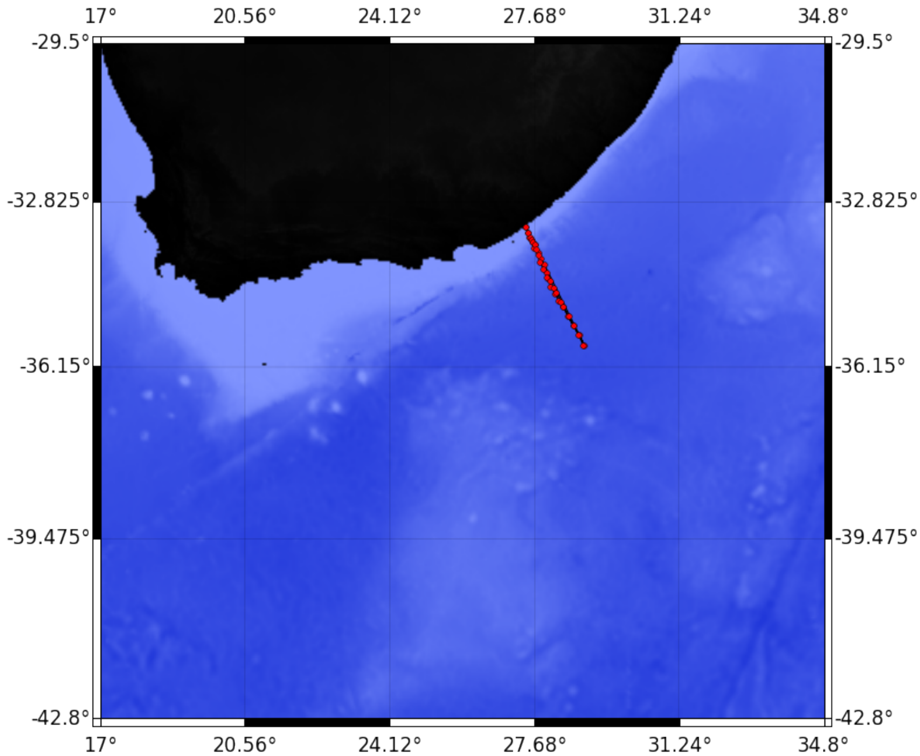
CRUISE REPORT: ACT2010

(Updated SEP 2017)



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	7 moorings deployed

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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.

Cruise Summary Information	Hydrographic Measurements
Description of Scientific Program	**CTD Data:**
Geographic Boundaries	Acquisition
Cruise Track (Figure): PI CCHDO	Processing
Description of Stations	Calibration
Description of Parameters Sampled	Temperature Pressure
Bottle Depth Distributions (Figure)	Salinities Oxygens
Floats and Drifters Deployed	**Bottle Data**
Moorings Deployed or Recovered	Salinity
	Oxygen
Principal Investigators	Nutrients
Cruise Participants	Carbon System Parameters
	CFCs
Problems and Goals Not Achieved	Helium / Tritium
Other Incidents of Note	Radiocarbon
Underway Data Information	**LADCP**
Navigation Bathymetry	
Acoustic Doppler Current Profiler (ADCP)	
Thermosalinograph	
XBT and/or XCTD	
Meteorological Observations	**Acknowledgments**
Atmospheric Chemistry Data	
Data Processing Notes	

ACT0410

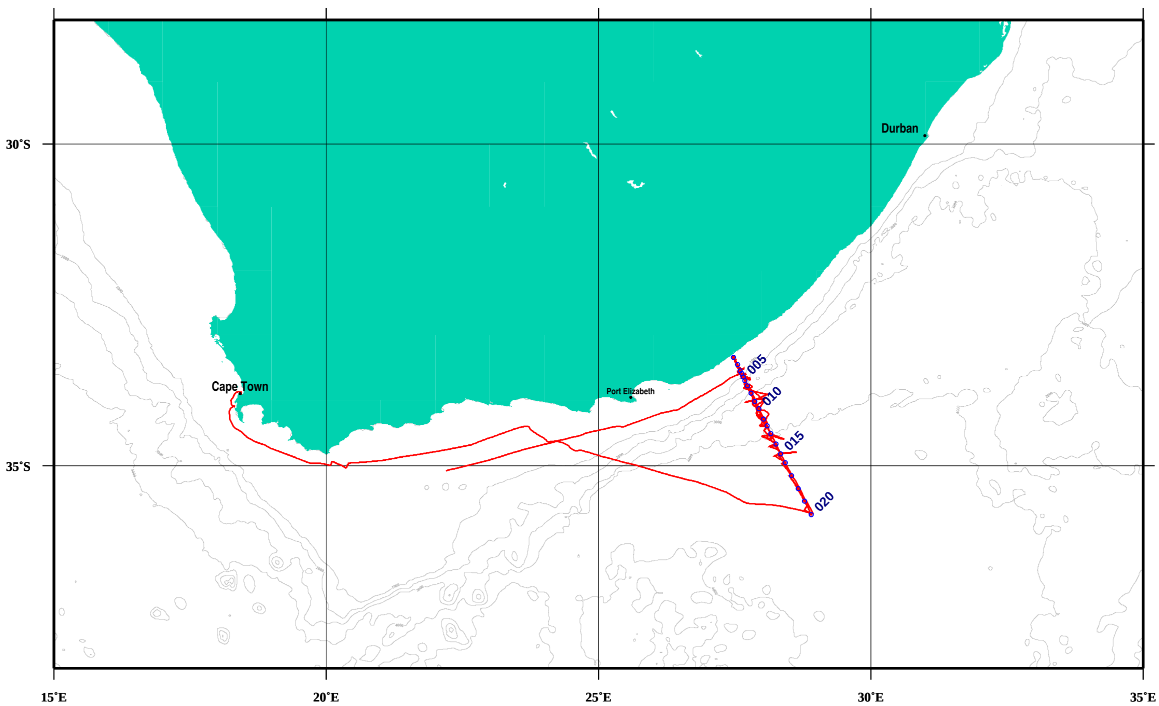
R/V *Knorr*, KN197-6

4 April 2010 to 23 April 2010

Cape Town, South Afr ica - Cape Town, South Afr ica

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.

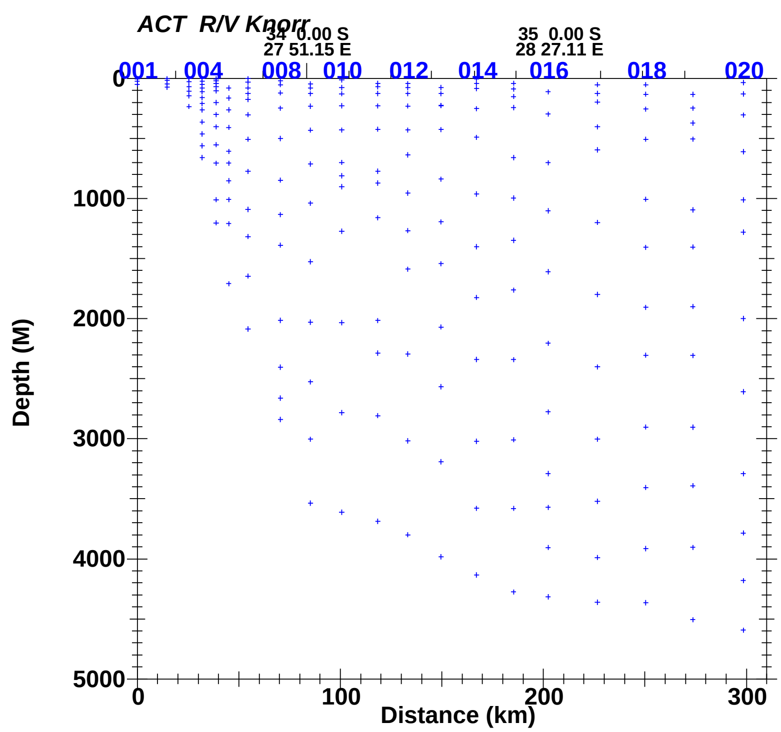


Figure 1.0 ACT0410 Sample distribution, stations 1-20.

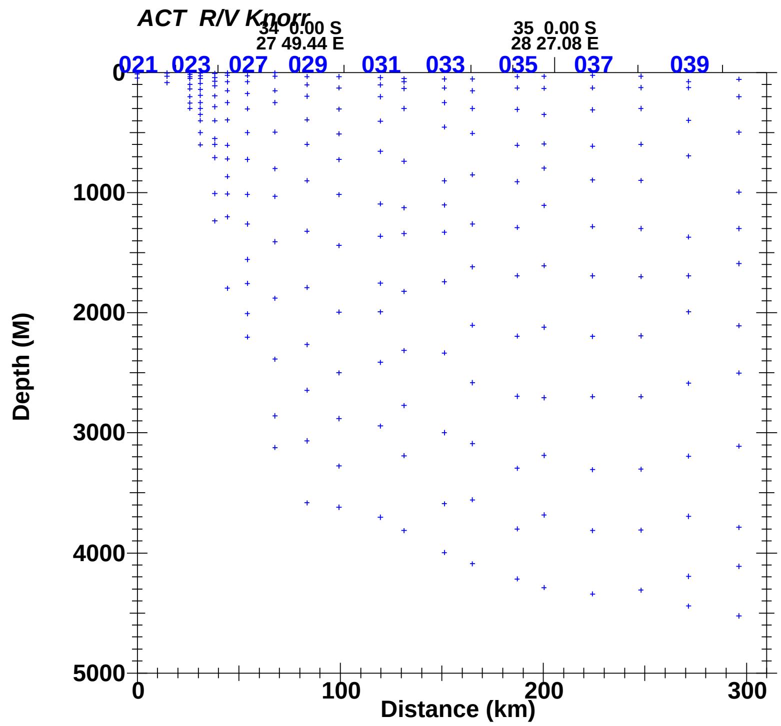


Figure 1.0 ACT0410 Sample distribution, stations 21-40.

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. Reter minations were perfor med pr ior to station 30 when a kink was found in the winch wire 2 ft above ter mination. Kink was from an unknown source. Technician also perfor med a total retermination after 14 kinks were found in about 50 meters of wire above ter mination. 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 por ts. 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 inventor y 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. The0.5-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 proper ties derived from sensor data and checke 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 perfor med 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 andsecondary 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:

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

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

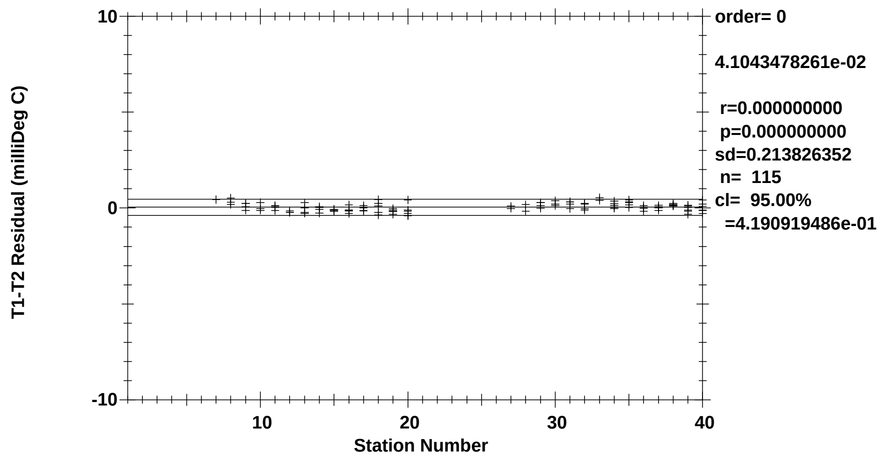


Figure 1.8.2.0 T1-T2 by station (-0.01°C $\leq T1 - T2 \leq$ 0.01°C).

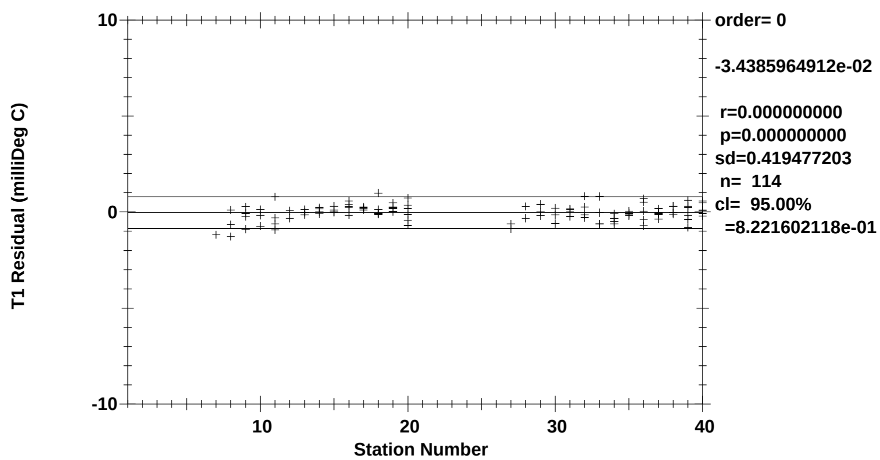


Figure 1.8.2.1 SBE35RT-T1 by station (-0.01°C $\leq T1 - T2 \leq$ 0.01°C).

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, deter mined 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.

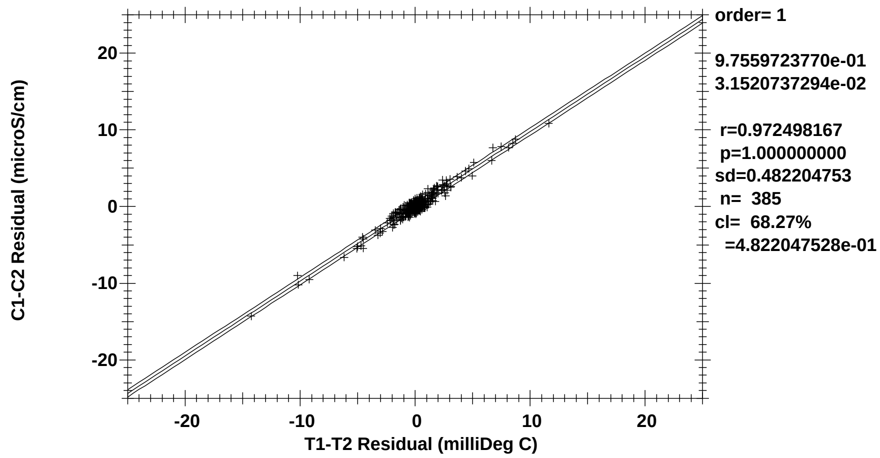


Figure 1.8.3.0 Coherence of conductivity differences as a function of temperature differences.

Uncorrected conductivity comparisons are shown in figures 1.8.3.1 through 1.8.3.3.

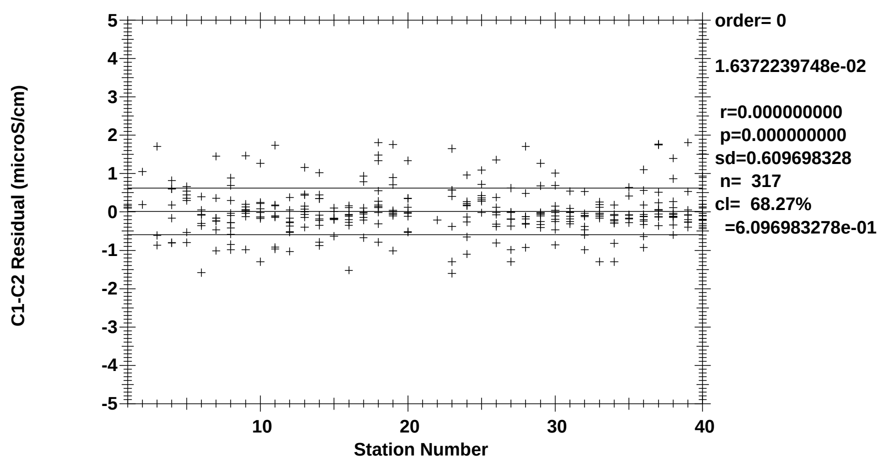


Figure 1.8.3.1 Uncorrected $C1 - C2$ by station (-0.01°C $\leq T1 - T2 \leq$ 0.01°C).

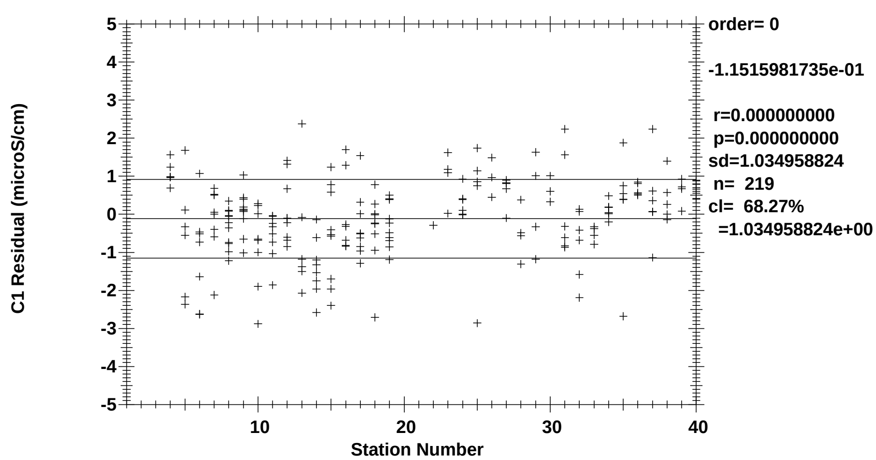


Figure 1.8.3.2 Uncorrected $C_{Bottle} - C1$ by station (-0.01°C $\leq T1 - T2 \leq$ 0.01°C).

