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RRS *James Clarke Ross* Cruise 139

05 DEC – 12 DEC 2005

Drake Passage repeat hydrography:
WOCE Southern Repeat Section 1b -
Burdwood Bank to Elephant Island

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2008

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ABSTRACT

This report describes the eleventh occupation of the Drake Passage section, established during the World Ocean Circulation Experiment as repeat section SR1b. It was first occupied by Southampton Oceanography Centre in collaboration with the British Antarctic Survey in 1993, and has been re-occupied most years. Thirty full depth stations were completed. The CTD was a Sea-Bird 911*plus* with dual temperature and conductivity sensors, an altimeter, an oxygen sensor, a transmissometer and a fluorometer. In addition, a SBE35 temperature sensor and a downward looking RDI Workhorse WH300 ADCP (WH) unit were attached to the CTD frame. On each station, the SBE35 collected data when the water sample bottles were fired and a LADCP profile was logged. The underway measurements included navigation, VM-ADCP, sea surface temperature and salinity, water depth and meteorological parameters.

KEYWORDS

ADCP, Antarctic Circumpolar Current, Antarctic Ocean, Acoustic Doppler Current Profiler, cruise 139 2005, CTD Observations, Drake Passage, *James Clark Ross*, Lowered ADCP, LADCP, Southern Ocean, Vessel Mounted ADCP, WOCE, World Ocean Circulation Experiment

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Key:

BAS:	British Antarctic Survey
OU:	Open University
NOC:	National Oceanography Centre
UKORS:	United Kingdom Oceanographic Research Services

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Elliott, Thomas	Third Engineer
Eadie, Steven	Fourth Engineer
Wright, Simon	Deck Engineer
Dunbar, Nicholas	Electrician
Gibson, James	Purser
Evans, Simon	Cadet
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Blaby, Marc	Bosun’s Mate
Jenkins, Derek	Seaman
Jolly, Lester	Seaman
Solly, Christopher	Seaman
Macleod, John	Seaman
Mullaney, Clifford	Seaman
Robinshaw, Mark	Motorman
Coutts, John	Motorman
MacIntyre, Duncan	Chef
Ballard, Glen	2nd Cook
Newall, James	Steward
Weston, Kenneth	Steward
Lee, Derek	Steward

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ACKNOWLEDGEMENTS

Kate Stansfield

It is a pleasure to acknowledge the efficiency and hospitality of the Master, officers and crew of the *RRS James Clark Ross*. A special mention must go to the cook's superb lentil soup, which kept one fussy vegetarian (me) extremely happy.

In particular, we thank Daniel Comden and John Wynar for offering support during the section and help in getting the CTD system up and running at the start of the cruise (less straight forward than one might think). We also thank Martin Millar (AFI) and Helen Rossetti (BAS) for volunteering to stand full 12 hour shifts during the Drake Passage section.

1. OVERVIEW

Kate Stansfield

This report describes the eleventh occupation of the Drake Passage section, established during the World Ocean Circulation Experiment as repeat section SR1b, first occupied by Southampton Oceanography Centre (now the National Oceanography Centre) in collaboration with the British Antarctic Survey in 1993, and re-occupied most years since then.

The main objectives are:

(i) to determine the interannual variability of the position, structure and transport of the Antarctic Circumpolar Current (ACC) in Drake Passage;

(ii) to examine the fronts associated with the ACC, and to determine their positions and strengths;

(iii) by comparing geostrophic velocities with those measured directly (by the lowered ADCP), to determine the size of ageostrophic motions, and to attempt to estimate the barotropic components;

(iv) to examine the temperature and salinity structure of the water flowing through Drake Passage, and to identify thereby the significant water masses;

(v) to calculate the total flux of water through Drake Passage by combining all available measurements.

The eleventh occupation of the SOC / BAS Drake Passage section went pretty much to plan apart from the delayed start and the initial problems encountered with the CTD. Most of the science party travelled south uneventfully on 24th November via Santiago with the remainder travelling with the MOD on the 28th after spending a night at Brize Norton. The late October ships schedule had the JCR departing Stanley on November 30th, but in fact due to a combination of bad weather and cargo work at South Georgia and Stanley our departure was delayed by 5 days.

