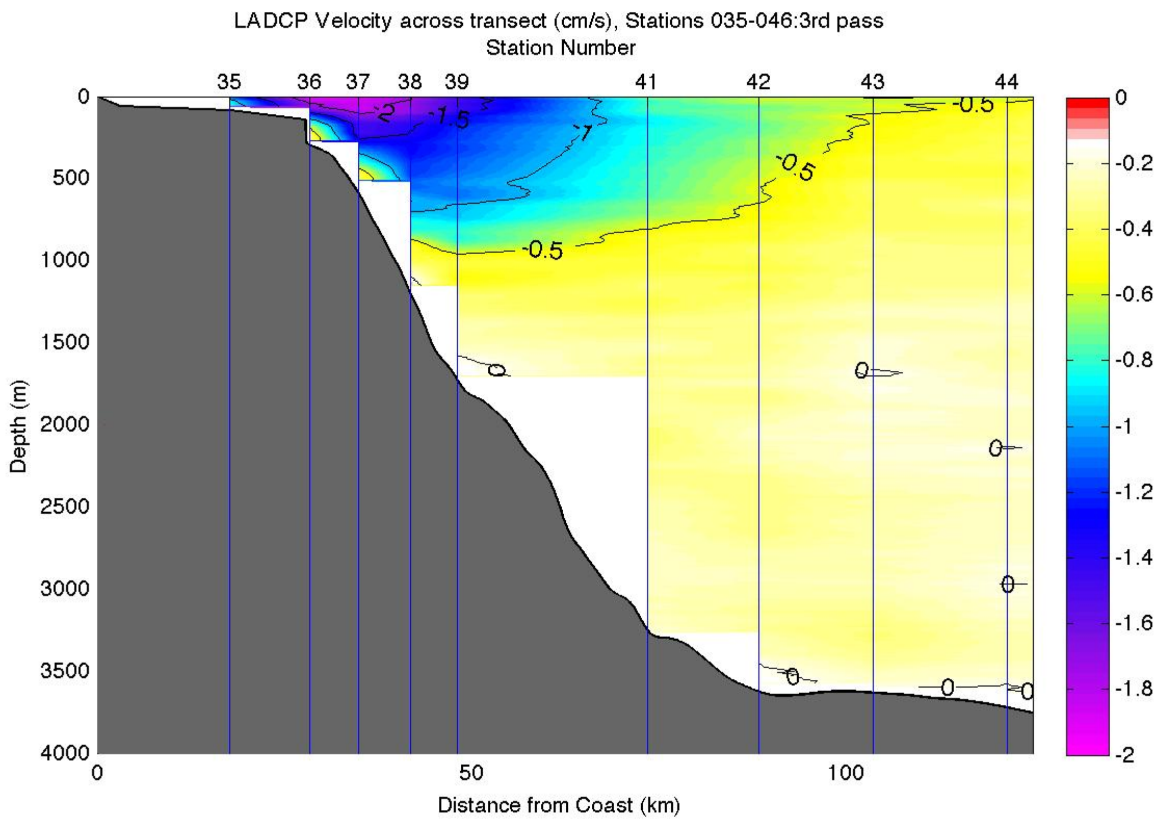


Figure 1: *Across-track velocity profile for stations 1-20*

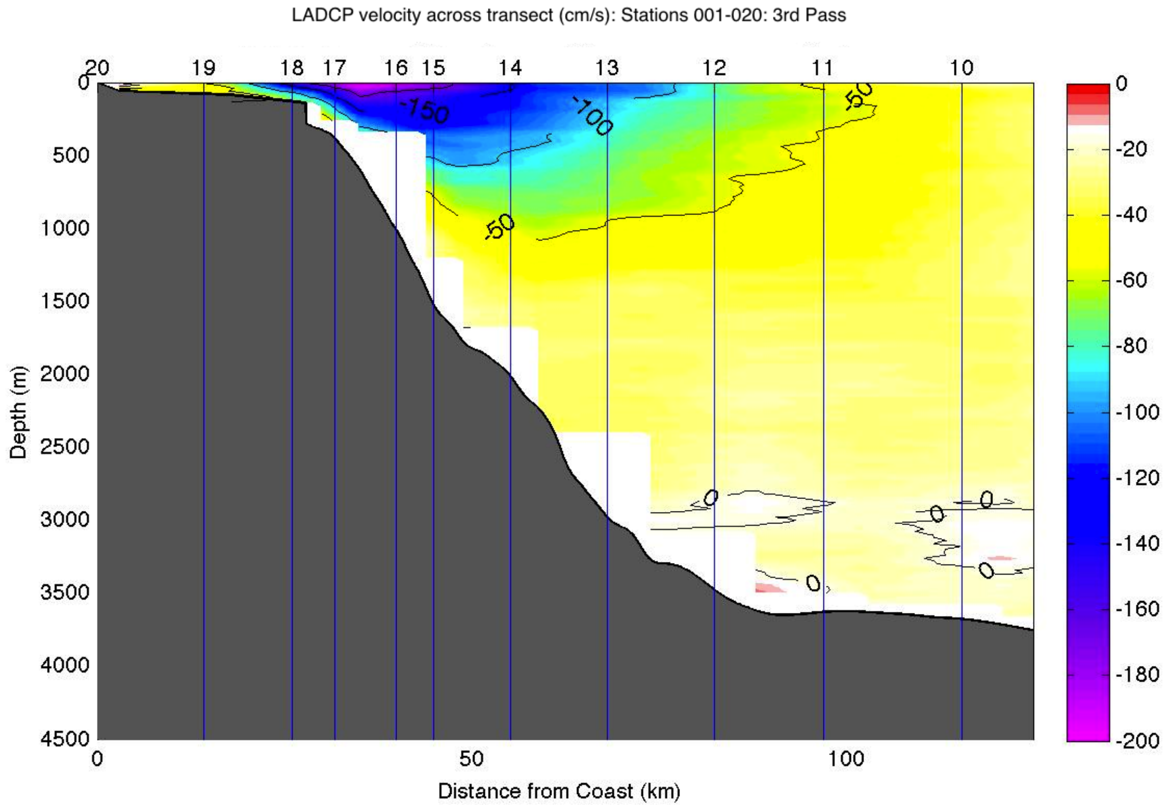


Figure 2: *Across-track velocity profile for stations 35-46*

Stn	Date (yyyy/mm/dd)	Start time	In-situ time	End cast time	Stop time	Int. w depth (m)	ctd max depth (m)	depth (m)	Latitude	Longitude
test	2013/02/14	11:20	11:59	13:03	13:13	989	988 dbar	1500	-35 12.124	23 47.714
1	2013/02/15	11:57	12:10	15:29	15:38	4617	4665	4613	-35 43.90	28 53.88
2	2013/02/15	16:33	17:31	20:35	20:46	4533	4510	4475	-35 32.00	28 46.62
3	2013/02/15	21:48	22:02	01:09	01:22	4376	4410	4365	-35 20.780	28 39.823
4	2013/02/16	02:21	02:33	05:35	05:45	4402	4377	4387	-35 9.0201	28 32.614
5	2013/02/16	06:41	06:56	09:59	10:09	4327	4375 dbar	4332	-34 57.377	28 25.5131