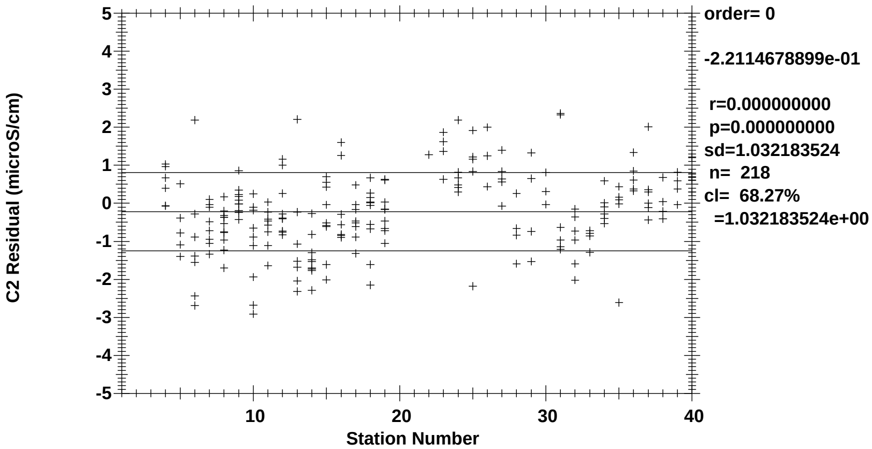


Figure 1.8.3.3 Uncorrected $C_{Bottle} - C2$ by station (-0.01°C ≤T1-T2≤0.01°C).

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 laborator y 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.

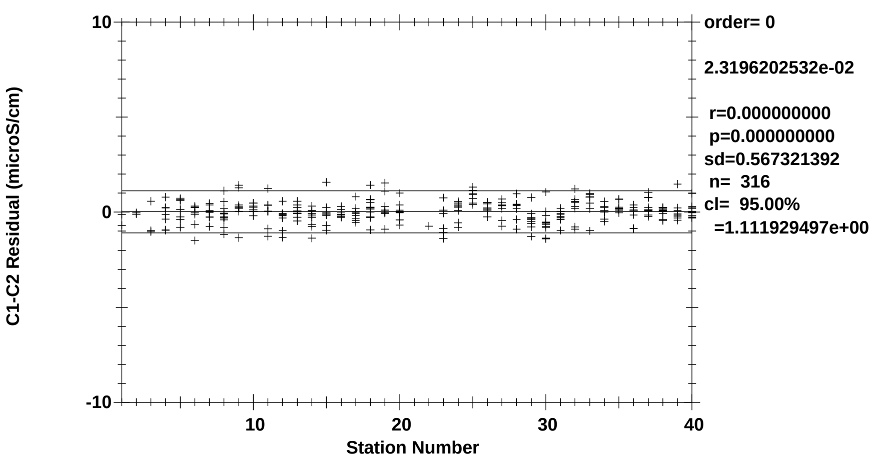


Figure 1.8.3.4 Corrected $C1 - C2$ by station (-0.01°C ≤T1-T2≤0.01°C).

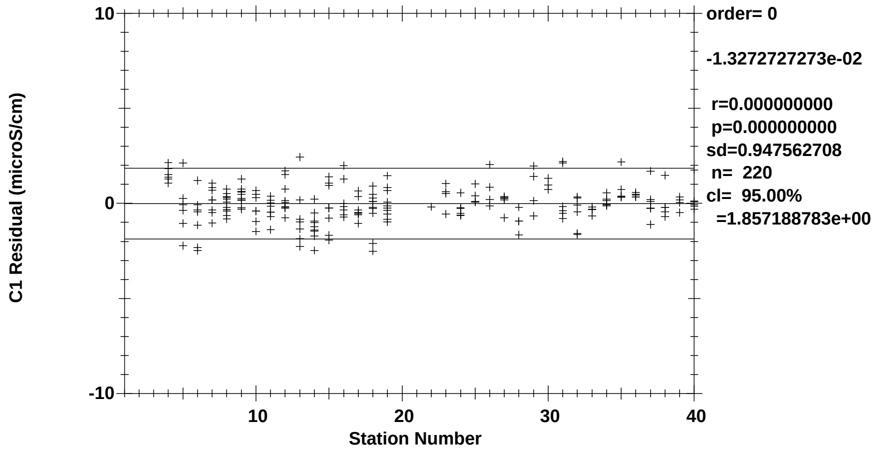


Figure 1.8.3.5 Corrected $C_{Bottle} - C1$ by station (-0.01°C ≤T1-T2≤0.01°C).

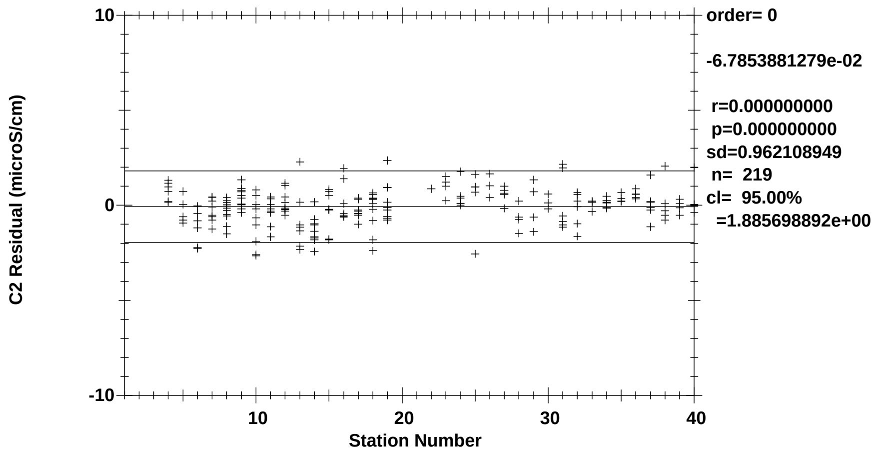


Figure 1.8.3.6 Corrected $C_{Bottle} - C2$ by station (-0.01°C ≤T1-T2≤0.01°C).

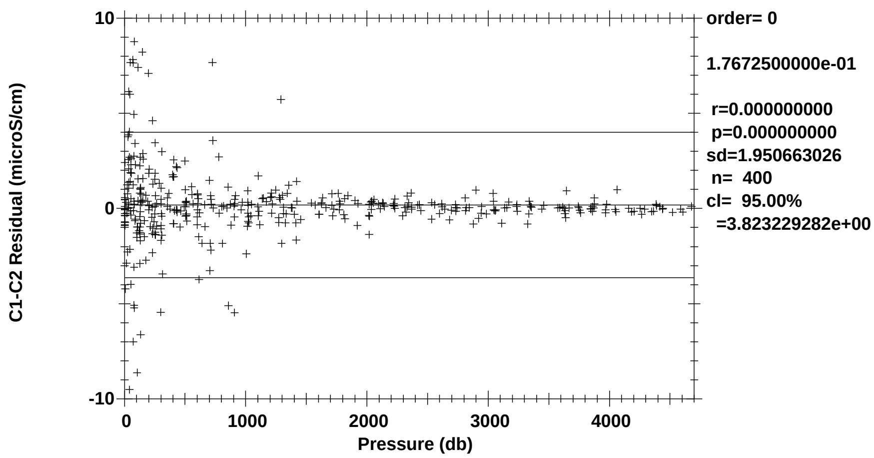


Figure 1.8.3.7 Corrected $C1 - C2$ by pressure (-0.01°C ≤T1-T2≤0.01°C).

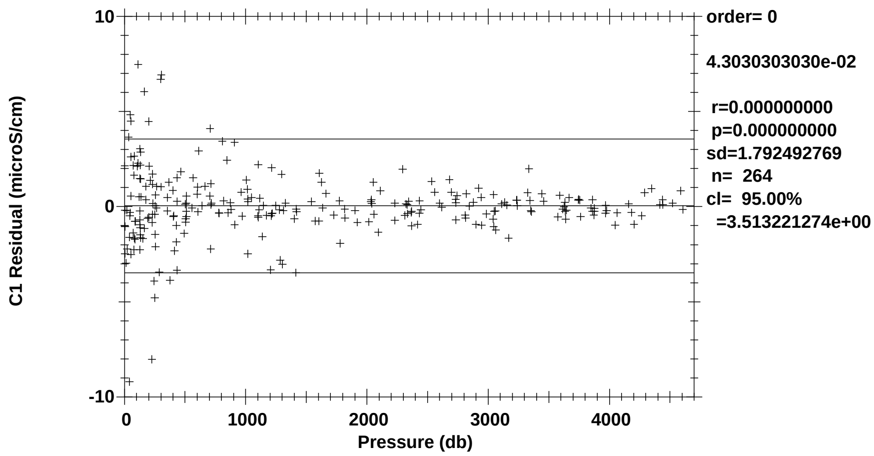


Figure 1.8.3.8 Corrected $C_{Bottle} - C1$ by pressure (-0.01°C ≤T1-T2≤0.01°C).

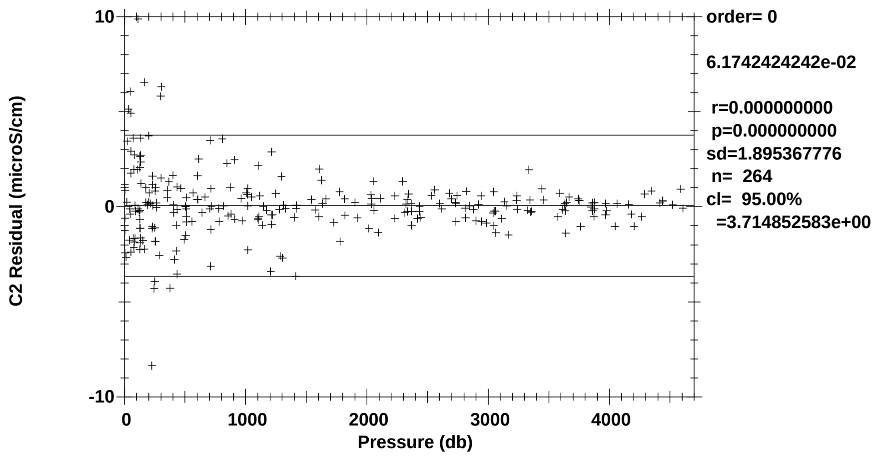


Figure 1.8.3.9 Corrected $C_{Bottle} - C2$ by pressure (-0.01°C ≤T1-T2≤0.01°C).

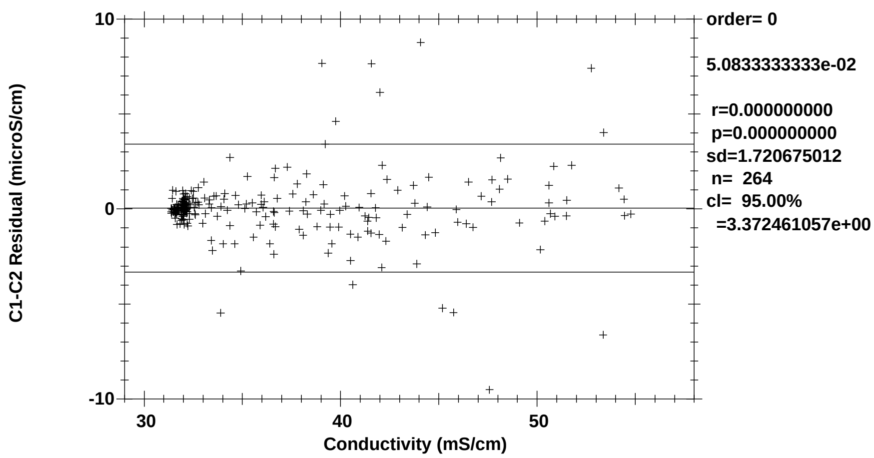


Figure 1.8.3.10 Corrected $C1 - C2$ by conductivity (-0.01°C ≤T1-T2≤0.01°C).

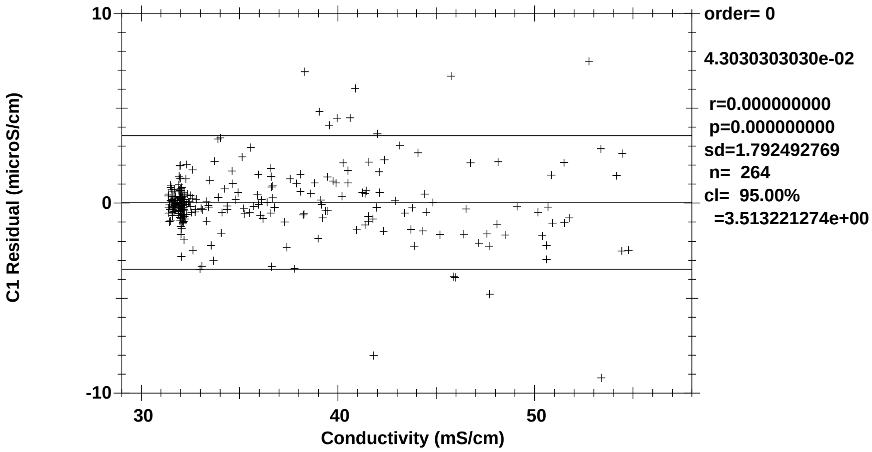


Figure 1.8.3.11 Corrected $C_{Bottle} - C1$ by conductivity (-0.01°C ≤T1-T2≤0.01°C).

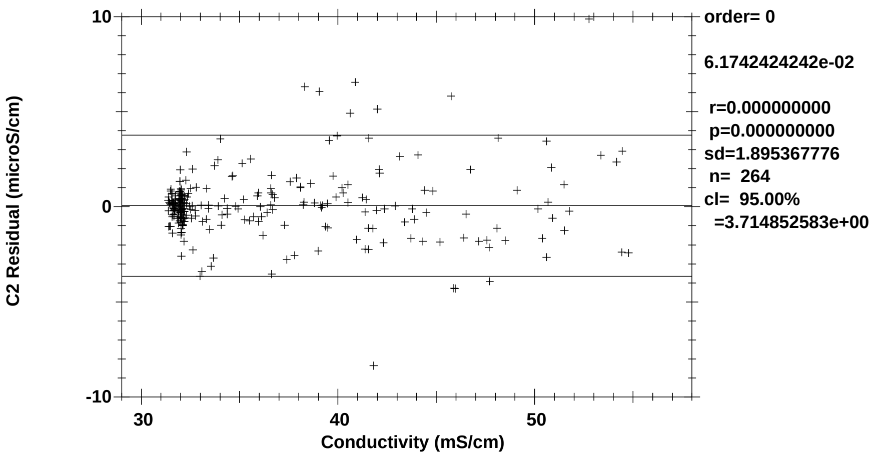


Figure 1.8.3.12 Corrected $C_{Bottle} - C2$ by conductivity (-0.01°C ≤T1-T2≤0.01°C).

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.

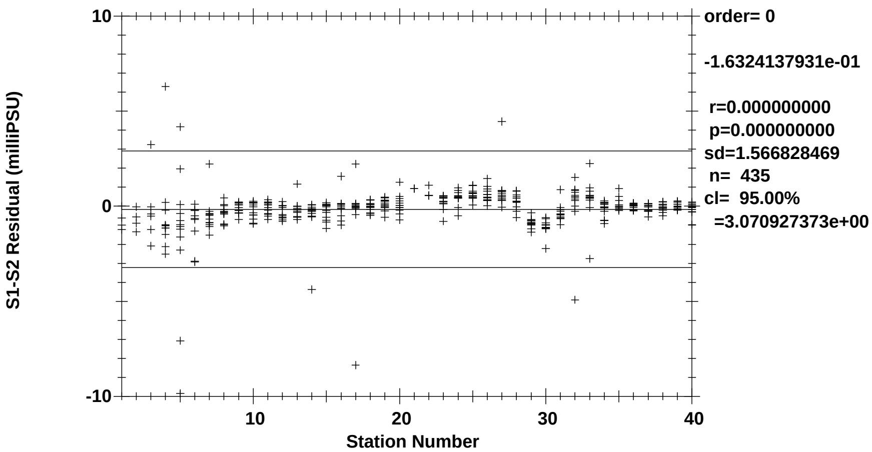


Figure 1.8.3.13 Salinity residuals by station (-0.01°C ≤T1-T2≤0.01°C).