Eventually everything was on board by the evening of 5th December and the ship set sail at around 8pm. We spent the next few hours in Port William Sound, giving the crew time to ensure that everything was fully lashed down before heading out into some moderately rough seas. Although the poor weather caused an additional delay to the start of the section (the ship cannot travel at full speed in rough seas) in fact this gave the science party a chance to get the CTD equipment ready and working for the first station. This year we used the BAS Sea-Bird CTD equipment with the UKORS 300 kHz RDI ADCP and CTD frame and rosette. Pat Cooper, John Wynar and Dan Comden worked long and hard to swap over all the sensors and assemble the CTD.

The JCR was almost full to capacity on this trip (36 passengers, in addition to the normal crew members), with scientific personnel, personnel destined for Port Lockeroy and Rothera, an artist and a novelist, as well as several hundred tonnes of cargo (including several JCBs) destined for the Antarctic bases at Port Lockroy and Rothera.

The CTD work started on the afternoon of December 6th with a test station just to the north of Burdwood bank (cast 01). The first test cast and two subsequent attempts were aborted due to data acquisition failure (casts 02 and 03). To give the technicians time to try and find the problem we headed south towards the start of the hydrographic section. The ship stopped again late on the 6th for a second test station, (casts 04, 05 and 06) this time the CTD pumps failed to turn on leading to poor agreement between the two CT sensor pairs. The problem with the pumps was rectified before reaching the first station of the section.

The CTD section itself started on December 7th. There were some problems on casts 16, 21 and 23 (stations 10, 15 and 17) with data acquisition failing in mid cast. These casts have been recorded in more than one file and have been patched together, some data may be missing. This may cause problems for the LADCP processing. Problems with the rosette firing mechanism were encountered on casts 16 and 17 (stations 10 and 11). Further details of the CTD data collection are given in Section 2. The cruise track is illustrated in Figure 1.1 and the location of the test casts in Figure1.2.

After the lumpy first 36 hours the sea-state settled out to no more than an easy swell, the skies cleared and during the remainder of the section the ship experienced some of the most pleasant weather that Drake Passage is ever likely to throw at a ship, perfect for bobbing up and down on the open ocean doing science.

Between stations 3 and 4 (casts 9 and 10), stations 18 and 19 (casts 24 and 25) and stations 27 and 28 (casts 33 and 34) the ship stopped so that the team from the Permanent Service for Mean Sea-level (PSMSL) from Proudman Oceanographic Laboratory (POL) could service their bottom pressure recorder moorings. The final CTD station was completed on the evening of December 11th with a spooky view of Elephant Island dipping in and out of the mist. After this the *James Clark Ross* did a U-turn to port and headed north-east to the final station on this part of the trip: the deployment of the MYRTLE deep sea pressure recorder by the team from the POL. All work was completed by 3am on December 12th.and the ship turned south headed for Rothera.

On the way south we dropped off the 3 summer residents of the Antarctic Heritage Base at Port Lockroy with a good supply of cargo (including t-shirts and postcards). We also made a brief call into Vernadsky Station (previously know as Faraday prior to being handed over to the

Ukrainians) so that the team from POL could service the tide gauge monitoring sea level there. Vernadsky has the longest record of sea-level of anywhere in the Antarctic.

The ship then continued south, into the ice, in an attempt to get to Rothera. The ship first encountered ice on the afternoon of Dec 14th , though we were clear of that in no more than a few hours. The next lot of pack ice encountered was to the west of Adelaide Island, less than 100 miles from Rothera Station. The JCR made good headway through this, though at slow speed until 1pm on the 16th. At this point the decision was made to stop and assess the direction of ice flow and await a visual report from a flyby by the Dash 7 from Rothera. The ship was left to drift overnight, allowing assessment of the movement of the ice.

The final push for Rothera started at 04:00 on December 17th; Jenny Island, in view from Rothera itself, was eventually passed at 14:45 and, in full view of the welcoming party up above the jetty we docked at the base at 17:00.