6	2013/02/16	10:48	11:33	14:31	14:39	4380	4352 dbar	4380	-34 49.14	28 20.718
7	2013/02/16	15:28	15:41	18:45	18:56	4181	4159	4156	-34 41.880	28 15.754
8	2013/02/16	19:44	20:04	22:54	23:04	4022	4003	4003	-34 32.596	28 9.665
9	2013/02/16	23:40	23:57	02:37	02:47	3842	3826	3830	-34 24.140	28 5.678
10	2013/02/17	06:06	06:15	09:06	09:14	3717	3696	3700	-34 17.314	28 1.066
11	2013/02/17	10:02	10:30	13:05	13:12	3622	3617	3646	-34 8.202	27 56.358
12	2013/02/17	13:59	14:12	16:49	16:57	3560	3594	3600	-34 01.242	27 51.798
13	2013/02/17	18:40	18:45	21:18	21:31	3079	3066	3070	-33 53.858	27 47.92
14	2013/02/17	22:47	22:56	00:55	01:08	2223	2217	2462	-33 47.486	27 41.921
15	2013/02/18	02:49	03:11	04:40	04:50	1700	1701	1764	-33 42.735	27 40.440
16	2013/02/18	05:49	06:01	07:18	07:29	1227	1225	1305	-33 39.968	27 39.037