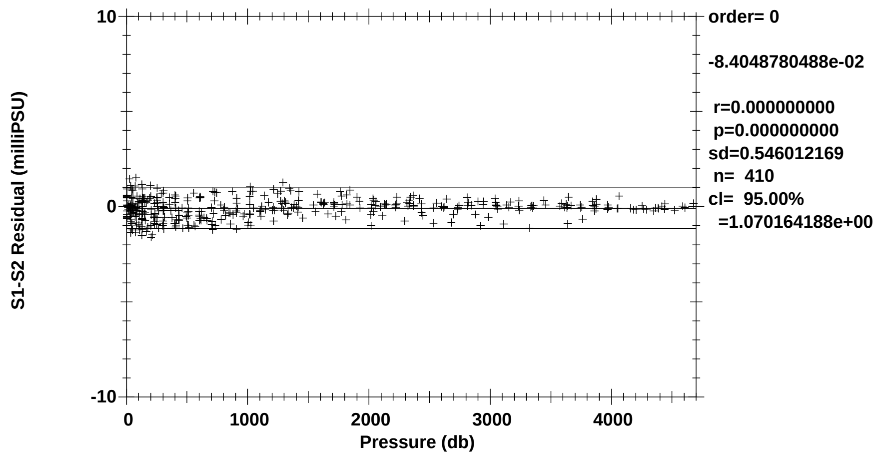


Figure 1.8.3.14 Salinity residuals by pressure (-0.01°C ≤T1-T2≤0.01°C).

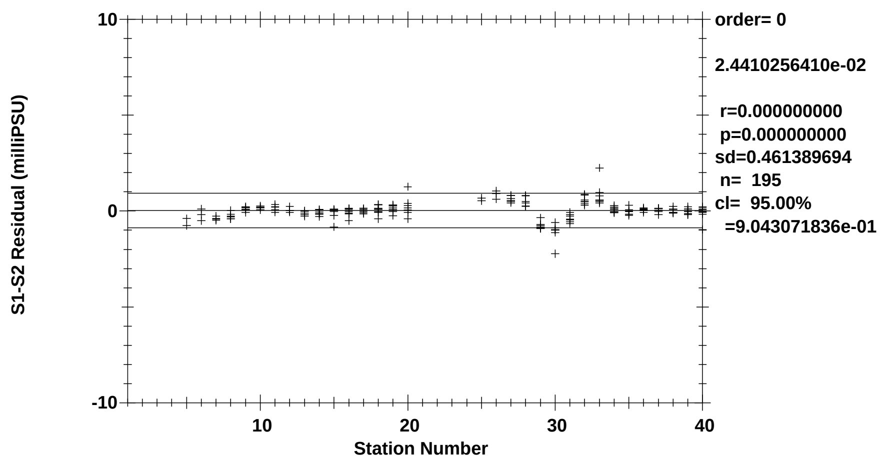


Figure 1.8.3.15 Salinity residuals by station (Pressure>2000db)

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.

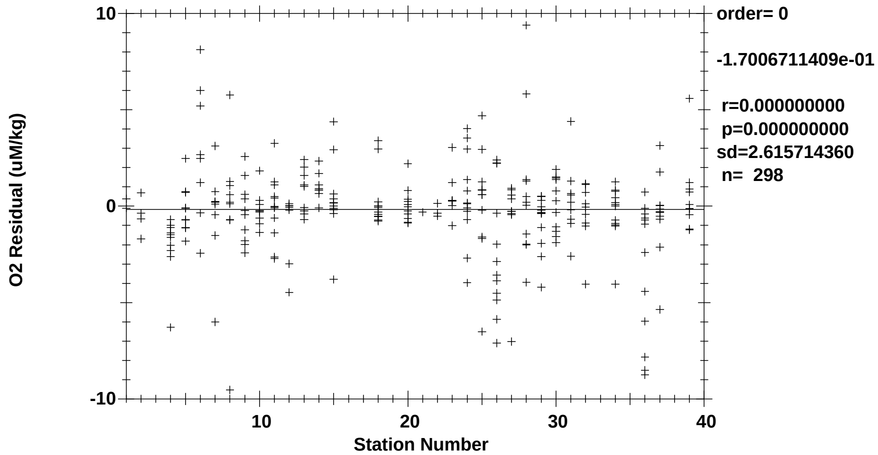


Figure 1.8.4.0 O_2 residuals by station (-0.01°C ≤T1-T2≤0.01°C).

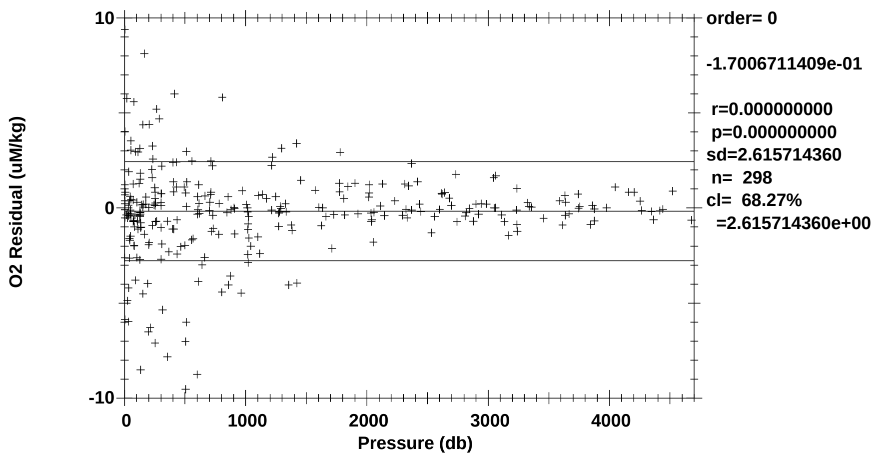


Figure 1.8.4.1 O_2 residuals by pressure (-0.01°C ≤T1-T2≤0.01°C).

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 for m 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:

$$O_2ml/l = [C_1V_{DO}e^{(C_2\frac{P_h}{5000})} + C_3] \cdot f_{sat}(T,P) \cdot e^{(C_4T_l+C_5T_s+C_7P_l+C_6\frac{dO_c}{dt}+C_8\frac{dP}{dt}+C_9dT)}$$

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].

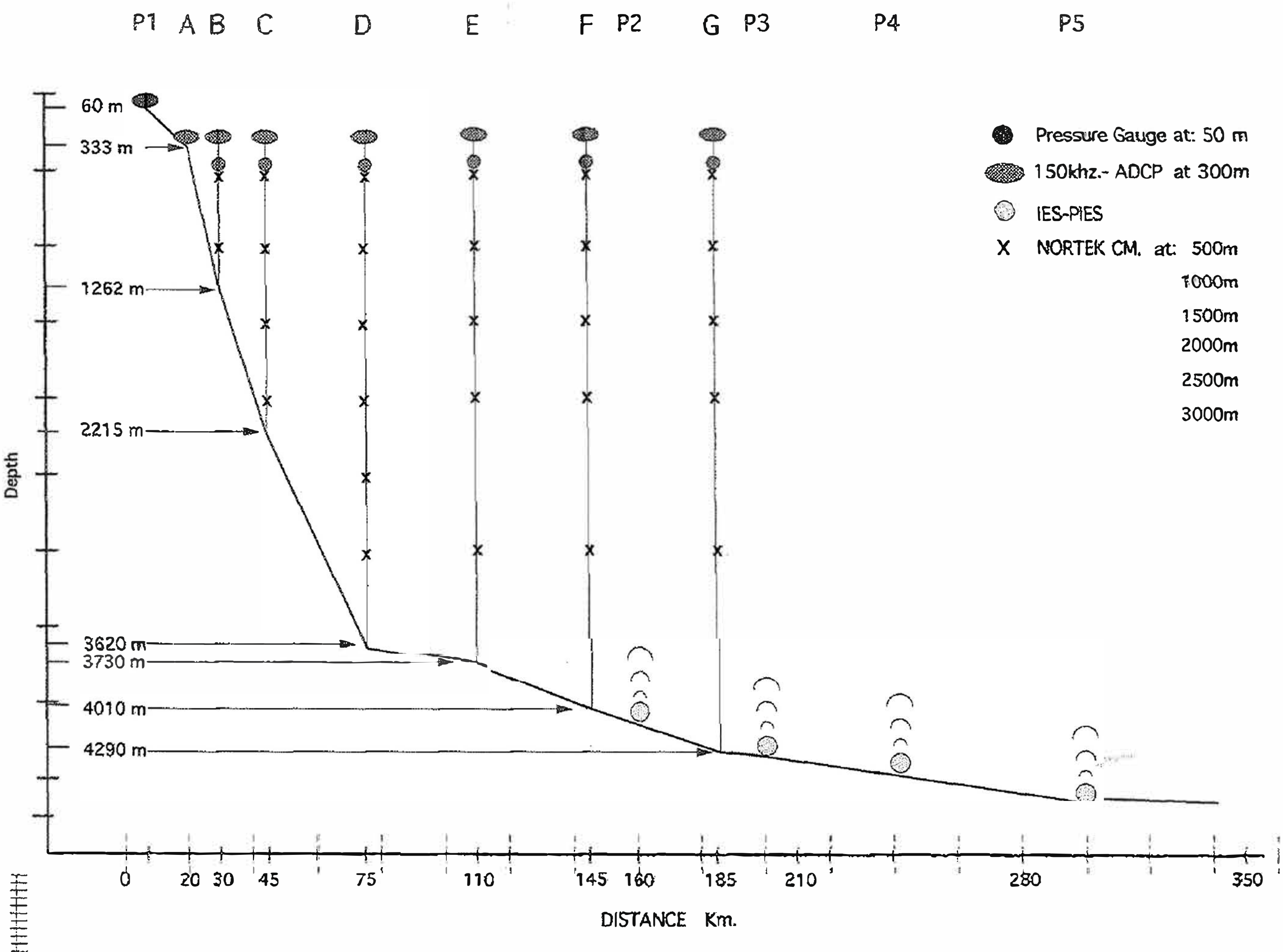
Table 1.10.0 shows the number of samples drawn and the number of times each WHP sample quality flag was assigned for each basic hydrographic property:

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.

ACT: AGULHAS CURRENT TIME SERIES



Science Party

Chief Scientist	Lisa Beal	RSMAS, University of Miami
Mooring Team	Mark Graham	
	Robert Jones	
Moorings/LADCP	Adam Houk	
SADCP/LADCP	Clement Rousset	
CTD	Courtney Schatzman	Scripps Institution of Oceanography
	Robert Thombley	
South African students	Tinus Sonnekus	Nelson Mandela Metropolitan University
	Brett Kuyper	University of Cape Town (bromoform
trace gas)		
	Megan van der Bank	University of the Western Cape
	Nausheena Parker	University of the Western Cape
Media	Dallas Murphy	
SSSG	Amy Simoneau	Woods Hole Oceanographic Institution Anton
	Zafereo	

General Cruise Plan

The plan was to deploy all moorings beginning inshore at P1 and ending offshore at P5, with CT- DO2/LADCP casts on and between mooring sites conducted at night. Then transit back inshore for a continuous underway shipboard ADCP section of the Current. Finally, conduct synoptic CTD line back offshore. Seven full-depth current meter moorings were successfully deployed, moorings A to G. One tide gauge and four C-PIES were also successfully deployed, P1 to P5. 40 CTDO2/LADCP stations were occupied. Only one weather day was used.

After a 48-hour steam from Cape Town, where the ship left port at about 17:00 GMT on 4th April 2010, a test CTD station and bathymetric survey for P1 were conducted on 6 April beginning at 18:00 GMT. Mooring deployment operations began 08:00 GMT on 7th April (first light and o6:00 local time) with P1 and A. Mooring deployments continued with one long mooring deployed per day, except 10th April when operations were suspended because of weather, through mooring F on 13th April. During this time CTDO2/LADCP casts were occupied at night on and between mooring positions. On the evening of the 13th April the first C-PIES (P2) mooring was deployed. The final long mooring G, was deployed on 14th April, followed by the three remaining C-PIES, to wrap up mooring operations on 15th April. Following the remaining CTDO2/LADCP cast, an underway transit across the Current was made during 16th April to obtain a synoptic section of velocities with as little contamination from time variability as possible. Once back inshore, mooring A was recovered (17th April) to amend a design flaw on the top float: a weight was added to the bottom of the frame to counterweight the ADCP and help the float stay upright (see next section). P1 and A were then redeployed successfully. To finish the cruise, we occupied another CTDO2/LADCP section across the Current from onshore to offshore (20 stations) out to P5, to capture as synoptic a dataset as possible. This line was begun on 17th April and finished on 20th, when we headed back towards Cape Town.

Current Meter Mooring Deployments

Deployment Operations: Each mooring deployment consisted of the following operations.

1. **Bathymetric survey of proposed site using SeaBeam**. Looked for a flat area 1/4 to 1/2 nautical mile square at the desired depth and near the mooring line. The SeaBeam swath width used was typically 60 degrees (1.7 x water depth). An averaged sound speed profile from the AUCE East London section was used to calibrate the SeaBeam for corrected depths. This worked well except over the shelf or in deep waters to the east of the Agulhas. For the latter, just-collected CTD data was used. You can tell the calibration is off when the bottom has a ridge along the mid-axis of the swath and the surveyed area looks “scolloped”. Previously planned survey grids didn’t necessarily work too well, since the depth required for mooring de- sign was not always found at the preliminary position (errors in ETOPO1). Therefore, coming up to the preliminary site along the mooring line and continuing until and past the desired depth was best, before doubling back for a swath either side if necessary. Waypoints for the survey were communicated to the bridge via telephone.

2. **Adjust mooring design for new target depth**. Once a new target was found, the new depth was communicated to Mark so that the mooring design can be modified with more or less shots of wire, if necessary. The time required for the mooring deployment was estimated as approximately 1 hour per 1000 m.

3. **Ship set up for Mooring Deployment:** For each set-up I asked the Mate to steer into the wind at 1.5 knots through the water for 15 minutes or so at the target site. By maintaining a heading into the wind, we eliminate windage from the ship - because there is almost no windage on the mooring as it is streamed out, windage on the ship causes wire angle.

During that time, the course and speed over ground was noted. Then, together with the expected duration of mooring deployment (approximately 1000 m per hour), we could ascertain how far off and in which direction the ship should set-up from the target site. When the wind was blowing opposite to the current, we needed 4 or 5 knots over ground to get 1-2 through the water with the current - hence some set-ups were over 10 nm from out target! On occasions when we headed into both wind and current, 1.5 knts through the water would have us approaching the target backwards, drifting 1-2 knts with the current! In those cases fall back was TOWARDS the target, hence our anchor drop was before we reached the target. For the most part, anchor drop was calculated as a vector product of fall back and current advection. For the moorings over 2000 m long, advection was equal or greater in distance than fall back.

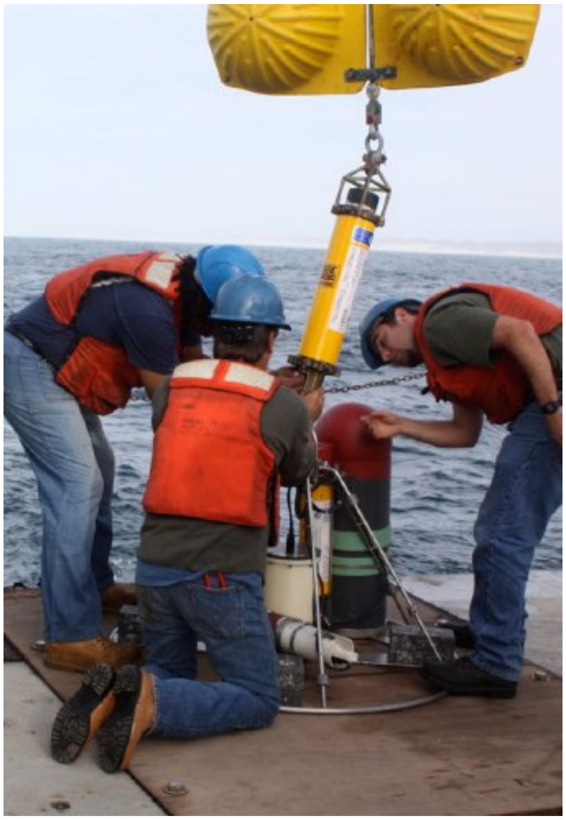
4 **Deployment**: Each mooring was deployed top buoy first, starting at the set-up site and ending at the target with anchor deployment. Serial numbers of instruments, notable changes, and times for each stage of the mooring were recorded on a mooring deployment sheet (from Mark). At anchor drop, position, time, and depth were noted.

5 **Ranging:** Immediately after the anchor drop, send someone up to the Bridge to watch the top float go under (if it remains on the surface the mooring has parted). Ask the Bridge to stop engines. Ask SSSG to switch off Knudsen and SeaBeam (anything around 12 kHz should be off). Listen for "last gasp" from the radio. The transducer is put over the starboard side to range off the releases. When the mooring reaches the bottom, the time is noted.

6 **Triangulation:** Once the mooring is on the bottom, Adam conducts a triangulation to get an accurate position for the final anchor site, after fall back and drift from the anchor drop position. (Only necessary for tall moorings that can be dragged for as last resort.) The triangulation requires ranging from three points 1/2 - 2/3 water depth from anchor drop position. Note - need to know average sound speed to the depth of the releases, not to the bottom. Finally, the releases should be DISABLED.

7. **CTD/LADCP cast** at mooring site.

P1: First day of mooring deployments (7/4/2010) were hampered by strong winds and sea state, plus currents of 3 or 4 knots. P1, the bottom-lander with pressure gauge, is designed so that the release on the package lets go two small buoys on a 150 m line and the package is then recovered by hauling on the line. A second release, the 'deployment release" is used to deploy the package by lowering on a wire (via winch) to the sea bed, then releasing and winding back in the wire together with the deployment release. For deployment, the ship maintained target position, hence the wire angle was large (next time better to make 1 - 1.5 kts through water, as for long mooring deployments).