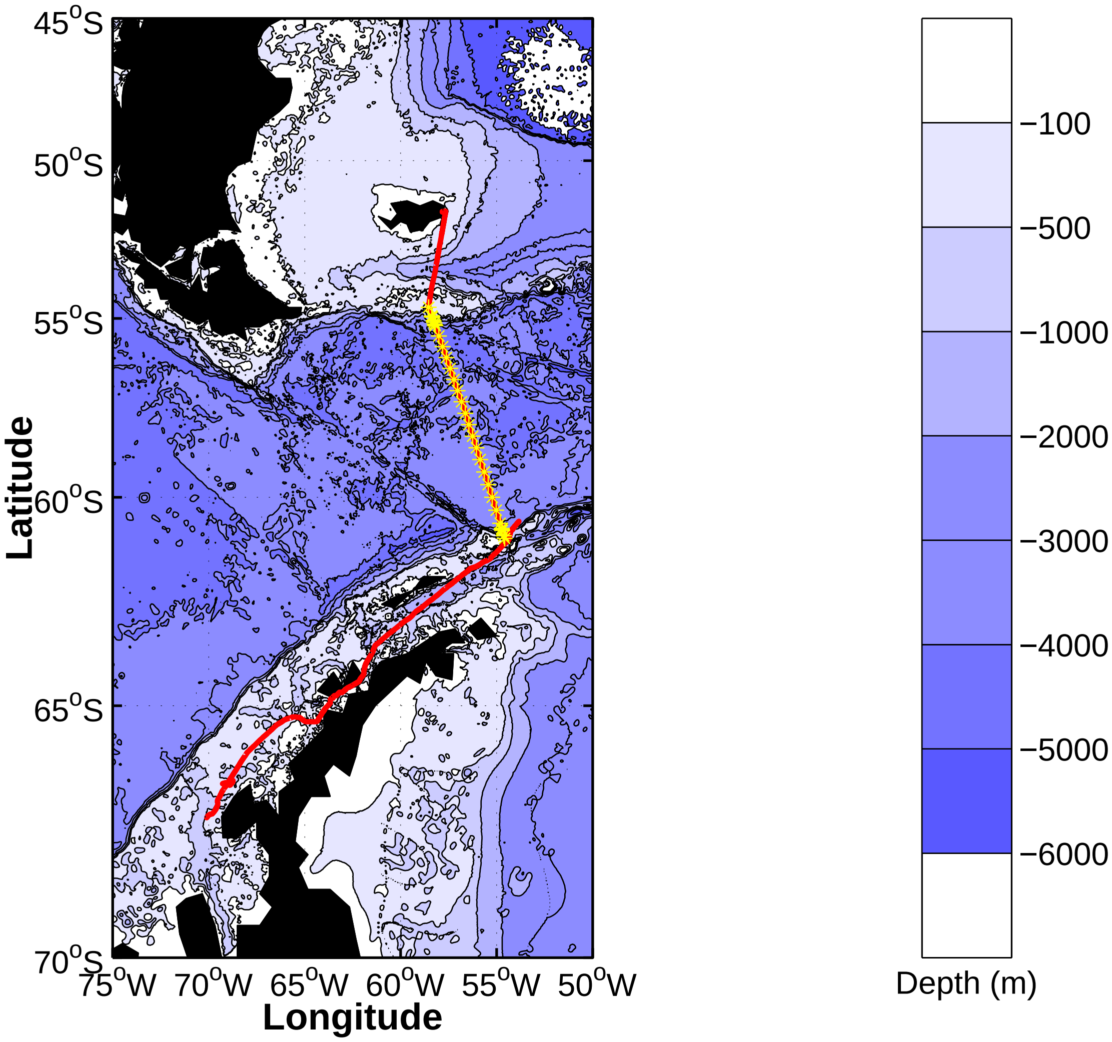

Figure 1.1: Cruise track for JR139. The cruise track (using data from BestNav) is illustrated in red, with the locations of the CTD stations represented by yellow stars.