Stn	Date (yyyy/mm/dd)	Start time	In-situ time	End cast time	Stop time	Int. w depth (m)	ctd max depth (m)	depth (m)	Latitude	Longitude
17	2013/02/18	08:37	08:40	09:45	09:46	538	570	580	-33 35.742	27 37.500
18	2013/02/18	10:35	10:57	11:30	11:29	298	303	340	-33 33.590	27 35.934
19	2013/02/18	12:06	-	12:43	12:44	89	94	80	-33 27.798	27 32.922
20	2013/02/18	13:22	13:34	13:51	13:58	54	61	6	-33 20.628	27 28.845
21	2013/02/18	23:30	23:45	23:54	00:02	56	62	61	-33 20.510	27 29.202
22	2013/02/19	00:30	00:55	01:02	01:10	88	87.6 dbar	95	-33 27.8642	27 32.911
23	2013/02/19	01:28	01:41	02:02	02:15	301	318 dbar	326	-33 33.498	27 35.834
24	2013/02/21	12:43	-	15:35	15:36	3724	3700	3700	-34 17.502	28 02.148
25	2013/02/21	16:08	16:15	18:58	19:11	3850	3889	3822	-34 23.674	28 5.443
26	2013/02/21	22:16	22:25	01:13	01:25	4030	4012	4010	-34 32.968	28 9.603
27	2013/02/22	08:02	-	11:09	11:10	4179	4156	4250	-34 40.368	28 15.426
28	2013/02/23	00:16	00:36	03:21	03:36	4302	4278	4275	-34 49.402	28 21.534
29	2013/02/23	07:34	-	10:59	10:59	4361	4335	4374	-34 57.486	28 25.662
30	2013/02/23	14:36	14:51	18:00	118:04	4418	4390	4414	-35 09.102	28 32.664
31	2013/02/23	19:02	19:14	22:10	22:19	4392	4363	4365	-35 20.763	28 39.688
32	2013/02/24	01:13	01:30	04:23	04:32	4537	4591	4475	-35 31.993	28 46.757
33	2013/02/24	05:27	05:43	09:00	09:00	4643	4707	4617	-35 44.064	28 53.892
34	2013/02/25	14:33	14:47	15:12	15:14	-	59	60	-33 20.864	27 28.992
35	2013/02/25	15:56	16:04	16:27	16:37	96	96	96	-33 27.552	27 32.724
36	2013/02/25	17:00	17:12	17:42	17:53	302	300	303	-33 33.40	27 35.84
37	2013/02/25	18:11	18:22	19:07	19:17	531	528	600	-33 35.711	27 37.42
38	2013/02/25	19:45	19:56	21:33	21:18	1155	1151	1263	-33 39.32	27 39.32
39	2013/02/25	21:55	22:05	23:54	00:00	1715	1730	1765	-33 42.273	27 41.078
40	2013/02/25	00:48	01:28	03:15	03:19	2245	2264	2354	-33 67.761	27 42.458
41	2013/02/25	04:08	04:18	06:40	06:55	3169	3201	3068	-33 53.7631	27 47.8130
42	2013/02/26	07:13	07:32	10:12	10:12	3595	3595	3578	-34 1.28	27 51.83
43	2013/02/26	10:48	11:08	13:47	13:46	3628	3611	3619	-34 8.217	27 36.300
44	2013/02/26	14:26	14:48	17:22	17:30	3717	3704	3707	-34. 17.177	28 1.443
45	2013/02/26	18:09	18:22	21:05	21:14	3845	3832	3828	-34 23.98	28 5.60
46	2013/02/26	22:12	22:26	01:10	01:21	4013	4056 dbar	3997	-34 32.289	28 9.783
47	2013/02/27	06:23	06:40	08:01	08:11	1741	1759 dbar	1764	-33 42.126	27 41.099
48	2013/02/27	09:28	09:43	11:12	11:12	1712	1730	1764	-33 42.668	27 40.414
49	2013/02/27	12:31	12:40	14:14	14:15	1677	1696	-	-33 42.160	27 41.209
50	2013/02/27	15:44	16:09	17:31	17:39	1687	1689	1745	-33 41.998	27 41.148
51	2013/02/27	18:27	18:35	20:01	20:10	1702	1722	1767	-33 42.132	27
52	2013/02/27	21:29	21:38	23:03	23:10	1697	1697	1767	-33 42.13	27 41.23
53	2013/02/28	00:25	00:41	02:01	02:11	1704	1726 dbar	1760	-33 42.2048	27 41.0930
54	2013/02/28	03:22	03:40	05:13	05:24	1693	1708 dbar	1758	-33 42.156	27 41.0906
55	2013/02/28	06:23	06:41	08:04	08:09	1731	1748	1776	-33 42.2735	27 41.1042
56	2013/02/28	09:21	09:30	11:05	11:05	1683	1702	1768	-33 42.102	27 41.226
57	2013/02/28	12:29	12:40	14:00	14:12	1698	1710	1722	-33 42.030	27 40.810