P1 touched the bottom (slack on the wire) before it was released quickly. But, subsequent interrogation with the pack- age release told us it was not upright (later realised that since release was mounted upside down on the package it would always tell us it was not upright). For this reason we thought the mooring was on its side and popped it to recover it and redeploy upright. The floats were seen on the surface, but after a few minutes the strong current pulled the floats under once the rope was unwound. Captain Kent Sheasley devised a way to recover the mooring even though we could no longer see the top float: the ship was positioned parallel to southwestward cur- rent, with mooring site 50 m from port side. The mooring line would be streaming SW with the current. A piece of weighted line, with chain and two grappling hooks attached was lowered over the fantail. The ship then manouevred sideways until the mooring site was left 50 m to starboard - i.e. passing the grappling line across the streaming line. The grappling line was then slowly pulled back aboard - and success! The mooring line was hooked first time and P1 was retrieved. Due to the design flaw, the mooring was not redeployed until 17/4/2010. An extra buoy was added to help float the line on the surface for recovery.

Final position of P1: 33° 20.608' S, 27° 28.889' E at 59.5 m depth.

A: During deployment of mooring A (7/4/2010) the ADCP was pushed out of the top buoy and jammed against the frame by towing through a hefty sea state. We brought it back onboard and cut a piece of PVC piping to wedge between the frame and the ADCP to keep it in place. The mooring was subsequently deployed successfully. However, Mark Graham later reported a design flaw of the top floats on all moorings - he noticed that they were floating upside down and should be weighted on the bottom so that upon recovery they would float upright. Otherwise there is no strobe, no radio, and no ARGOS beacon to aid recovery. We returned to mooring A on 17/4/2010 and recovered it successfully on a calm day with small northwestward current (meander). A small length of chain with 20 lb weight was added to the top float and the mooring redeployed.

Final position of A: 33° 33.384' S, 27° 35.916' E at 329 m depth.

B through G: The rest of the moorings were deployed without incident, except that G was towed for several hours because the mooring set-up was estimated while in 3-4 knots of current (Agulhas meandered offshore), but the current was actually 1 -2 knots for most of the deployment. All top buoys, with the exception of mooring B, were ballasted to float upright. For configuration of the ADCPs and Aquadopps, see Appendix A. Fall rates averaged 125 m per minute.

Final positions of moorings:

B: 33° 39.216’ S, 27° 39.474’ E at 1275 m depth.

C: 33° 46.938’ S, 27° 43.188’ E at 2210 m.

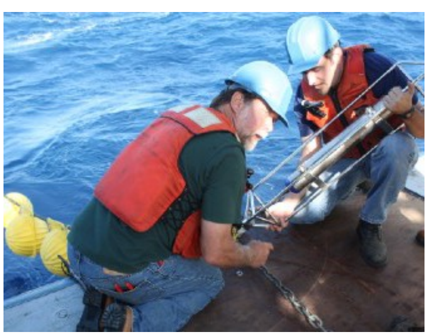
D: 34° 01.242’ S, 27° 51.798’ E at 3620 m.

E: 34° 17.190’ S, 28° 01.554’ E at 3730 m.

F: 34° 32.322’ S, 28° 09.732’ E at 4010 m.

G: 34° 49.314’ S, 28° 20.502’ E at 4270 m.

Detailed mooring diagrams A through G can be found in Appendix C.

C-PIES Deployment and Telemetry

Four current-meter and pressure-sensor equipped inverted echo sounders (C-PIES) were deployed at the offshore end of the mooring line; P2 - P5. Configuration of the C-PIES was for a 3.6 year deployment (with 20% safety margin): Travel time 24 times per hour (4 times every 10 minutes), Pressure and temperature 3 times per hour, speed and direction 3 times per hour (burst sampling). Deployments were simple and quick, made with the ship making 1 - 1.5 knts through the water. The toggle line, float, and current meter were lowered aft by hand, and 50 m of wire streamed. Then the PIES was lifted by it's bottom-mount frame using the outboard winch on the A-frame and a quick-release line. We released the PIES on target, not accounting for advection down- stream. Ranging on the C-PIES was successful, with the time to bottom well predicted by a 72 m per minute fall-rate. Telemetering on the C-PIES was much less successful. A DS-7000 deckset was borrowed from Sabrina Speich's group in Brest specifically for burst telemetering. However, using an over-the-side transducer, the results were inconsistent. Only on P4 were we able to obtain data that made sense (i.e. travel times in the 5-6 s range for ~4000 m depths). **Setting a gain of anymore than 5 produced garbage data** (easy to tell because numbers come in continuously rather than in bursts after measurement intervals).

The single biggest problem for signal-to-noise seemed to be the depth of the transducer. When the current was strong the transducer streamed and did not sink very well - this made for noisy data. **For successful telemetry of data on the turnaround cruise we will need to utilise the shipboard transducer.** Telemetering during CTD operations also poses challenges from thruster noise, however parallel operations will be necessary to cut down on the long time frame needed for file telemetry during the turn- around cruise.

Launch positions and nominal depths of the C-PIES are as follows:

P2: 34° 40.368' S, 28° 15.4270' E at 4157 m depth.

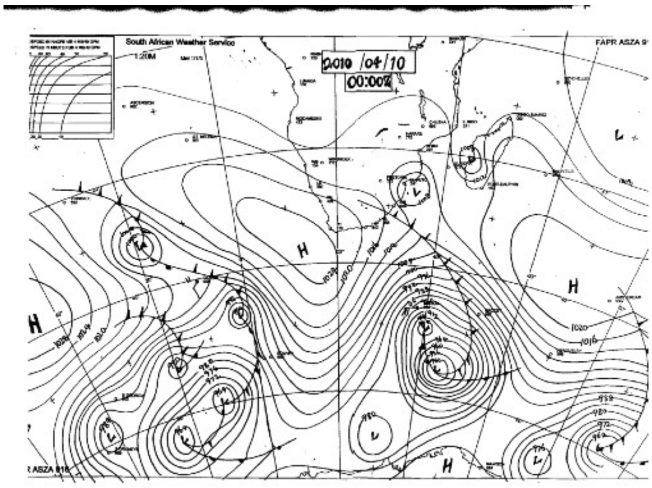
P3: 34° 57.4852' S, 28° 25.6620' E at 4327 m.

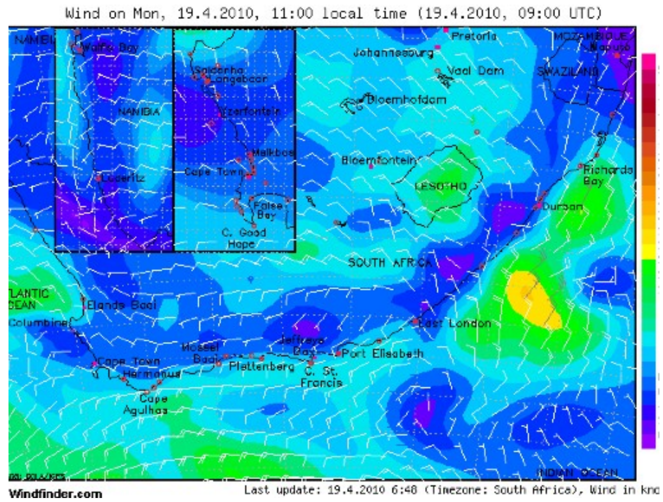
P4: 35° 20.7544' S, 28° 39.7290' E at 4360 m.

P5: 35° 44.03' S, 28° 54.o0' E at 4480 m.

Weather and Sea Surface Temperature (Brett Kuyper)

The weather data fell into three main categories; synoptic charts, daily predicted wind fields, and sea state. In addition we downloaded sea surface temperature images which proved very useful to track the Agulhas meander that passed the ACT line during our experiment.

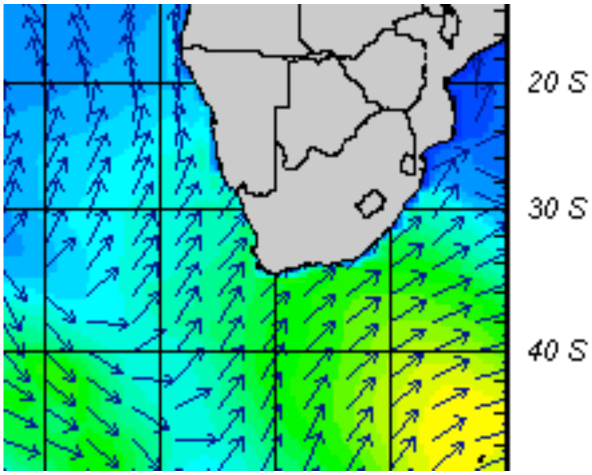


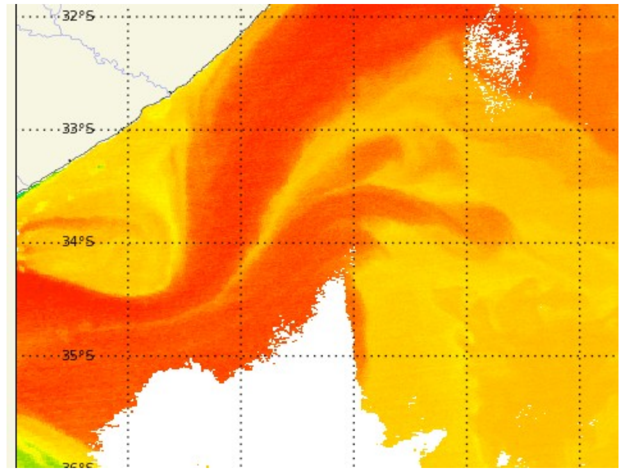


Synoptic charts were gathered from the South Africa Weather Service (SAWS) website. The charts were updated approximately every 6 hours, based on UTC time and can be obtained from either: http://metzone.weathersa.co.za/images/articles/ma_sy.gif ?1271298099935 or http://www.weathersa.- co.za/Weather.asp?Dte=Today&Vw=Over&Zoom=Ctry&Ref=01&Ad=0&Skin=Default&ProdType=1&Menu=1&VI=True&M=0&Menu=3&ProdType=3&Zoom=Ctry&Ref=01&Vw=Over&Dte=Today&frameURL=http://metzone.weathersa.co.za/viewforum.php?f=1 This is simply a chart showing the weather as it is, there is no analysis that has been applied to the charts.

Wind forecasts were obtained from WindFinder (http://www.windfinder.com/forecasts/wind_- globe_akt.htm), which provides forecast projections of the wind for different times of the day at different scales. Charts of South Africa turned out to be the most useful, however more localised information can be obtained if needed. One chart every morning was gathered for the wind at about noon every day. This data complimented the synoptic charts in better understanding the weather on any given day.

The Oceanweather website (http://www.oceanweather.com/data/) provided information on sea state twice daily. We downloaded one chart each morning. The data are a composite of observa- tional data through VOS and model data. There is probably a fair degree of skill in the chart, how- ever the spatial scale was too large to be of much help in predicting wave heights along the moor- ing line.





Finally, sea surface temperature images were obtained from The Marine Remote Sensing Unit (MRSU) in South Africa. Images were usually available from their website (http://www.afro- sea.org.za/) at approximately 11:30 am local time each day for the previous day. The images can be emailed to your account either by subscribing on the website or by emailing Christo Whittle (christo.whittle@uct.ac.za). The images were produced reliably each day (not at the weekend), however cloud cover often limited coverage.

The SST images showed a solitary meander passing over the ACT line, beginning 8th April. The meander propagated downstream with a speed of roughly 12 km per day and measured about 150 km in offshore extent and 200 km in alongshore extent. The Agulhas found offshore did not ap- pear to be diminished in speed or transport. Strong northwestward flow was found at the leading edge of the shear-edge cyclone.

Shipboard ADCP Program (Clement Rousset)

Knorr is equipped with two hull-mounted ADCPs: a 300 kHz instrument profiling down to 100 m with 4 m bins and a 75 kHz collecting interleaved broadband and narrowband pings each with 16- m bin length and ranges of 600 m and 800 m, respectively. The 300 kHz was switched on from the beginning of the cruise, collecting bottom-track and water-track pings for the two-day transit over the shelf. On 6th April at 14:12 the 300 kHz was reconfigured with water-track pings only, and the OS75 was switched on in interleaved mode. This set-up remained for the rest of the cruise.

The data acquisition system aboard is UHDAS, maintained by Jules Hummon and Eric Firing at the University of Hawaii. Data are processed in real time and provided as 15-minute average ocean

velocity profiles in matlab format. Live figures of ocean velocity, updated every 5 minutes, are available on the shipboard website: http://www.knorr.whoi.edu/n_index.shtml. Heading correction was supplied by posmv (primary) and phins (back up).

wh300_cont_uv.mat, os75bb_cont_uv.mat and os75n- b_cont_uv.mat contain ocean velocities stored in variable uv. Eastward velocities were stored in uv(:,1:2:end) and northward velocities were stored in uv(:,2:2:end). Bad data are represent- ed by NaN.

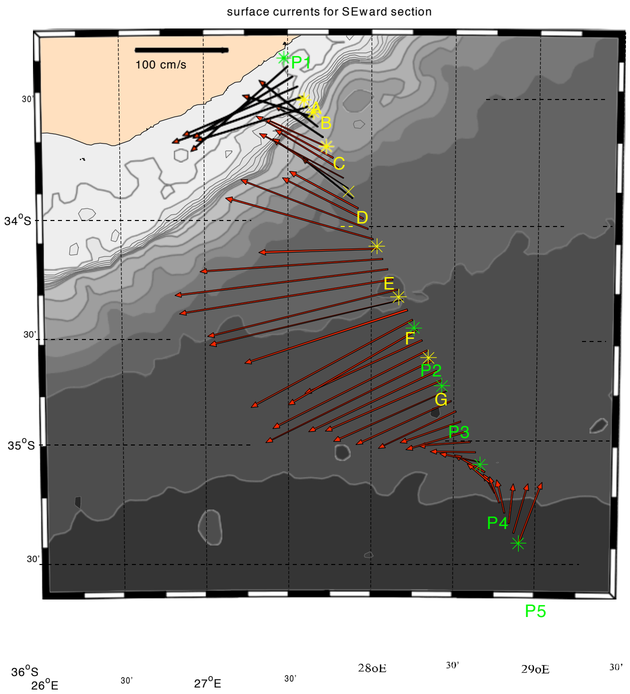
wh300_cont_xy.mat, os75bb_cont_xy.mat and os75n- b_cont_xy.mat contain three variables: z which is the depth bins, zc which is the center of depth bins, and xyt, in which the first column is longitude, the second is latitude, and the third is time.
Time is zero-based decimal days, counting from January 1st 2010 at 00:00, so that January 1st 2010 at 12:00 is 0.5. Therefore, OS75 started at decimal day 95.5920, while WH300 started at decimal day 93.5808.

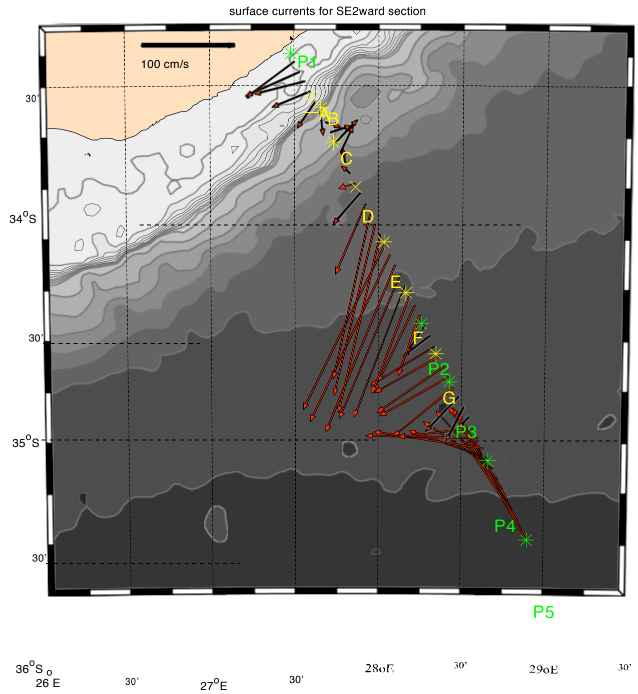
Three transects of the Agulhas Current were extracted during the cruise, named SE, NW, and SE2 (see figures in this section and front page). SE is from data collected onshore to offshore (in SouthEast direction at 154°T) during mooring deployments. Because the transect took 10 days to complete and an Agulhas meander moved over the mooring line during this period, these data are badly aliased by unresolved temporal variability. The NW transect was completed underway in 15 hours and represents the best snapshot. The final transect, SE2 was a synoptic CTD/LADCP section collected over 3.5 days.

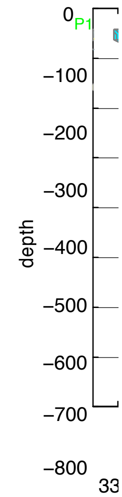
The Agulhas Current transport between the surface and 800 m is about 50 Sv (from NW section).