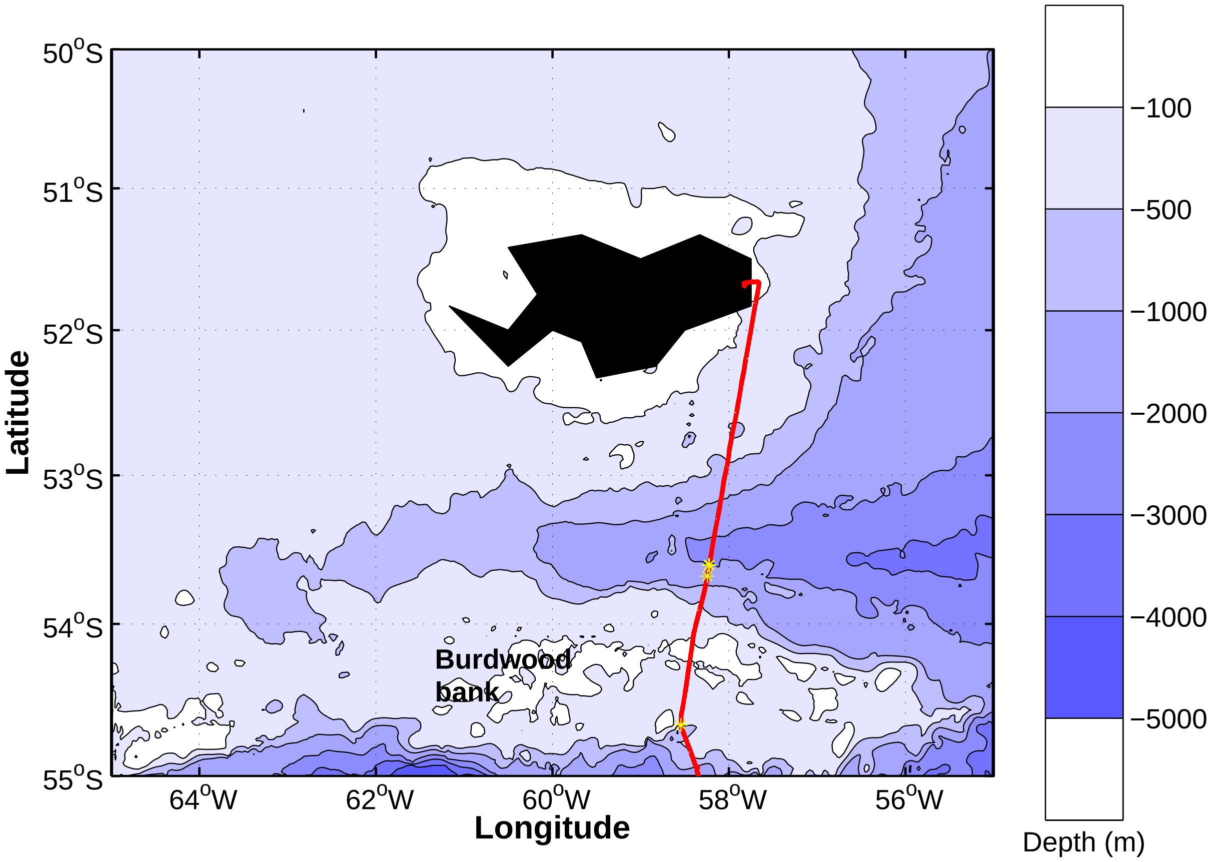

Figure 1.2: Location of CTD test stations for JR139. The cruise track (using data from BestNav) is illustrated in red, with the locations of the CTD stations represented by yellow stars.

Figure 1.3: Extent of ice cover on Sunday 4th December 2005.

Figure 1.4: View of the pack ice from the bow of the JCR on December 16th, position north-west of Rothera. Photograph by Dave Farrance.

2. CTD DATA AQUISITION AND DEPLOYMENT

Jo Hopkins and Oliver Browne

2.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used on JR139 to vertically profile the temperature and salinity of the water column. In total, 36 CTD casts were taken; the SR1b Drakes Passage section comprised 30 of these casts, and was preceded by 6 test stations (however a full depth test station was not realised). The method of acquisition and calibration of the data are described below. Tests of the CTD were performed before the start of the Drake's Passage section, and to delineate the two we use the notation *test station [nn]* and *station [nn]* respectively.

2.2 CTD unit and deployment

A full sized SBE 32 carousel water sampler, holding 12 bottles, connected to an SBE 9 plus CTD and an SBE 11 plus deck unit was used to collect vertical profiles on the water column. The deck unit provides power, real time data acquisition and control. The underwater SBE 9 plus unit featured dual temperature (SBE 3 plus) and conductivity (SBE 4) sensors, and a *Paroscientific* pressure sensor. A TC duct and a pump-controlled flow system ensure that the flow through the T-C duct is constant to minimize salinity spiking. Used in conjunction with the SBE 32 and SBE 911, the SBE 35 Deep Ocean Standards Thermometer makes temperature measurements each time a bottle file confirmation is confirmed. A file containing the time, bottle position and temperature is recorded allowing comparison of the SBE 35 record with the CTD and bottle data.