CPIES Telemetry and Recovery Report

Agulhas Current Time-series Cruise
February 2013

CPIES recovery and telemetry operations were conducted aboard the R/V *Knorr* during the third and final Agulhas Time-series cruise from February 21st through the 24th 2013. All CPIES were found to be sampling prior to recovery; the 4-ping 12 kHz pulses could be clearly heard at each site. All CPIES responded, without fail, to the various commands sent (clear, transpond, release, etc.) The acoustic environment could not have been more favorable.

Telemetry Sessions

Before starting a telemetry session or recovery operations, we used the CPIES' transpond mode to triangulate a more precise location of the instruments. In all cases, the surveyed position was some distance away from the deployment location, due to the varying strength of the current. Telemetry was performed on two of the 5 CPIES: S/N 243 (site P5) and S/N 241 (site P2). S/N 241 telemetry was successful, with the full 34 month record transmitted in about 10 hours. S/N 243 telemetry also covered the entire deployment, but no 12 kHz pulses marking the year-day were heard, save for the last one marking the end of the record (year-day 376).

Our deck box was a Benthos UDB9000 (S/N 48700, modem sw ver. 2.2.1 rev 6046, display sw ver. 2.2.1) plugged into the ship's hull-mounted transducer amidships (model EDO 323-B) via an impedance matching box. We used a receive threshold of 122, which seemed to work well, with very few stray signals detected. No other changes to the deck box settings were necessary. Acoustic conditions were excellent for both telemetry sessions. There was very little current or wind at both sites, which allowed the ship to sit on station using dynamic positioning for the duration of the telemetry period. We used a Java-based IES Telemetry application written by Pedro Pena of NOAA's AOML group. This application, while still in development, successfully interfaced to the UDB9000, captured and decoded the PDT blocks, and stored all data collected. The software creates a URI-compatible telemetry data file, which allowed us to run the CPlotPDT_r3.m script to visualize the incoming data. Upon completion of the telemetry session, the release command was sent, and the unit recovered.

Recovery Operations

The remaining 3 CPIES were surveyed in, and then sent their release command. The burn-wire releases appeared to take between 12 and 16 minutes to fully break the link. The deeper CPIES appeared to take slightly longer to burn through than the shallower ones. We were able to track the relative position of the CPIES once the release command was sent using the ship's depth sounder in "pinger" mode to plot a trace of the beacon signal on the strip chart screen. A change from a flat-line trace to a sloping one signaled that the CPIES had left the bottom and was moving towards the surface. The rubber stoppers glued to the inside of the sphere did not stick well to the glass surface, and nearly all of them were found to have fallen off at some point during the ascent and recovery. Most of the CPIES were recovered at night, and despite the shifting of the electronics boards inside the sphere, the strobe light was clearly visible, and the radio beacon was detected. Two CPIES, s/n 245 and s/n 243, suffered broken radio antennas due to the board shifting. S/N 243 appeared to have a small oil leak at the top of sphere, near the pressure sensor.

Recoveries were done by grappling for the tag line above the flotation when the CPIES drifted along the starboard side of the ship. The glass flotation sphere and Z-Pulse current meter were pulled in by hand. The crew then hooked a line into the bail attached to the transducer end of the unit and used a crane to pick it up out of the water. In one instance, S/N 247's Z-Pulse cable got caught when trying to hook into the bale. The plug was disconnected and the locking sleeve popped off one end, however the connector pins did not appear to suffer any damage.