Lowered ADCP Program (Adam Houk)

LADCP Setup: Full water column velocity profiles were collected using a dual-300kHz Workhorse Monitor configuration. All equipment, including a back-up instrument, cables, and two battery packs were supplied by Dan Torres of Woods Hole Oceanographic Institution. The serial numbers of the WH300's were 4896, 4897, and 10417. The batteries were "SeaBattery" 48-Volt power modules, looking like square plastic boxes with an oil filled bladder inside. Mounting brackets for the ADCP's and battery on the CTD frame were provided by Scripps Institution of Oceanography.



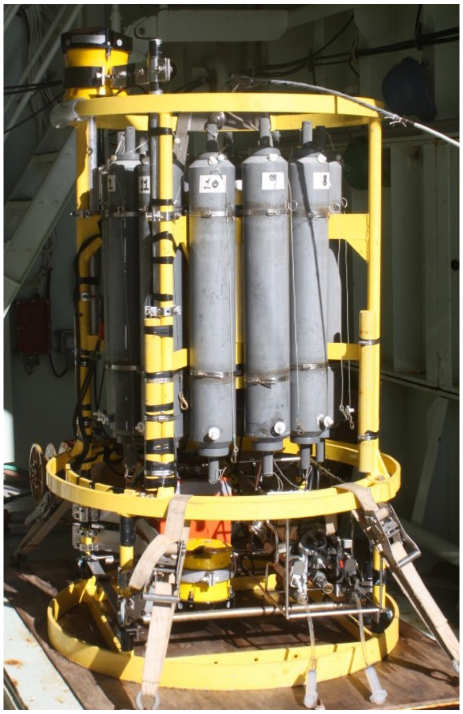




The upward-looking ADCP was mounted near the outer edge of the rosette, above the upper rim of the frame. The downward-looking ADCP was mounted in the center of the frame with the transducer face about 20cm above the deck. The sea-battery was secured adjacent to the downward-looking ADCP using ratchet straps. Both ADCP's ran off a single battery pack using a star-cable.

The ADCPs were configured for 20 8-meter bins, zero blanking distance, and an ambiguity velocity of 250 cm/s. The units were configured for staggered single-ping ensembles every 0.8/1.2 seconds. Measurements were saved in beam coordinates, with 3-beam solutions and bin-mapping disabled (see Appendix B for command files). Both upward-looking ADCPs were running firmware version 51.36, while the downward-looking ADCP was running version 50.36.

Data Acquisition Setup: Inside the main lab of the *Knorr*, a dedicated computer running Windows 2000 with two built-in serial ports was set up as the primary data acquisition platform. An American Reliance Inc. LPS-305 programmable power supply was used as the primary battery charger. The supply was programmed to output 58 Volts (+29/-29). Initially, the charger was plugged directly into the battery for recharging between stations using a third cable. About half- way through the first series of casts, the charger was plugged into one of the two long power/ communication cables that ran from the acquisition computer to the ADCPs while the rosette was inside its bay. This was done on Dan Torres' recommendation that the battery be charged through the star cable.



Deployment and Recovery: Lowered ADCP operations began on April 6th, 2010 with a "test" cast near the beginning of the main transect line. No operational problems were found with the dual-300kHz setup. Station 01 was on April 7th, around 20:48 UTC. Initial operations proceeded more slowly than anticipated, as the two LADCP shift operators needed to familiarize themselves with the equipment and procedures. After the first four or five casts, as they became more comfortable with the equipment, the typical deployment procedure was as follows:

- About 10 minutes prior to arrival on station, the LADCP operator wakes up the two ADCPs using RDI's BBTalk terminal program.
- After verifying the current drawn by the battery has reached minimal level (0.2 to 0.4 Amps), the battery charger is powered off.
- Internal clock, memory and instrument voltage check are made. Clocks are synchronized to the ship's GPS. The operator would NOT erase the ADCP's recorder unless the unit was over two-thirds of its capacity, and then only with my permission.
- The appropriate command file would then be sent to the instrument to initiate sampling. The output from this operation is captured to a log-file.
- Once the 'cs' command was sent, the operator would listen for audible 'pings' from both ADCPs to verify operation.
- Replace the vent plug on the battery, disconnect the two serial cables, and insert the dummy plugs.

The operator noted the time and position for the beginning of the cast, the maximum CTD depth in the middle of the cast, and the end of the cast on the log sheet. Upon the safe recovery of the rosette, the operator would begin the recovery procedure:

- After verifying the battery charger is off, the operator would plug both serial cables into the appropriate connectors and open the battery purge port.
- The battery charger is powered on as soon as possible to maximize the time available for charging.

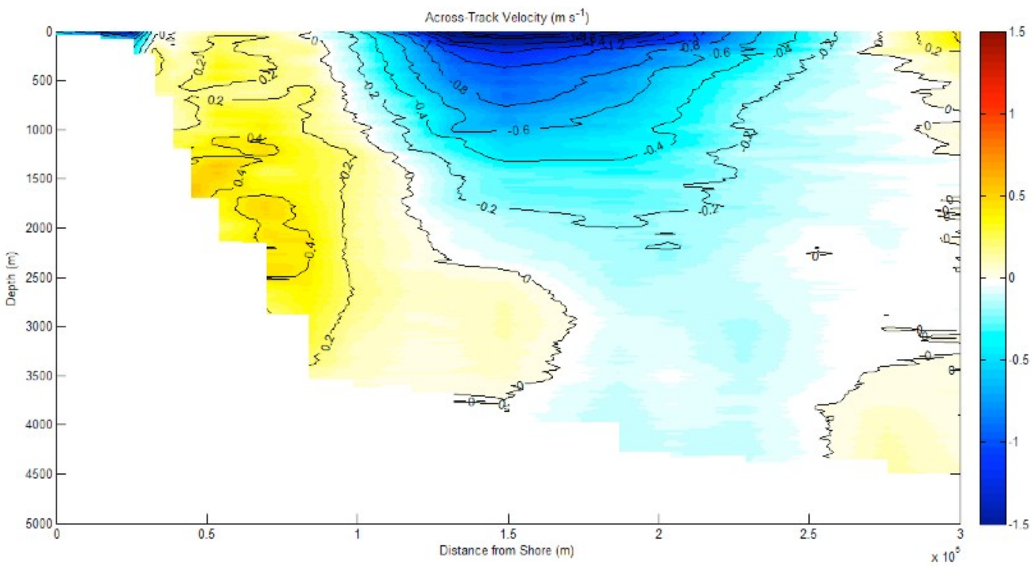
- The operator uses BBTalk to send a 'break' signal to both ADCPs, halting data collection and closing the data file.
- The instrument baud rate is changed to 115,200 bps to minimize the download time.
- The most recent good data file is transferred to a temporary cruise directory on the acquisition computer.
- The operator copies the downloaded data files to a separate folder, labeled by station number. The files are renamed here using the cruise convention: 'ACT0410_DN_nnn.000' or 'AC-T0410_UP_nnn.000' where 'nnn' is the station number.
- The baud rates are changed back to 9600 and the ADCPs are powered down.

The main transect line was 20 CTD stations, starting with 'CTD-01' at mooring 'P1' and ending with station CTD-20, at mooring 'P5'. CTD/LADCP casts were made at each of these stations during the mooring deployment period, April 7th through the 15th. A second series of consecutive casts along the same transect line began at station CTD-22, between moorings P1 and A (CTD-21 was only 60 m deep, so the LADCP was not deployed), on April 17th at 08:15 UTC, ending at station CTD-40, near station P5 on April 20th at 07:05 UTC.

Of the total 40 LADCP casts performed, only one station was a loss for data. The instruments did not ping on CTD-14 due to an error in the 'wh300_master.cmd' file. The command file had been temporarily altered to comment out the 'cs' or start pinging command. This was a result of troubleshooting steps taken in an attempt to resolve a perceived problem with the upward-looking (slave) ADCP not producing an audible 'ping' upon reaching station 12. Initially, it was thought to be a problem with the instrument itself, and s/n 4896 was swapped out for the spare, s/n 10417. When this unit also did not produce an audible ping, the battery was swapped out with its spare as well. This action, at first, appeared to solve the problem, and we proceeded with the cast at station 12.

At station 13, the audible ping again was absent. The chief scientist decided to proceed with the full cast in lieu of a short test cast to examine the echo intensity from the ADCPs. Upon recovery, we discovered that the data from both units appeared to be fine, and it was then apparent that there was never any problem with the upward-looking transmitted power. Only the audible ping produced by the ADCP's DSP board was missing, or at least intermittent. The LADCP operator on duty for station 14 was not aware of the change to the command file, and ran the script as instructed. Since the master ADCP was never told to start pinging, no data were collected from either unit during this cast. The master script was corrected for subsequent casts. A table summary of station times and locations can be found in Appendix B.

Data Processing: The two raw ADCP data files were copied to a dedicated laptop for processing. Using RDI's WinADCP, the files were examined to determine the approximate in-situ and out-situ ensemble numbers. The raw data files were then trimmed, discarding any out-of-water ensembles, using RDI's 'BBSub' utility. A trimmed version of the raw file was saved to a separate directory for processing. Navigation data were extracted from the uncorrected half-second time-series CTD data provided by the CTD operator, downloaded over the ship's network. Once the files were in the proper directories, the "first-pass" processing could be executed.



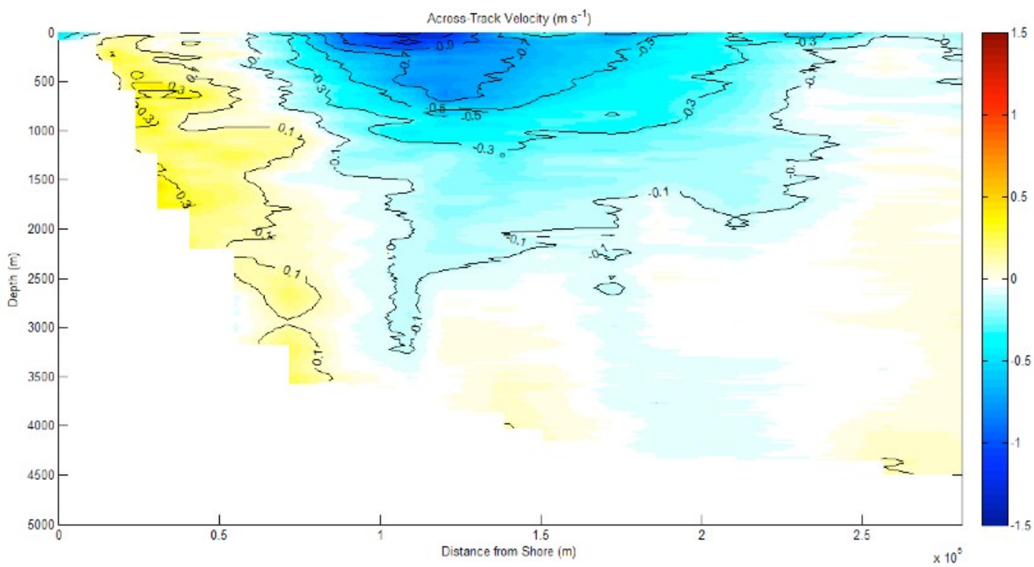
The initial processing of the raw ADCP data was done using version 10.8 of the M. Visbeck (& A. Thurnherr) MATLAB toolbox, modified by G. Krahmann. The 'process_cast(nnn)' script was run, with 'nnn' representing the station number, which called subroutines to copy, load, scan in, and run the shear and least-squares inverse methods. About a dozen graphics are generated with use- ful diagnostic information and the final water column profile. The processing scripts required sig- nificant modifications that were not anticipated, primarily to ensure the ADCP and GPS data were properly loaded. Two small m-files were added: 'load_ctd_for_nav.m' and 'load_ctd_- for_prof.m' to the local /m directory that were called by the 'prepctdprof.m', 'prefctdtime.m' and 'prepnav.m' scripts to generate mat-files for processing. Manual changes to the 'cruise_params.m' and 'prepare_cast.m' code were also necessary to ensure that only the navigation data would be used in the first-pass processing. When the first-pass was finished, the operator would note in the log sheet the calculated depth based on the integrated vertical velocity and compare it to the max- imum depth reported by the CTD.

During processing the following warning messages were encountered:

- 16 casts returned the warning message: "Large up-down compass difference", with a value ranging from 15 to 20 degrees.

- Two casts, stations 2 and 24 returned the warning “Different Lag Results!!! Check New Rou- tine”.
- 30 out of 40 casts returned the warning: “Increased error because of shear-inverse difference”.

Cast 6 had an unusually large calculated time lag between CTD and LADCP, -103 seconds. Casts 23 and 24 were -6 and -7 seconds respectively. All other casts were between 0 to 3 seconds. Cast 30 showed evidence of being dragged along the bottom for a brief period, however no damage was done to the downward-looking ADCP.



Towards the end of the cruise, all casts were re-processed to include CTD data and 15-minute averaged ADCP profile data from the hull-mounted 75 kHz Ocean Surveyor. The SADCP data were downloaded from UHDAS as two mat-files: ‘contour_xy.mat’ and ‘contour_uv.mat’. Stations 1 and 22 had no SADCP data available, and stations 2, 4, 5 and 6 had no ‘good’ data available, likely due to rough sea conditions during the cast. The two figures show, respectively, final-processed cross- sections from stations 1 through 20, and stations 21 through 40.

Summary: Overall, the two 300kHz ADCPs performed well, with no major communication or power issues. The practice of listening for an audible ping to confirm the instruments are sampling may not necessarily be a reliable test, since it became clear that both upward-looking AD- CPs used during this cruise, have a sporadic problem with their audible output. Both units experienced significant drops in profile range at depths below 2000 meters, down to around 50 meters at the 3000 to 4000 meter range. Calculated depths based on the integrated w-velocity tended to over-estimate the maximum depth of the cast, possibly due to the large lateral movement of the CTD package and high pitch and roll values? Many stations appeared to have a small negative bias in the u-velocity error plot of the upward-looking ADCP during the downcast, possibly related to turbulence in the wake of the rosette.

CTD Program (Courtney Schatzmann and Robert Thombley)

A full report of the ODF CTDO2 program is available separately. Included here is a summary of the most pertinent information. A total of 40 stations were occupied and 40 Rosette/CTD/LADCP casts made. Water samples (up to 12) and CTD data (pressure, temperature, conductivity, dissolved oxygen) were collected on each cast, usually to within 5-70 meters of the bottom (distance off bottom increased after package grounded during station 31).

Instrumentation: The package consisted of a 12-bottle rosette frame (SIO/STS), a 12-place carousel (SBE32) and 12 10.0L Bullister bottles (SIO/STS). Underwater electronic components consisted of a Sea-Bird Electronics SBE9plus CTD (SIO/STS #796) with dual pumps (SBE5), dual temperature (SBE3plus), dual conductivity (SBE4C), dissolved oxygen (SBE43), and an 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. Pump exhausts were attached to the sensor bracket on the side opposite from the sensors. The altimeter was mounted on the in- side of the bottom frame ring. The downward-looking 300 KHz LADCP (RDI) was mounted vertically on one side of the frame between the bottles and the CTD. The LADCP battery pack was also mounted on the bottom of the frame. The upward-looking 300 kHz LADCP was mounted above the rosette on the top 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. Re-terminations were performed prior to station 30 and 31, after a kinks were found in the winch wire.

Operations: 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 wireout reading, and begin the descent.

For bottom approaches, the altimeter, wire out, Knudsen depth, and CTD depth were all used to help determine distance off bottom. For each up cast, the winch operator was directed to stop the winch at between 3 and 12 sampling depths, which 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. Routine CTD maintenance included soaking the conductivity and oxygen sensors in fresh water between casts to maintain sensor stability.

Data Acquisition and Processing: The data acquisition system consisted of three PCs running linux. One was designated as console and connected to the CTD deck unit. The console provided an interface and graphic display for monitoring incoming data and closing bottles. CTD sensor pumps were configured with a 5-second delay after detecting sea water conductivities. The target lowering rate was 60 m/min, but this was not achieved for the first few stations because the package was flying too much in the strong currents. Weight was added to the bottom of the frame, which solved the problem. After the last bottle was closed, the console operator directed the deckwatch 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.

Shipboard CTD data processing (and data back-up) was performed automatically during each cast, when the laboratory calibrations for pressure, temperature, and conductivity were applied. 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 (primary and secondary sensors com- pared), clean sensor response, and calibration shifts. A 2-decibar pressure series was then generated from the down cast. 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. 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.

The 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 and 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 was corrected prior to station 4. Timing offsets were applied in processing to 1-3 and corrected for salinity.

Calibration: For shipboard calibration procedures, including salinity and oxygen analysis, see the full CTD report. For salinity, the 95% confidence limits are ±0.00120 PSU relative to bottle salinities for deep salinities, and ±0.00335 PSU relative to bottle salinities for all salinities where T1-T2 is within ±0.01°C. The standard deviations of 2.05 µmol/kg for all oxygens and 0.49 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 O2 data.

Phytoplankton and Nutrients (Tinus Sonnekus)

Samples for phytoplankton and nutrients were collected at 30 of the 40 ACT CTD stations. Normally, the Deep Chlorophyll Maximum (DCM) or Fluorescence Maximum (F-Max) are identified on the downcast and Niskin bottles triggered in them on the upcast. In this instance, with no fluorescence measurements the maximum was assumed to be near the thermocline.