In addition, an altimeter, a fluorometer, an oxygen sensor and a transmissometer were attached to the carousel. The altimeter gave real time accurate measurements of height off the sea bed once the instrument package was with approximately 100 m of the bottom. The Simrad EA600 and EM120 systems would sometimes lose the bottom or give erroneous readings on station, so care was needed to interpret these digitised records.

Although collected, the fluorometry, transmissometry and oxygen data have not been processed beyond the initial SBE data processing package and will thus not be discussed further. Problems were encountered with the oxygen sensor so any data on oxygen should be treated with caution.

For all stations a UKORS downward looking LADCP was attached to the main CTD frame (see section 3) A fin was also added to the frame to reduce rotation of the package underwater.

The CTD data were logged via the deck unit to a 1.4GHz P4 PC, running Seasave Win32 version 5.37b (Sea-Bird Electronics Inc.). This new software is a great advance on the DOS version, allowing numerical data to be listed to the screen in real time, together with several graphs of various parameters. The data rate of recorded data for the CTD was 24 Hz.

The CTD package was deployed from the mid-ships gantry and A-frame, on a single conductor torque balanced cable connected to the CTD through the BAS conducting swivel. This CTD cable was made by Rochester Cables and was hauled on the 10T traction winch. The general procedure was to start data logging, deploy, and then to stop the CTD at 10 m cable out. The pumps are water activated and typically do not operate until 30-60 seconds after the CTD is in the water. If the word display on the Deck Unit is set to 'E' then the least significant digit on the display indicates whether the pumps are off (0) or on (1). After a 2 minute soak, the package was raised to just below the surface and then continuously lowered to near bottom, with the Niskin bottles being closed during the upcast. The final CTD product was formed from the calibrated downcast data averaged to 2 db intervals.

The ideal station positions for the Drake Passage section are listed in Table 2.1 and a summary of all CTD deployments is given in Table 2.2. The CTD configurations used during the cruise are detailed in Table 2.3, together with the serial numbers of the relevant sensors. The corresponding calibration coefficients are given in Table 2.4.

The CTD system was tested before arrival at the first designated station. The first three of these tests suffered from communication failures and were aborted before full depth was reached; this resulted in a change of the underwater unit. The calibration file was then adjusted for the new sensors and testing recommenced. On the 4^{th}, 5^{th} and 6^{th} test casts significant differences in the primary and secondary temperature and conductivity readings was noted (0.7 °C and 0.1 V respectively). This was attributed to problems with the pump-controlled flow system which was subsequently repaired before the first station proper was reached.

It was noted during the first station (cast 7) of the Drake's Passage section that the Altimeter was faulty. The instrument was replaced after the 3rd station (cast 9) but only became fully functional on the 5^{th} station (cast 12) of the JR139 section when it was realised that the communication ports for the fluorometer and altimeter had become reversed.

Bottle firing problems occurred on stations 7, 10 and 11 (casts 13, 16 and 17) of the section. On station 7 (cast 13) it was unclear when the 12^{th} bottle had been fired; attributed to a loose firing wire. During station 10 (cast 16), bottles 1 through to 5 fired correctly, but upon firing of bottle 6 (2000m wireout) confirmation of closure was not received. Remediary action included restarting the Seasave program and power cycling of the deck unit, this was however unsuccessful. At 200 m wireout on the upcast firing was attempted once again and was successful for the remainder of the cast. On the next station, the 11^{th} of the section (cast 17), the same problem reoccurred. Whilst there were no bottle firing confirmations for the first 8 sample depths, upon recovery of the carousel, all 12 bottles were found to have closed. It is unclear as to at which depths and in which order these bottles closed. To check that the bottles were closing in the correct order, bottle 12 was left unfired on stations 12 to 20 of the section.

During the downcast of station 15 (cast 21) the transmit light flashed and there was a poor data transmit rate. It appeared that the CTD was only sampling at a rate of 0.33 seconds (3Hz) instead of 0.0416 seconds (24Hz). This was corrected by rebooting the PC between the up and downcasts. On station 17 (cast 23) the PC crashed at the bottom of the cast. It was rebooted and the cast continued without further problems. In both the aforementioned cases and at station 10 (cast 16) the up and downcasts were recorded in separate files.