Once each CPIES was recovered, it was brought into the main lab to download the data. Unfortunately, the communication cable supplied with the CPIES was inadvertently not shipped, so it was necessary to rig up a replacement. From the manual, we determined the pinout of the CPIES' RS-232 connector and connected our replacement cable accordingly. Unfortunately, we were ultimately unable to successfully communicate with any of the CPIES. S/N 247 did not respond at all when power was cycled, and while the others displayed the splash screen, they did not respond to the spacebar command to interrupt the automatic redeployment cycle. A copy of the output from one such instance is included in this report. We did not have sufficient time or energy to do exhaustive troubleshooting, therefore we opted to disconnect the battery, and copy the contents of the memory card directly to a computer.

All five units had complete records. The system log file contains a final message that states that this mission was aborted due to low system battery, which occurred at the time we attempted to communicate after recovery. In addition, S/N 247's system log contains several messages the others do not, but we were unable to interpret their meaning. At the moment we surmise that the batteries were too low to bring up the main menu at the prompt, but further testing is necessary.

Table 1. Summary of CPIES Recovery Period. Some survey positions are not as yet available, so the initial launch positions are used. Water depths are approximate and not corrected for average sound velocity.

Stn	Latitude	Longitude	Uncorr. Depth (m)	Release date/time	Off bottom time	Surface time	On board time	Clock offset (from GMT)
P2	-34 40.688 (from survey)	28 14.485	4163	22 Feb. 2013 22:18	22:31	23:14	23:30	-190 sec
P3	-34 57.485 (launch pos.)	28 25.662	4327	23 Feb. 2013 12:00	12:12	13:00	13:20	-381 sec
P4	-35 20.79 (from survey)	28 39.47	4400	23 Feb. 2013 22:56	23:12	23:57	24 Feb. 2013 00:10	-75 sec
P5	-35 43.99 (launch pos.)	28 53.865	4616	24 Feb. 2013 20:25	20:42	21:31	21:40	-140 sec
P6	-34 24.011 (launch pos.)	28 5.660	3824	21 Feb. 2013 20:17	20:29	21:09	21:22	N/A

```
******************************************************************************
       Inverted Echo Sounder Model 6.2B - Version: Nov  4 2009 15:26:26
Serial No.245  Optional Sensors Installed: pressure and ZPulse current sensors
             Configured for Acoustic Transducer Model: ITC3431C
          Persistor CF1 SN: 52729      BIOS: 2.28      PicoDOS: 2.28
         University of Rhode Island - Graduate School of Oceanography
******************************************************************************

  Current IES day, date and time is Sun Feb 24 00:16:50 2013

  Adjusting transmitter power... wait

   Warning!... power discharger not working!

\DATA

  RESET record written to system.log...

  *ping

  Press the <space> key within the next 10 seconds to enter the IES Main Menu,
  otherwise data collection will start with previous operating parameters.

  Checking System.... wait

  System Battery = 21.99 Volts @ 45.10 mA
  System battery O.K.
  Release Battery = 22.24 Volts @ 26.34 mA
  FAILURE: Release Battery below 10.0 Volts or current greater than 10 milliAmps

            Mission Aborted!

  MISSION ABORTED! --- Battery voltage too low!
          Invalid year-day... check clock function
          Day buffers appended to data files...
          ABORT record written to system.log...
          ATTENTION:      Low battery detected!
                      RAM buffers written to flash card
                      Abort record written to system log
                      Data acquisition system STOPPED
                      Watchdog timer disabled
                      You must replace battery to restart!
```