Sampling: Water was collected from the surface, seasonal thermocline, and below (0, 5-113 m, and 150 m). Samples were collected for size fractionated chl-a, phytoplankton identification, and nutrients.

Chlorophyll-A analysis: Half a litre (500 ml) of water from each sample depth was filtered through a Sartorius filter tower cascade set-up with the following filter paper: Top - 20 µm Nylon Net Millipore filter to collect microphytoplankton; Middle - 2 µm Macherey-Nagel filter to collect nanophytoplankton; Bottom - 0.7 µm GF/F Whatman filter to collect picophytoplankton.

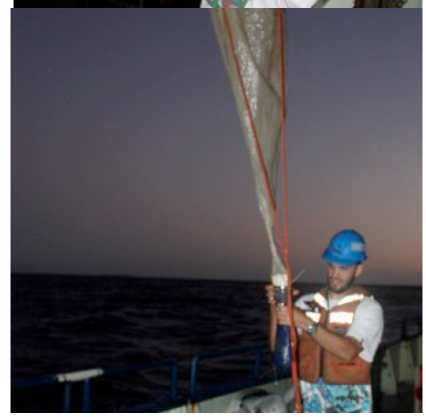
The filter papers were sealed in tin foil, labeled and placed in a -20°C freezer for later analysis.

Chl-a will be extracted and read on a Turner Designs 10AU Fluorometer in the phytoplankton laboratory of the South African Institute for Aquatic Biodiversity, South Africa.

Phytoplankton identification: One litre of water was collected from each sample depth, pre- served with either 2% Lugols (20 ml) (Karayanni et al. 2004), 10 % buffered formalin, or gluterhaldehyde and stored for later analyses. The samples were always added to the fixative so that the preserved cells experienced the minimum target fixative concentration at all times.

Phytoplankton cast: At CTD stations 9,10,11, and 12 an 80 µm ring net was deployed vertically to 100 m and winched up to the surface at 0.5 m/s. The contents of the cod-end were washed into a 250 ml honey jar containing 2% Lugols solution and stored for later analyses. Identification of all taxa to the lowest taxonomic level will be done at the Nelson Mandela Metropolitan University (NMMU) and SAIAB using Light and Scanning Electron Microscopy.

Nutrients: Acid washed 50 ml "urine jars" were rinsed twice with water directly from each sample depth and filled ¾ full (5 – 10 ml space were left to allow expansion during freezing). Bottles were labelled and placed in a -20°C freezer for later analysis. The nutrients will be analysed in Dr. Howard Waldron's laboratory in the Department of Oceanography at the University of Cape Town.



To access the data please contact Dr Tom Bornman at t.bornman@saiab.ac.za.

Appendix A - Configuration of Moored ADCPs and Aquadopps

WorkHorse Monitor, 150 kHz

```
CR1
WM1
CF11111
EA0
EB0
EC1500
ED3000
ES35
EX11111
EZ0111101
WA50
WB1
WD111100000
WF352
WN50
WP45
WS800
WV175
TE01:00:00.00
TP01:20.00
CK
CS
;
;Instrument        = Workhorse Monitor
;Frequency         = 153600
;Water Profile     = YES
;Bottom Track      = NO
;High Res. Modes   = NO
;High Rate Pinging = NO
;Shallow Bottom Mode= NO
;Wave Gauge        = NO
;Lowered ADCP      = NO
;Ice Track         = NO
;Surface Track     = NO
;Beam angle        = 20
;Temperature       = 10.00
;Deployment hours  = 14400.00
;Battery packs     = 2
;Automatic TP      = YES
;Saved Screen      = 3
;
;Consequences generated by PlanADCP version 2.05:
;First cell range  = 12.21 m
;Last cell range   = 404.21 m
;Max range         = 234.57 m
;Standard deviation = 1.06 cm/s
;Ensemble size     = 1154 bytes
;Storage required  = 16.90 MB (16617600 bytes)
;Power usage       = 741.58 Wh
;Battery usage     = 1.6
```

Aquadopp

```
Measurement interval  (s) : 1200
Average interval      (s) : 120
Blanking distance     (m) : 0.35
Diagnostics interval(min) : 720
Diagnostics samples       : 20
Measurement load      (%) : 4
Power level               : HIGH
Compass upd. rate     (s) : 2
Coordinate System         : ENU
Speed of sound      (m/s) : 1500
Salinity            (ppt) : N/A
File wrapping             : OFF
------------------------------------------------------------
Assumed duration   (days) : 640.0
Battery utilization   (%) : 450.0
Battery level         (V) : 11.4
Recorder size        (MB) : 5
Recorder free space  (MB) : 5.000
Memory required      (MB) : 2.9
Vertical vel. prec (cm/s) : 1.0
Horizon. vel. prec (cm/s) : 0.7
------------------------------------------------------------
Aquadopp Version 1.23
Copyright (C) 1997-2002 Nortek AS
============================================================
```

Appendix B - LADCP Station Summary and Command Files

Station	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
1	2010/04/07	20:31	20:42	20:56	21:04	59	60	59	-33 20.7508	27 28.854
2	2010/04/07	22:05	22:21	22:27	22:45	74	74	93	-33 27.9732	27 32.3864
3	2010/04/07	23:36	23:44	00:09	00:17	236	236	248	-33 33.6756	27 33.9405
4	2010/04/09	11:33	11:52	12:45	12:55	660	662	672	-33 35.6379	27 37.8186
5	2010/04/09	13:32	13:50	15:21	15:25	1203	1206	1217	-33 38.7961	27 39.2926
6	2010/04/09	17:17	17:33	19:22	19:25	1708	1713	1720	-33 41.2994	27 41.7789
7	2010/04/10	22:07	22:16	00:01	00:06	2135	2093	2110	-33 45.9951	27 40.9008
8	2010/04/11	01:05	01:22	03:46	03:51	2874	2844	2914	-33 52.3487	27 47.6027
9	2010/04/11	11:53	12:26	15:15	15:22	3583	3544	3559	-33 59.29	27 51.2047
10	2010/04/11	17:46	18:09	20:49	20:59	3638	3615	3627	-34 6.8261	27 55.506
11	2010/04/12	09:47	10:00	12:39	12:47	3725	3692	3700	-34 16.2511	27 59.4323
12	2010/04/12	17:20	17:31	20:25	20:30	3870	3807	3822	-34 23.79	28 1.919
13	2010/04/13	14:34	14:37	17:47	17:53	4049	3989	3999	-34 32.7666	28 4.7396
14										
15	2010/04/14	16:56	17:07	20:12	20:16	4313	4259	4274	-34 50.2774	28 16.8616
16	2010/04/15	23:38	23:43	02:40	02:47	4355	4320	4331	-34 57.741	28 23.6439
17	2010/04/15	04:11	04:30	07:30	07:38	4375	4366	4380	-35 9.4014	28 31.4052
18	2010/04/15	10:42	10:51	14:02	14:07	4394	4372	4387	-35 20.706	28 39.5077
19	2010/04/15	15:27	15:41	18:45	18:52	4556	4510	4522	-35 31.4728	28 47.2116
20	2010/04/15	22:20	22:25	01:32	01:31	4625	4600	4612	-35 43.2417	28 54.945
21										
22	2010/04/17	08:04	08:15	08:32	08:38	90	87	95	-33 27.8219	27 32.6014
23	2010/04/17	11:33	11:40	12:13	12:25	310	300	309	-33 33.4452	27 35.3443
24	2010/04/17	12:48	12:58	13:56	14:00	625	602	615	-33 35.6743	27 37.3345
25	2010/04/17	14:20	14:32	15:57	16:09	1271	1239	1252	-33 39.2773	27 39.4926
26	2010/04/17	16:24	16:33	18:16	18:20	1832	1800	1813	-33 42.4899	27 41.7325
27	2010/04/17	18:46	19:01	20:55	21:00	2253	2206	2215	-33 47.4201	27 44.0349
28	2010/04/17	21:30	21:41	23:55	00:04	3180	3127	3178	-33 54.205	27 47.9048
29	2010/04/18	00:50	00:53	03:36	03:44	3629	3585	3604	-34 3.0619	27 49.9382
30	2010/04/18	04:17	04:25	07:40	07:53	3622	3622	3622	-34 11.6624	27 55.0878
31	2010/04/18	10:52	10:59	14:00	14:04	3770	3712	3742	-34 21.6532	27 59.7579
32	2010/04/18	14:42	15:00	18:02	18:07	3770	3823	3881	-34 26.0943	28 4.059
33	2010/04/18	18:48	19:13	22:15	22:21	4042	4004	4054	-34 35.027	28 9.7359
34	2010/04/18	23:04	23:07	02:00	02:07	4145	4095	4166	-34 40.9026	28 14.1271
35	2010/04/19	03:06	03:30	06:30	06:34	4248	4222	4282	-34 51.3657	28 20.281
36	2010/04/19	07:49	07:53	10:56	10:59	4305	4293	4333	-34 57.6936	28 24.3573
37	2010/04/19	12:09	12:19	15:25	15:31	4370	4346	4386	-35 9.3159	28 31.9035
38	2010/04/19	16:52	17:02	20:11	20:17	4360	4316	4366	-35 20.5161	28 38.7652
39	2010/04/19	21:43	21:54	00:55	00:57	4470	4446	4498	-35 31.3463	28 46.5924
40	2010/04/20	03:08	03:17	07:05	07:11	4512	4529	4612	-35 43.2062	28 53.4102

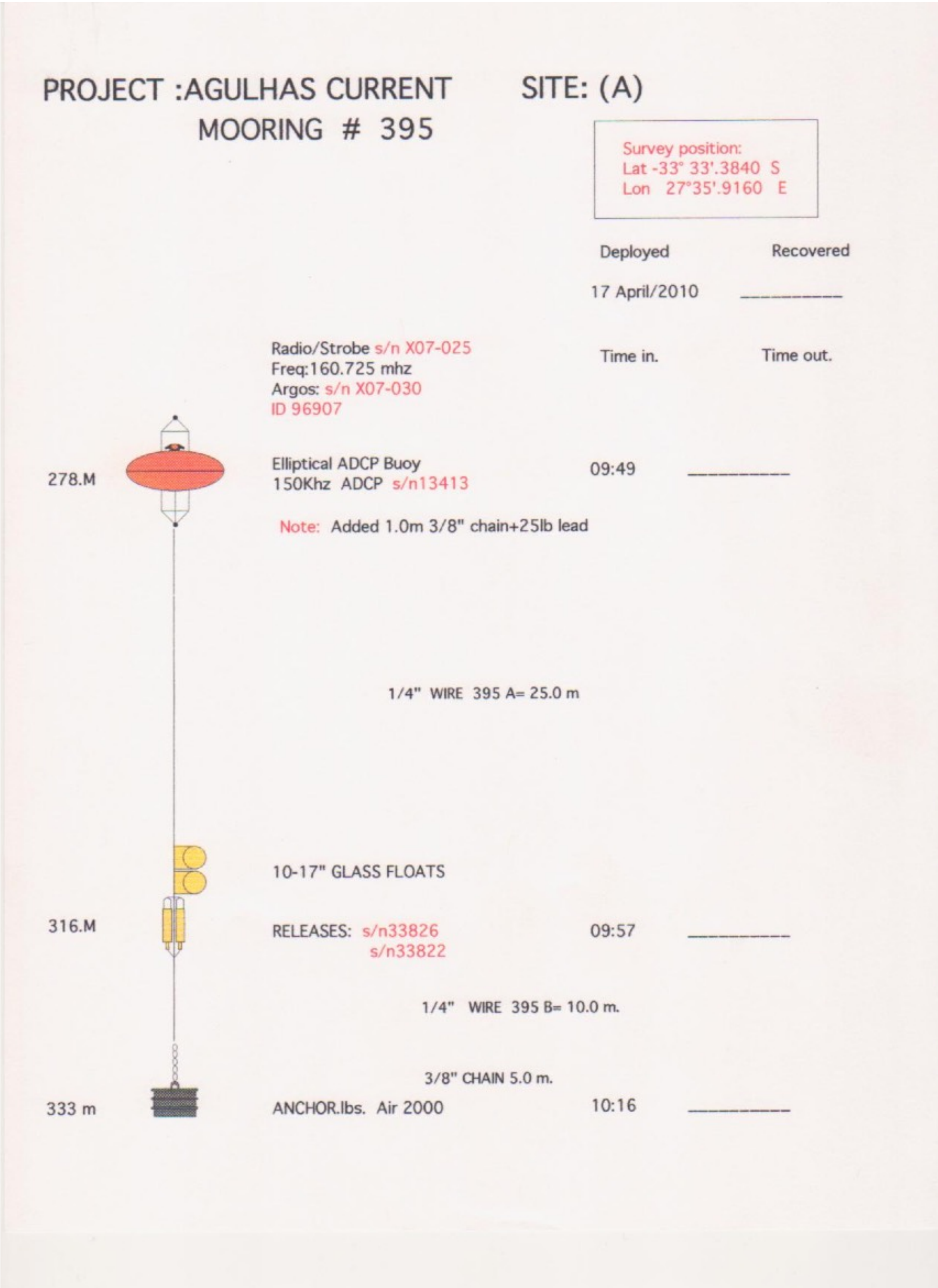
```
;==================================================
;  W H M A S T E R _ P R O T O . C M D
;  LMB: Tue Apr  1 15:38:43 EDT 2008
;
;  WH300kHz master/downlooker deployment script
;  for new firmware v16.30
;==================================================
; Changes from previous deployment scripts:
; (1) "wm15" command for LADCP mode and no longer need "L" commands
; (2) only commands that change defaults are included (EA,ES etc removed)
; (3) data collected in beam coordinates (allows better inspection of
;     raw data and 3-beam solutions if necessary)
; (4) staggered single-ping ensembles every 0.8/1.2 s (Andreas has seen
;     bottom-interference in WH300 data in Antarctic - seems unlikely for
;     Abaco, but does not lose us pings).
; (5) 20 8 m bins - for a range of 200 m (try less for deep casts)
;
```

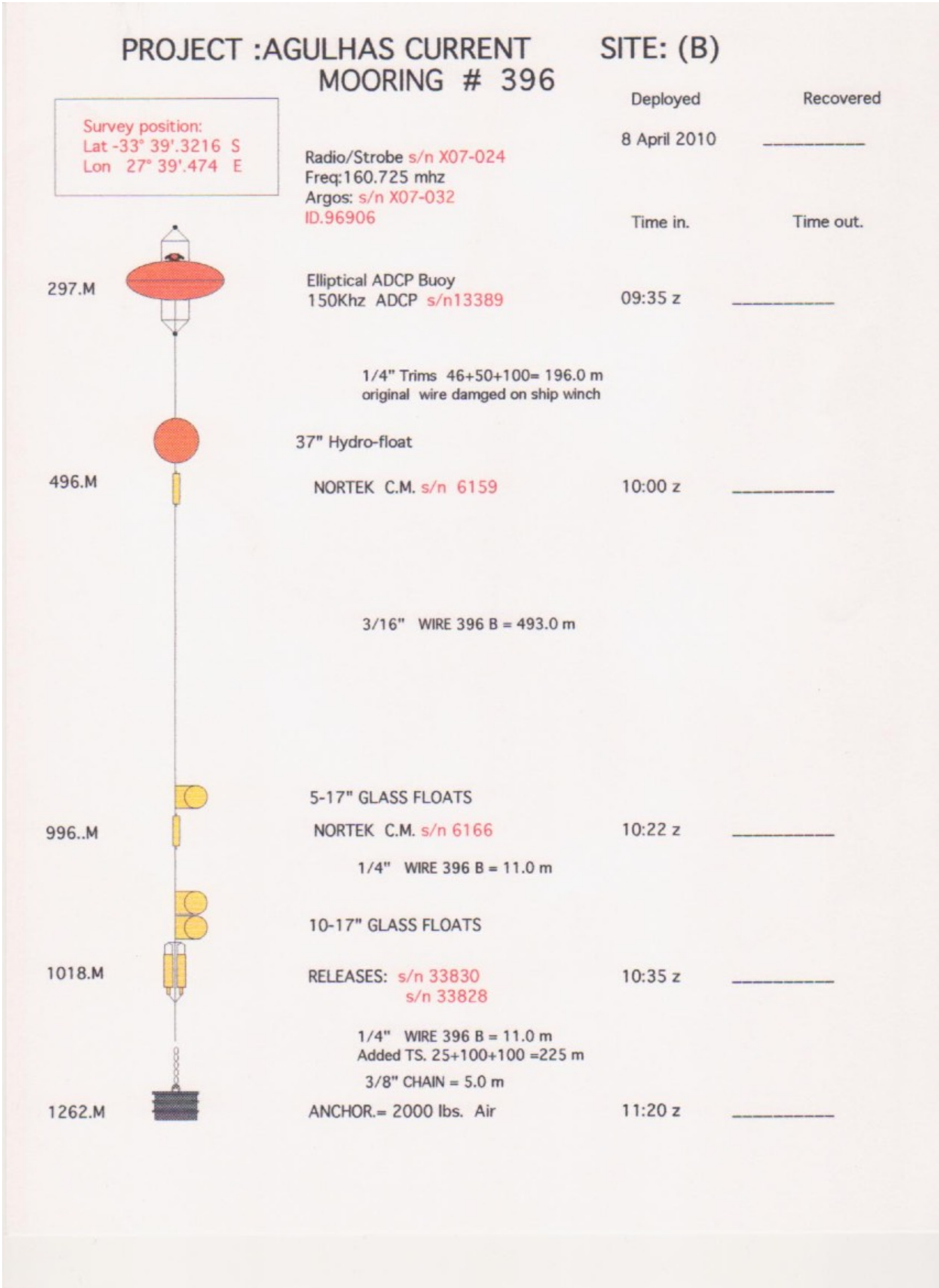
```
; Changes made after email discussions with Eric and Andreas, April 2008
;
; Ask for log file
$L
; display ADCP system parameters
PS0
; Pause
$D2
; return to factory default settings
CR1
; activates LADCP mode (BT from WT pings)
WM15
; Flow control:
;	- automatic ensemble cycling (next ens when ready)
;	- automatic ping cycling (ping when ready)
;	- binary data output
;	- disable serial output
;	- enable data recorder
CF11101
$D2
; coordinate transformation:
;	- radial beam coordinates (2 bits)
;	- use pitch/roll (not used for beam coords?)
;	- no 3-beam solutions
;	- no bin mapping
EX00100
; Sensor source:
;	- manual speed of sound (EC)
;	- manual depth of transducer (ED = 0 [dm])
;	- measured heading (EH)
;	- measured pitch (EP)
;	- measured roll (ER)
;	- manual salinity (ES = 35 [psu])
;	- measured temperature (ET)
EZ0011101
;
$D2
;  - configure staggered ping-cycle
; ensembles per burst
TC2
; pings per ensemble
WP1
; time per burst
TB 00:00:01.20
; time per ensemble
TE 00:00:00.80
; time between pings
TP 00:00.00
$D2
; - configure no. of bins, length, blank
; number of bins
WN020
; bin length [cm]
WS0800
; blank after transmit [cm]
WF0000
$D2
; ambiguity velocity [cm]
WV250
; amplitude and correlation thresholds for bottom detection
LZ30,220
```