Also worthy of note are:

- Drift of 1 knot at station 13 due to the ACC[1]
- The EA600 echo sounder was unreliable at stations 25, 26 and 27 (casts 31, 32 and 33)
- At stations 20 and 27 (casts 26 and 33) the upcast was paused at 1000m cable out to allow the testing of an acoustic release mechanism for moorings by UKORS.

2.3 Data Acquisition

1. At the end of each CTD cast, four files were created by the Seasave Win32 version 5.28e module:

139_0[nn].dat	a binary data file
139_0[nn].con	an ascii configuration file containing calibration information
139_0[nn].con	an ascii header file containing the sensor information
139_0[nn].bl	a file containing the data cycles at which a bottle was closed on the rosette

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[1] Antarctic Circumpolar Current

where *[nn]* refers to the cast number, running from 00 through to 06 for test casts and 07 to 36 for Drake's Passage section stations. These files were saved on the D:\ drive of the CTD PC. They were also copied to the \\samba\\pstar drive, as soon as possible, as a back up.

2. The CTD data was converted to ascii and calibrated by running the Sea-Bird Electronics Inc. Data Processing software version 5.37b *Data Conversion* module. This program was used only to convert the data from binary, although it can be used to derive variables. This outputted an ascii file *139_0[nn].cnv*.

The sensors were calibrated following:

Pressure Sensor: $$P = C\left(1-\frac{T_0^2}{T^2}\right)\left(1-D\left(1-\frac{T_0^2}{T^2}\right)\right)$$

where P is the pressure, T is the pressure period in μS, U is the temperature in degrees Centigrade, D is given by $D = D_1 + D_2U$, C is given by $C = C_1 + C_2U + C_3U^2$, T_0 is given by $T_0 = T_1 + T_2U + T_3U^2 + T_4U_3 + T_5U_4$.

Conductivity Sensor: $$cond = \frac{\left(g + h\, f^2 + i\, f^3 + j\, f^4\right)}{10\left(1+\delta t + \varepsilon p\right)}$$

where the coefficients are given in Appendix A, , p is pressure, t is temperature, and $\delta = CTcorr$ and $\varepsilon = Cpcorr$.

Temperature Sensor: $$Temp\,(ITS-90) = \left\{\frac{1}{g = h\,(\ln\left(f_0/f\right) + i\,(\ln^2\left(f_0/f\right) + j\left(\ln^3\left(f_0/f\right)\right)}\right\} - 273.15$$

where the coefficients are given in Appendix A, and f is the frequency output by the sensor.

The Sea-Bird Electronics Inc. Data Processing software version 5.37b was then used to apply the following four processing steps:

- *Filter Module*. A low pass filter was applied to the conductivity and pressure to increase the pressure resolution prior to the *loopedit module*. Output file is of the form *139_0[nn]f.cnv*.

- *Align Module*. Oxygen variables were advanced by 5 seconds relative to the scan number to account for time constants of sensors and water transit time delay in the pumped plumbing line. No alignment was made for conductivity since the deck unit was programmed to advance both the primary and secondary conductivity with respect to the pressure by 1.75 scans (at 24hz this is 0.0073 seconds). Output file is of the form *139_0[nn]fa.cnv*.

- *Cell Thermal Mass module*. This was used to remove the conductivity cell thermal mass effects from the measured conductivity. This takes the output from the data conversion program and re-derives the pressure and conductivity to take into account the temperature of the pressure sensor and the action of pressure on the conductivity cell. The output file is of the form *139_0[nn]fac.cnv*. This correction followed the algorithm:

  Corrected Conductivity = c + ctm

  where,

  *ctm = (-1.0 * b * previous ctm) + (a * dcdt * dt),*

  dt = (temperature - previous temperature),

  *dcdt = 0.1 * (1 + 0.006 * (temperature - 20),*

  *a = 2 * alpha / (sample interval * beta + 2*)

  and *b = 1 - (2 * a / alpha)* with *alpha = 0.03* and *beta = 7.0*

- *Loopedit module*. This routine marks scans where the CTD package is moving less than minimum velocity or travelling backwards due to ship roll. Minimum velocity was fixed, and set to 0.25 m/s. Output file is of the form *139_0[nn]facl.cnv*.