Mooring ID	Depth (m)	Instrument S/N	Instr. Type	In-situ (UTC)	Out-situ (UTC)	Clock Drift	Comments/Problems
M407 (A)							
M407-01	300	13389	150 kHz WHQM-ADCP	11 Nov. 2011 05:30	19 Feb. 2013 05:09	+546 sec	Data look OK, range steady at 300m
M408 (B)							
M408-01	600	15927	75 kHz WHLR-ADCP	11 Nov. 2011 10:55	19 Feb. 2013 06:52	+737 sec	Data look good, infrequent blow-downs, 520m nominal range
M408-02	1000	6166	Nortek Aquadopp	18 Apr. 2010 10:00	6 Nov. 2011 14:35	+26 sec.	Lower SNR due to blanking distance bug, but beam amplitudes adequate. Data look good.
M409 (C)							
M409-01	600	15873	75 kHz WHLR-ADCP	12 Nov. 2011 05:41	19 Feb. 2013 10:19	+342 sec	Data look good, infrequent blow-downs, 520m nominal range
M409-02	1000	6172	Nortek Aquadopp	12 Nov. 2011 06:19	19 Feb. 2013 12:47	+47 sec	Lower SNR due to blanking distance bug, but beam amplitudes adequate. Data look good.
M409-03	1500	6136	Nortek Aquadopp	12 Nov. 2011 06:45	19 Feb. 2013 11:10	+66 sec	Low beam 2&3 amplitude relative to beam 1, lower SNR due to blanking bug, but data seems OK
M409-04	2000	6155	Nortek Aquadopp	12 Nov. 2011 07:05	19 Feb. 2013 11:29	+44 sec	Some comms problems on recovery. Beam amps. Low due to blanking bug. Lower SNR, but data seem OK
M410 (D)							
M410-01	600	3714	75 kHz WHLR-ADCP (on loan)	13 Nov. 2011 05:24	21 Feb. 2013 09:45	+355 sec	Data looks good, infrequent blow-downs, 520m nominal range
M410-02	1000	6137	Nortek Aquadopp	13 Nov. 2011 05:44	21 Feb. 2013 10:02	+30 sec	Beam 2 & 3 amplitudes significantly lower than beam 1. Lower SNR due to blanking bug, but data are OK
M410-03	1500	6143	Nortek Aquadopp	13 Nov. 2011 06:02	21 Feb. 2013 10:18	+45 sec	Low beam amplitudes & SNR, due to blanking bug, but data are OK
M410-04	2000	6139	Nortek Aquadopp	13 Nov. 2011 06:19	21 Feb. 2013 10:30	+12 sec	Low beam amplitudes & SNR, due to

							blanking bug, but data are OK
M410-05	2500	6157	Nortek Aquadopp	13 Nov. 2011 06:37	21 Feb. 2013 10:43	+39 sec	Low beam amplitudes & SNR, due to blanking bug, data are noisy but useable
M410-06	3000	6138	Nortek Aquadopp	13 Nov. 2011 06:56	21 Feb. 2013 10:56	+61 sec	Low beam amplitudes & SNR, due to blanking bug, data are noisy but useable

M411 (E)

M411-01	300	8988	150 kHz WHQM-ADCP	14 Nov. 2011 06:12	21 Feb. 2013 04:55	+203	Data look good, three strong blow-downs (+250m, +400m, +500m) 250m nominal range, significant (around 100m) diurnal range loss
M411-02	500	6147	Nortek Aquadopp	14 Nov. 2011 06:30	21 Feb. 2013 05:10	+22 sec	Low beam amp.& SNR due to blanking bug, data looksOK though.
M411-03	700	6154	Nortek Aquadopp	14 Nov. 2011 06:42	21 Feb. 2013 05:20	+36 sec	Instrument deployed at wrong depth. Low beam amp.& SNR due to blanking bug, data look OK though.
M411-04	1000	6173	Nortek Aquadopp	14 Nov. 2011 06:55	21 Feb. 2013 05:31	+43 sec	Low beam amp.& SNR due to blanking bug, data look OK though.
M411-05	1500	1136	Nortek Aquadopp	14 Nov. 2011 07:11	21 Feb. 2013 05:47	+108 sec	Low beam amplitudes, data very noisy due to blanking bug. Data are useable though. brief periods of high (+20 deg) tilt during mooring blow-downs
M411-06	2500	1138	Nortek Aquadopp	14 Nov. 2011 07:43	21 Feb. 2013 06:13	+112 sec	Beam amplitudes very low or dead, data are just noise, nothing useable. Unclear whether this is due to blanking bug or instrument failure, but is likely the latter.

M412(F)

M412-01	300	13392	150 kHz WHQM-ADCP	16 Nov. 2011 06:26	22 Feb. 2013 05:40	+763 sec	Data split into 5 files with roughly 9 hour gaps in between, otherwise OK. Was the only profiler that split files on this deployment. 250m nominal range with