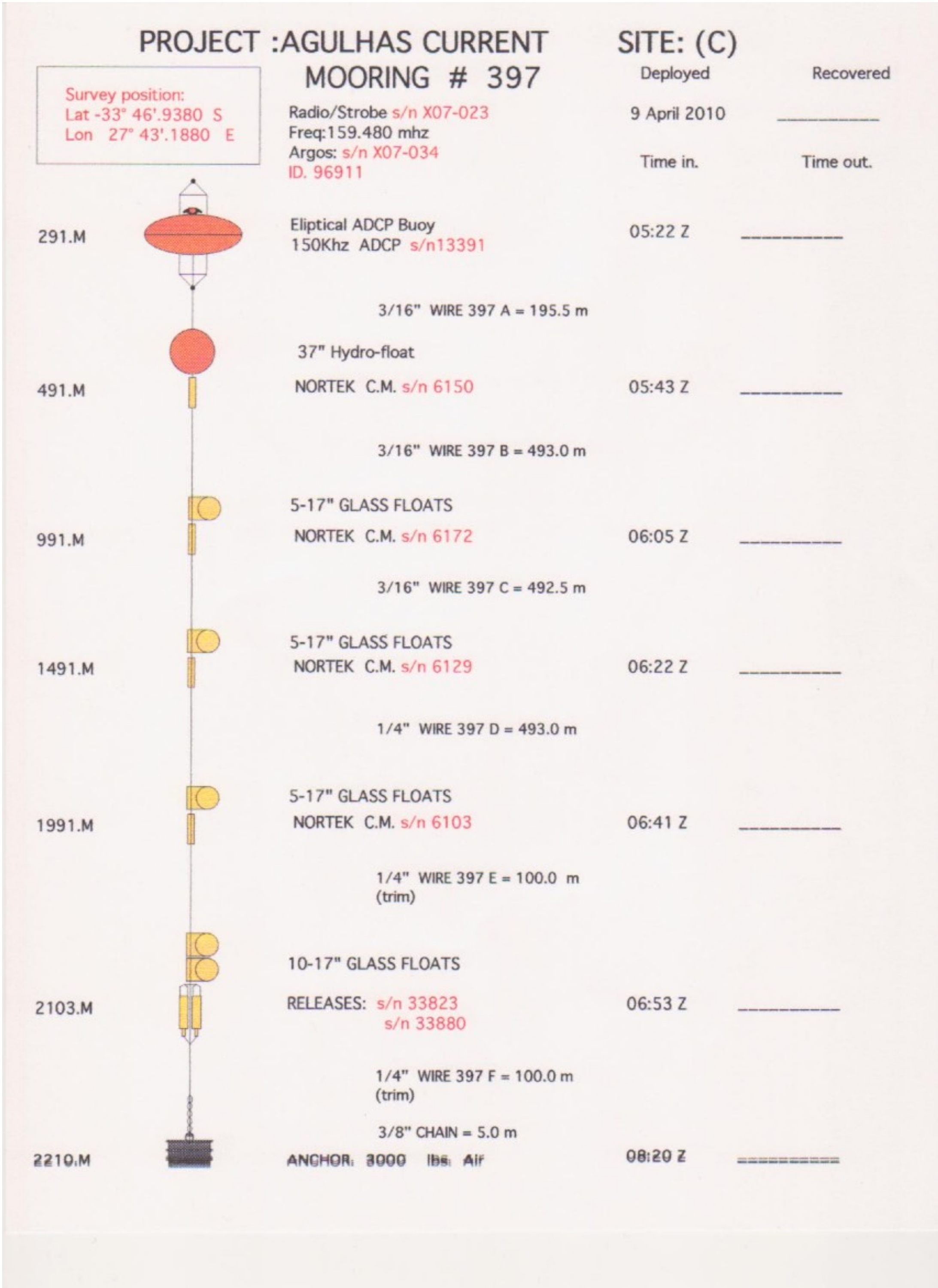
```
$D2
; master
SM1
; send pulse before each ensemble
SA011
; wait .5500 s after sending sync pulse
SW05500
; # of ensembles to wait before sending sync pulse
SI0
$D2
; keep params as user defaults (across power failures)
CK
; echo configuration
T?
W?
$D5
; start Pinging
CS
; End Logfile
$L


;==============================================
;  W H S L A V E _ P R O T O . C M D
;  LMB: Sat Apr  5 15:03:52 EDT 2008
;
;  WH300kHz slave/uplooker deployment script
;  for new firmware v16.30
;==============================================
; Changes from previous deployment scripts:
; (1) "wm15" command for LADCP mode and no longer need "L" commands
; (2) only commands that change defaults are included (EA,ES etc removed)
; (3) data collected in beam coordinates (allows better inspection of
;     raw data and 3-beam solutions if necessary)
; (4) staggered single-ping ensembles every 0.8/1.2 s (Andreas has seen
;     bottom-interference in WH300 data in Antarctic - seems unlikely for
;     Abaco, but does not lose us pings).
; (5) 20 8 m bins - for a range of 160 m.
;
; These changes made after email discussions with Eric and Andreas, April 2008.
;
; Ask for log file
$L
; display ADCP system parameters
PS0
; Pause
$D2
; return to factory default settings
CR1
; activates LADCP mode (BT from WT pings)
WM15
; Flow control:
;       - automatic ensemble cycling (next ens when ready)
;       - automatic ping cycling (ping when ready)
;       - binary data output
;       - disable serial output
;       - enable data recorder
CF11101
$D2
; coordinate transformation:
;       - radial beam coordinates (2 bits)
```

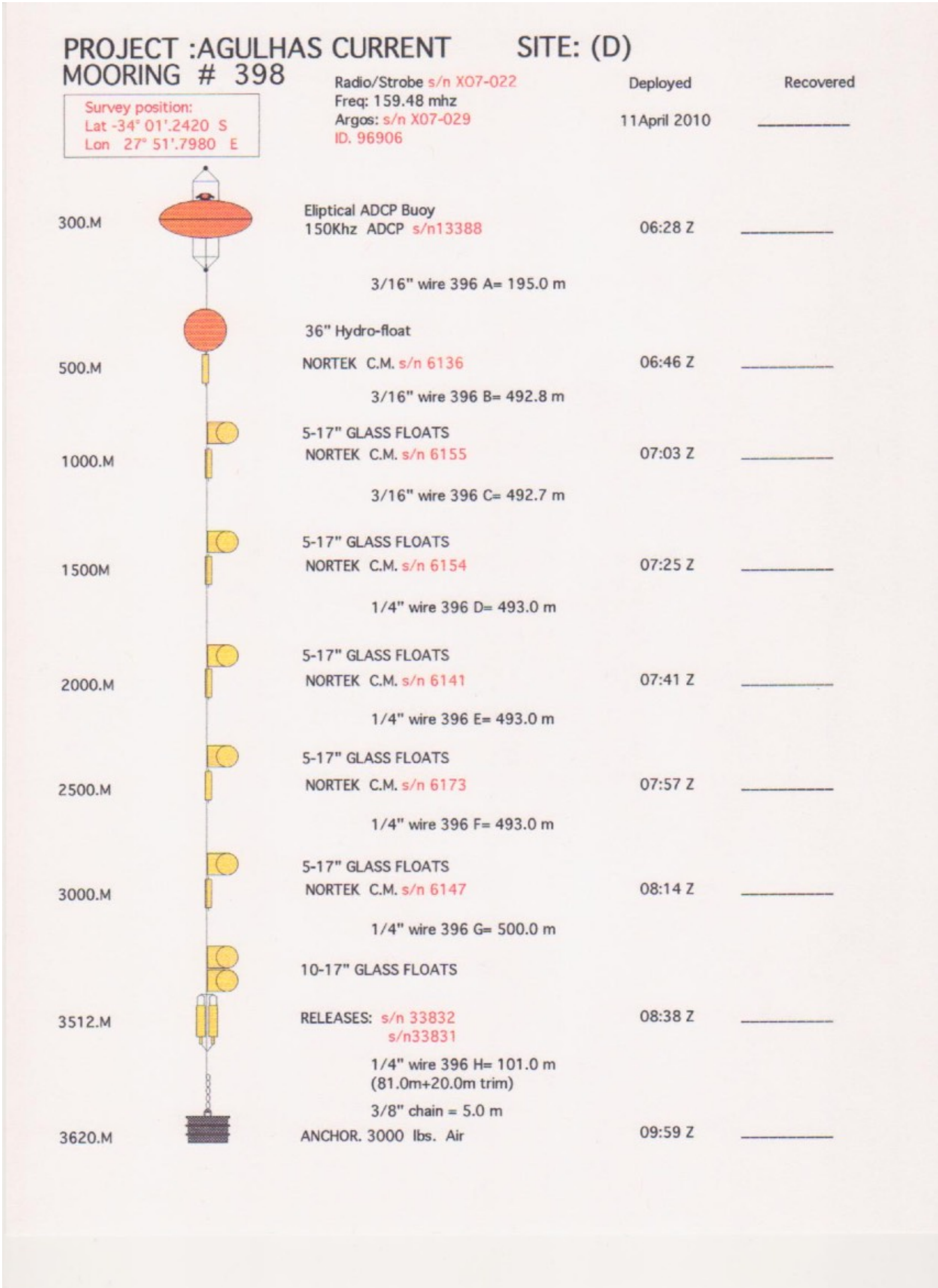
```
;       - use pitch/roll (not used for beam coords?)
;       - no 3-beam solutions
;       - no bin mapping
EX00100
; Sensor source:
;       - manual speed of sound (EC)
;       - manual depth of transducer (ED = 0 [dm])
;       - measured heading (EH)
;       - measured pitch (EP)
;       - measured roll (ER)
;       - manual salinity (ES = 35 [psu])
;       - measured temperature (ET)
EZ0011101
$D2
;  - configure for slave
; pings per ensemble
WP1
; time per ensemble
TE 00:00:00
; time between pings
TP 00:00.00
; slave
SM2
; listen for sync pulse before each ensemble
SA011
$D2
; - configure no. of bins, length, blank
; number of bins
WN020
; bin length [cm]
WS0800
; blank after transmit [cm]
WF0000
$D2
; ambiguity velocity [cm]
WV250
; amplitude and correlation thresholds for bottom detection
LZ30,220
$D2
; keep params as user defaults (across power failures)
CK
; echo configuration
T?
W?
$D5
; start Pinging
CS
; End Logfile
$L
```

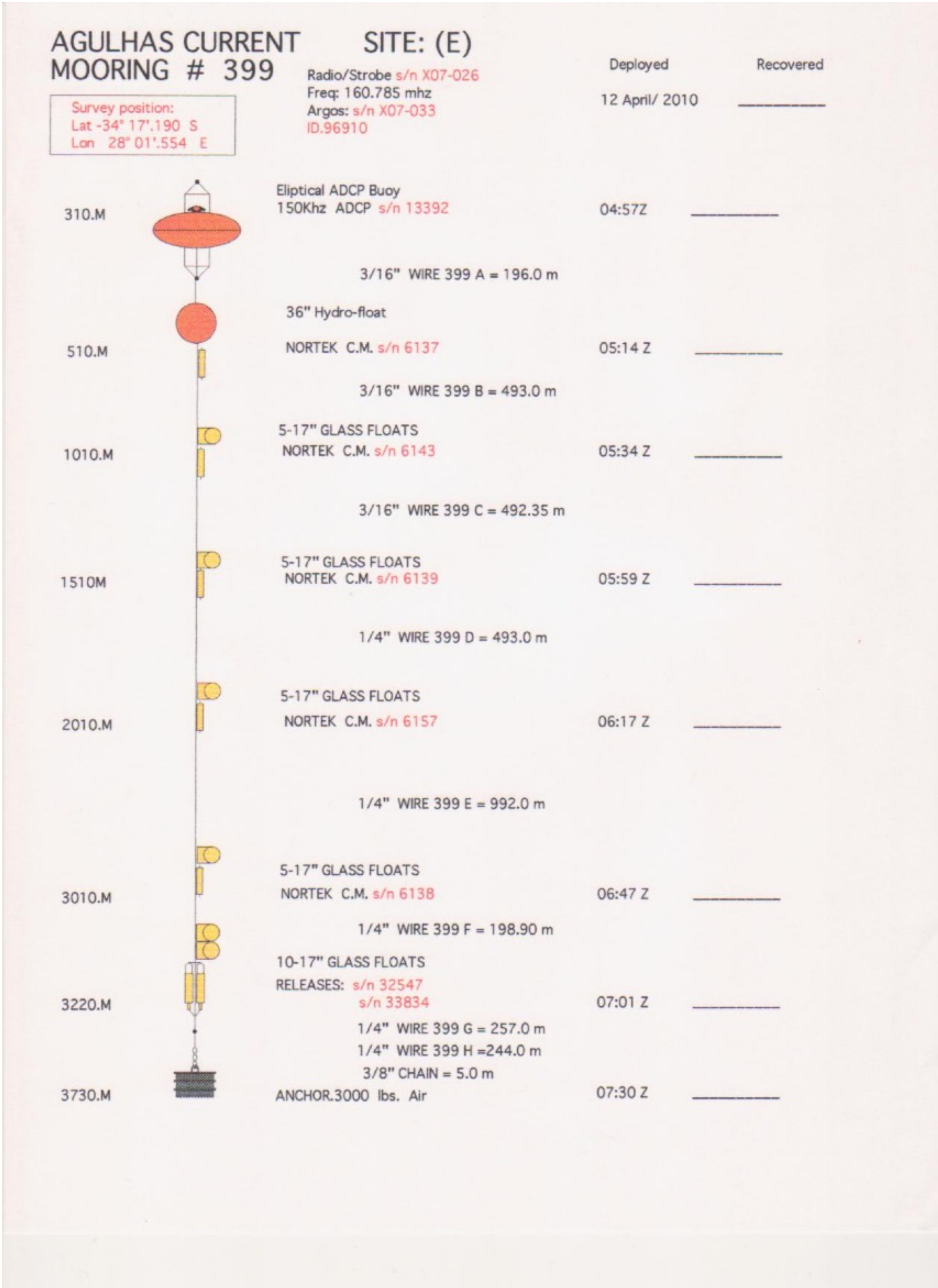
Appendix C - Mooring diagrams

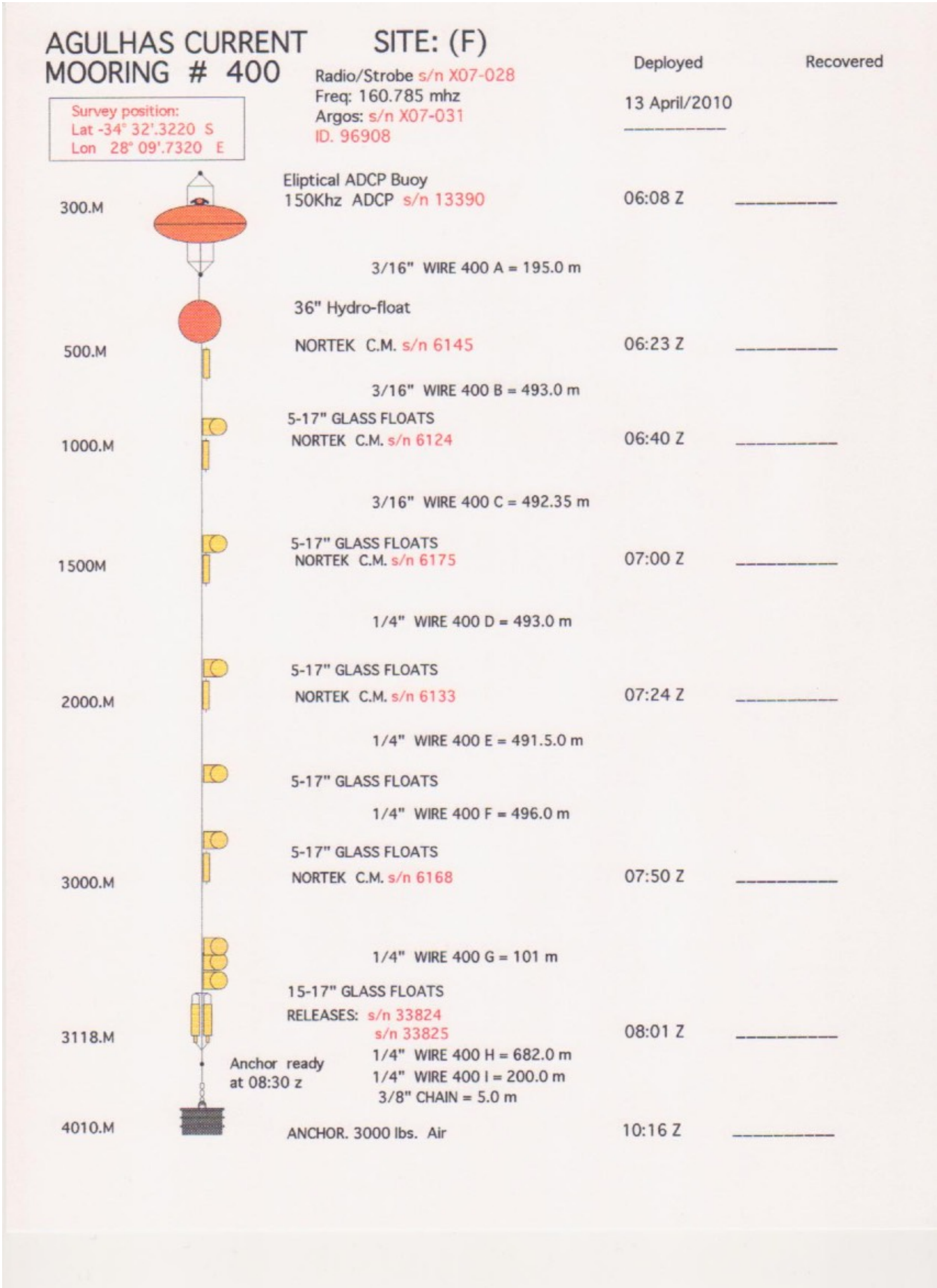


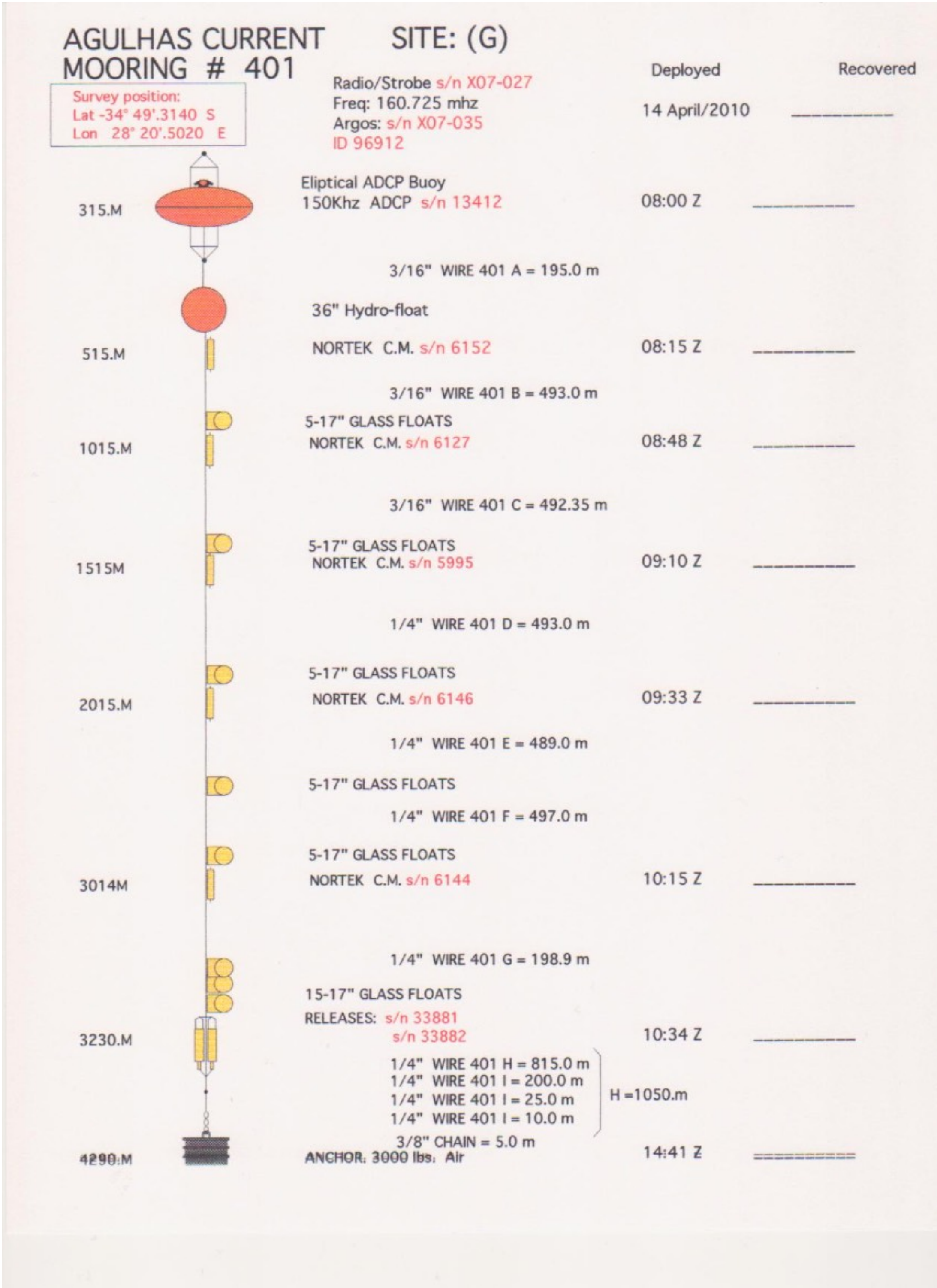

PROJECT :AGULHAS CURRENT
SITE: (B)
MOORING # 396
Deployed
Recovered
Survey position:
Lat -33° 39'.3216 S
Lon 27° 39'.474 E
8 April 2010
Radio/Strobe s/n X07-024
Freq:160.725 mhz
Argos: s/n X07-032
ID.96906
Time in.
Time out.
297.M
Elliptical ADCP Buoy
150Khz ADCP s/n13389
09:35 z
1/4" Trims 46+50+100= 196.0 m
original wire damged on ship winch
37" Hydro-float
496.M
NORTEK C.M. s/n 6159
10:00 z
3/16" WIRE 396 B = 493.0 m
5-17" GLASS FLOATS
996..M
NORTEK C.M. s/n 6166
10:22 z
1/4" WIRE 396 B = 11.0 m
10-17" GLASS FLOATS
1018.M
RELEASES: s/n 33830
s/n 33828
10:35 z
1/4" WIRE 396 B = 11.0 m
Added TS. 25+100+100 =225 m
3/8" CHAIN = 5.0 m
1262.M
ANCHOR.= 2000 lbs. Air
11:20 z


PROJECT :AGULHAS CURRENT
MOORING # 397
SITE: (C)
Survey position:
Lat -33° 46'.9380 S
Lon 27° 43'.1880 E
Deployed
Recovered
Radio/Strobe s/n X07-023
Freq:159.480 mhz
Argos: s/n X07-034
ID. 96911
9 April 2010
Time in.
Time out.
291.M
Eliptical ADCP Buoy
150Khz ADCP s/n13391
05:22 Z
3/16" WIRE 397 A = 195.5 m
37" Hydro-float
491.M
NORTEK C.M. s/n 6150
05:43 Z
3/16" WIRE 397 B = 493.0 m
5-17" GLASS FLOATS
991.M
NORTEK C.M. s/n 6172
06:05 Z
3/16" WIRE 397 C = 492.5 m
5-17" GLASS FLOATS
1491.M
NORTEK C.M. s/n 6129
06:22 Z
1/4" WIRE 397 D = 493.0 m
5-17" GLASS FLOATS
1991.M
NORTEK C.M. s/n 6103
06:41 Z
1/4" WIRE 397 E = 100.0 m
(trim)
10-17" GLASS FLOATS
2103.M
RELEASES: s/n 33823
s/n 33880
06:53 Z
1/4" WIRE 397 F = 100.0 m
(trim)
3/8" CHAIN = 5.0 m
2210.M
ANCHOR: 3000 lbs. Air
08:20 Z


PROJECT :AGULHAS CURRENT
SITE: (D)
MOORING # 398
Survey position:
Lat -34° 01'.2420 S
Lon 27° 51'.7980 E
Radio/Strobe s/n XO7-022
Freq: 159.48 mhz
Argos: s/n X07-029
ID. 96906
Deployed
11April 2010
Recovered
300.M
Eliptical ADCP Buoy
150Khz ADCP s/n13388
06:28 Z
3/16" wire 396 A= 195.0 m
36" Hydro-float
500.M
NORTEK C.M. s/n 6136
06:46 Z
3/16" wire 396 B= 492.8 m
5-17" GLASS FLOATS
1000.M
NORTEK C.M. s/n 6155
07:03 Z
3/16" wire 396 C= 492.7 m
5-17" GLASS FLOATS
1500M
NORTEK C.M. s/n 6154
07:25 Z
1/4" wire 396 D= 493.0 m
5-17" GLASS FLOATS
2000.M
NORTEK C.M. s/n 6141
07:41 Z
1/4" wire 396 E= 493.0 m
5-17" GLASS FLOATS
2500.M
NORTEK C.M. s/n 6173
07:57 Z
1/4" wire 396 F= 493.0 m
5-17" GLASS FLOATS
3000.M
NORTEK C.M. s/n 6147
08:14 Z
1/4" wire 396 G= 500.0 m
10-17" GLASS FLOATS
3512.M
RELEASES: s/n 33832
s/n33831
08:38 Z
1/4" wire 396 H= 101.0 m
(81.0m+20.0m trim)
3/8" chain = 5.0 m
3620.M
ANCHOR. 3000 lbs. Air
09:59 Z


AGULHAS CURRENT
MOORING # 399
SITE: (E)
Radio/Strobe s/n X07-026
Freq: 160.785 mhz
Argos: s/n X07-033
ID.96910
Deployed
Recovered
12 April/ 2010
Survey position:
Lat -34° 17'.190 S
Lon 28° 01'.554 E
310.M
Eliptical ADCP Buoy
150Khz ADCP s/n 13392
04:57Z
3/16" WIRE 399 A = 196.0 m
36" Hydro-float
510.M
NORTEK C.M. s/n 6137
05:14 Z
3/16" WIRE 399 B = 493.0 m
5-17" GLASS FLOATS
1010.M
NORTEK C.M. s/n 6143
05:34 Z
3/16" WIRE 399 C = 492.35 m
5-17" GLASS FLOATS
1510M
NORTEK C.M. s/n 6139
05:59 Z
1/4" WIRE 399 D = 493.0 m
5-17" GLASS FLOATS
2010.M
NORTEK C.M. s/n 6157
06:17 Z
1/4" WIRE 399 E = 992.0 m
5-17" GLASS FLOATS
3010.M
NORTEK C.M. s/n 6138
06:47 Z
1/4" WIRE 399 F = 198.90 m
10-17" GLASS FLOATS
3220.M
RELEASES: s/n 32547
s/n 33834
07:01 Z
1/4" WIRE 399 G = 257.0 m
1/4" WIRE 399 H =244.0 m
3/8" CHAIN = 5.0 m
3730.M
ANCHOR.3000 lbs. Air
07:30 Z


AGULHAS CURRENT
MOORING # 400
SITE: (F)
Radio/Strobe s/n X07-028
Freq: 160.785 mhz
Argos: s/n X07-031
ID. 96908
Deployed
Recovered
13 April/2010
Survey position:
Lat -34° 32'.3220 S
Lon 28° 09'.7320 E
300.M
Eliptical ADCP Buoy
150Khz ADCP s/n 13390
06:08 Z
3/16" WIRE 400 A = 195.0 m
36" Hydro-float
500.M
NORTEK C.M. s/n 6145
06:23 Z
3/16" WIRE 400 B = 493.0 m
5-17" GLASS FLOATS
1000.M
NORTEK C.M. s/n 6124
06:40 Z
3/16" WIRE 400 C = 492.35 m
5-17" GLASS FLOATS
1500M
NORTEK C.M. s/n 6175
07:00 Z
1/4" WIRE 400 D = 493.0 m
5-17" GLASS FLOATS
2000.M
NORTEK C.M. s/n 6133
07:24 Z
1/4" WIRE 400 E = 491.5.0 m
5-17" GLASS FLOATS
1/4" WIRE 400 F = 496.0 m
5-17" GLASS FLOATS
3000.M
NORTEK C.M. s/n 6168
07:50 Z
1/4" WIRE 400 G = 101 m
15-17" GLASS FLOATS
RELEASES: s/n 33824
s/n 33825
3118.M
08:01 Z
Anchor ready
at 08:30 z
1/4" WIRE 400 H = 682.0 m
1/4" WIRE 400 I = 200.0 m
3/8" CHAIN = 5.0 m
4010.M
ANCHOR. 3000 lbs. Air
10:16 Z


AGULHAS CURRENT
MOORING # 401
SITE: (G)
Survey position:
Lat -34° 49'.3140 S
Lon 28° 20'.5020 E
Radio/Strobe s/n X07-027
Freq: 160.725 mhz
Argos: s/n X07-035
ID 96912
Deployed
Recovered
14 April/2010
315.M
Eliptical ADCP Buoy
150Khz ADCP s/n 13412
08:00 Z
3/16" WIRE 401 A = 195.0 m
36" Hydro-float
515.M
NORTEK C.M. s/n 6152
08:15 Z
3/16" WIRE 401 B = 493.0 m
5-17" GLASS FLOATS
1015.M
NORTEK C.M. s/n 6127
08:48 Z
3/16" WIRE 401 C = 492.35 m
5-17" GLASS FLOATS
1515M
NORTEK C.M. s/n 5995
09:10 Z
1/4" WIRE 401 D = 493.0 m
5-17" GLASS FLOATS
2015.M
NORTEK C.M. s/n 6146
09:33 Z
1/4" WIRE 401 E = 489.0 m
5-17" GLASS FLOATS
1/4" WIRE 401 F = 497.0 m
5-17" GLASS FLOATS
3014M
NORTEK C.M. s/n 6144
10:15 Z
1/4" WIRE 401 G = 198.9 m
15-17" GLASS FLOATS
RELEASES: s/n 33881
s/n 33882
3230.M
10:34 Z
1/4" WIRE 401 H = 815.0 m
1/4" WIRE 401 I = 200.0 m
1/4" WIRE 401 I = 25.0 m
1/4" WIRE 401 I = 10.0 m
H =1050.m
3/8" CHAIN = 5.0 m
4290.M
ANCHOR: 3000 lbs. Air
14:41 Z

CCHDO Data Processing Notes

- **File Online CCHDO Staff**

316N20100404.exc.csv (download) #66e2c
Date: 2015-10-09
Current Status: unprocessed

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

Date: 2015-10-09
Data Type: submission
Action: Website Update
Note:
```
316N20100404.exc.csv  available as received, submitted 2015-07-07 by Robert
Key
notes: I started with the original bottle file you had posted, created a
header with minimal metadata, reset a few CTDOXY flags and values (from 0.0
and 2 to -999 and 9), and reprinted
```

- **File Submission Robert Key**

316N20100404.exc.csv (download) #66e2c
Date: 2015-07-07
Current Status: unprocessed
Notes
```
I started with the original bottle file you had posted, created a header with
minimal metadata, reset a few CTDOXY flags and values (from 0.0 and 2 to -999
and 9), and reprinted

System Message: Submitter requests file be attached to cruise 653
```

- **Text version online J Kappa**

Date: 2014-12-05
Data Type: CrsRpt
Action: Website Update
Note:
```
I've placed a new Text version of the cruise report on the website.
It includes all the reports provided by the cruise PIs, summary pages and
CCHDO data processing notes.
```

- **PDF version online J Kappa**

Date: 2014-11-21
Data Type: CrsRpt
Action: Website Update
Note:
```
I've placed a new PDF version of the cruise report:  316N20100404_do.pdf
online.
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.
```

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.		