							several 200-400m blow-downs
M412-02	500	6133	Nortek Aquadopp	16 Nov. 2011 06:40	22 Feb. 2013 05:48	+9 sec	Low beam amplitudes due to blanking bug, but data look OK
M412-03	1000	6145	Nortek Aquadopp	16 Nov. 2011 06:55	22 Feb. 2013 06:03	+51 sec	Low beam amplitudes due to blanking bug, but data look OK
M412-04	1500	6124	Nortek Aquadopp	16 Nov. 2011 07:10	22 Feb. 2013 06:20	+55 sec	Low beam amplitudes due to blanking bug. Large vertical (error) velocity, but data are useable.
M412-05	2000	6175	Nortek Aquadopp	16 Nov. 2011 07:26	22 Feb. 2013 06:36	+45 sec	Low beam amplitudes due to blanking bug. Large vertical (error) velocity, but data are useable.
M412-06	3000	6168	Nortek Aquadopp	16 Nov. 2011 08:00	22 Feb. 2013 07:06	N/A	Batteries dead on recovery. Voltage dropped off in mid-Nov 2012 and cut out around mid-December. Very low beam amplitudes and high vertical (error) velocity. Data are marginal but useable.

M413 (G)

M413-01	300	13413	150 kHz WHQM-ADCP	18 Nov. 2011 05:05	23 Feb. 2013 05:38	+858 sec	Several large (200-400+ m) blow-downs, but data is OK. 250m nominal range.
M413-02	500	5995	Nortek Aquadopp	18 Nov. 2011 05:15	23 Feb. 2013 05:49	+35 sec	Lower beam amplitudes due to blanking bug, but data look OK
M413-03	1000	6144	Nortek Aquadopp	18 Nov. 2011 05:30	23 Feb. 2013 06:02	+25 sec	High vertical (error) velocity due to blanking bug. Beam 1 amplitude significantly higher than other two. Data are useable
M413-04	1500	6146	Nortek Aquadopp	18 Nov. 2011 05:44	23 Feb. 2013 06:16	N/A	Battery dead on recovery. Instrument only worked for a brief time (about 1 day) before stopping. Unknown whether this was battery failure or instrument failure.
M413-05	2000	6127	Nortek Aquadopp	18 Nov. 2011 06:00	23 Feb. 2013 06:29	+18 sec	Low beam amplitudes due to blanking bug. High vertical (error)

							velocity. Data are useable though.
M413-06	3000	6152	Nortek Aquadopp	18 Nov. 2011 06:33	23 Feb. 2013 07:05	+18 sec	Large vertical (error) velocity and very log beam amplitudes due to blanking bug. Data are useable. Vertical velocity is -20 to -40 cm/s

CCHDO Data Processing Notes

- **various errors noted** **Bob Key**

Date: 2014-04-15
Data Type: BTL/CTD
Action: Update needed
Note:

```
I just finished import and found a few minor things you'll want to fix at
some point. If it would help, I can provide an updated bottle file once I
know the answer to BOTTLE#3 below.

BOTTLE:
1. The Day, Month and Year are all wrong. These can be taken from the CTD
files with no problem
2. in the header names replace 2 occurrences of  "REFTEMP" with "REFTMP"
3. I don't know what "SALTREF" (and flag) is. Is it the same as "SBE35"??
4. The CTDOXY values have not been added to the bottle file. This would be a
good test case for our discussion next week regarding update of ctd values in
bottle files
5. The bottle oxygen are labeled as umol/kg, but that can't be correct. The
values also cannot be ml/liter, so I don't know what they are. May have to
pose that one to the ChSci.
bob

CTD:
1. There are a number of values >600 for CTDOXY. I set all these to NA
2. Station 10 has values that are highly unlikely for CTDOXY. I set all flag
values for station 10 ctdoxy to 3
3. The ctdoxy values for station 998 are strange, but this seems to be a test
station, so I did nothing
4. The ctdsal data appear to be very nicely calibrated to the bottle values
```

- **Re-zipped act2013.tar.gz** **Matt Shen**

Date: 2014-04-15
Data Type: BTL/CTD/CrsRpt
Action: Website Update
Note:

```
unzipped and re-gzipped act2013.tar.gz to correct trailing garbage.
```

File contains CTD & BTL data plus prelim. cruise report.

- **File Submission** **Frank Delahoyde**

act2013.tar.gz (download) #dd542
Date: 2014-04-11
Current Status: unprocessed
Notes
BTL and CTD data (WHP-Exchange / F. Delahoyde) in addition to preliminary cruise Documentation from ODF in PDF.

- **Available under 'Files as received'** **CCHDO Staff**

Date: 2014-04-11
Data Type: BTL/CTD/CrsRpt
Action: Website Update
Note:
The following files are now available online under 'Files as received', unprocessed by the CCHDO.

act2013.tar.gz (contains BTL / CTD data and prelim. cruise report)