All processed files were then placed in *~/pstar/data_jr139/ctd/proc/139_0[nn]/*

2.4 SBE35 High Precision Thermometer

The BAS SBE35 high-precision thermometer was fitted to the CTD frame. Each time a water sample was taken using the rosette, the SBE35 recorded a temperature in EEPROM. This temperature was the mean of 8 * 1.1 seconds recording cycles (therefore 11 seconds) data. The thermometer has the facility to record 157 measurements but the data was downloaded approximately every few casts and then transferred to the unix system using samba.

To process the data, communication was established between the CTD PC and the SBE35 by switching on the deck unit. The *SeaTerm* programme was used to process the data. This is a simple terminal emulator set up to talk to the SBE35. Once you open the program the prompt is ">". The SBE35 will respond to the command ‘*ds*’ (display status) by telling you the date and time of the internal clock, and how many data cycles it currently holds in memory. A suitable file name can be entered via the ‘capture’ toolbar button, and the data downloaded using the command ‘*dd*’ (dump data).

The data currently held in the memory is listed to the screen. This can be slow due to the low data transfer rate. Once the download is completed the 'capture' button should be clicked to close the open file, and the memory of the SBE 35 cleared using the command **"*samplenum=0*".** To check the memory is clear the command '*ds*' should again be entered before shutting down the system.

The SBE35 data files were divided into separate files for each station with upto 12 records (one level for each bottle, see section 2.2. for details) called *sbe35139_[nn].txt*. These were transferred to unix via samba and placed in the directory *~/pstar/data_jr139/ctd/SBE35/*.

2.5 Salinity Samples

At each CTD station up to 12 Niskin bottles were closed at varying depths through the water column and then sampled for salinity analysis. At shallower sites salinity samples were not collected from all 12 bottles and at some sites there were difficulties with communication with the bottle-release mechanism (as detailed in section 2.2). These resulted in only 9 samples being collected at station 10, unclear sample depths at station 11, and only 11 samples collected for stations 12-20. In total 328 salinity samples were collected and analysed.

The primary purpose of collecting salinity samples is to calibrate the salinity measurements made by the CTD sensors. Samples were taken in 200 ml medicine bottles. Each bottle was rinsed three times and then filled to just below the neck, to allow expansion of the (cold) samples, and to allow effective mixing upon shaking of the samples prior to analysis. The rim of each bottle was wiped with a tissue to prevent salt crystals forming upon evaporation, a plastic seal was inserted into the neck of the bottle and the screw cap was replaced. The bottle crates were colour coded and numbered for reference. The salinity samples were placed close to the salinometer - sited in the chemistry lab - and left for at least 24 hours before measurement. This allowed the sample temperatures to equalise with the ambient of the chemistry lab.

The samples were then analysed on the BAS Guildline Autosal model 8400B, S/N 63360 against Ocean Scientific standard seawater (hereafter OSIL) from batches P144 and P146. At the start of the cruise the salinometer was standardised with OSIL P144. At the beginning, and at the end of each crate of samples one vial of OSIL standard seawater was run through the salinometer enabling a calibration offset to be derived and to check the stability of the salinometer.

At first there were problems with the external peristaltic pump that draws the sample into the salinometer. The pump failed, resulting in the loss of 1 sample from station 1. A new Watson Marlow peristaltic pumping system was installed. Initial problems with the new pump, involving flow speed, caused air bubbles in the cell, which resulted in 1 sample from station 2 being unreliable. Directly after this problem was encountered an additional standard was run, producing reliable results.

Samples from Station 24 and 25 (cast 30 and 31) were processed with a P144 standard at the start, but due to insufficient P144 standards remaining, a P146 standard was used at the end. After these samples were complete, the salinometer was re-standardised to the P146 standard seawater. Samples from stations 26 to 30 (cast 31 to 36) were analysed after this.

Once analysed, the conductivity ratios were entered by hand into an EXCEL spreadsheet, converted to salinities and transferred to the Unix system using samba. They were then read into an ascii data file and used in the further CTD data processing. 26 P144 and 6 P146 Standard Seawater vials were used for the analysis.

Eight replicate samples were taken. The mean absolute difference in the salinity obtained from replicate pairs was 0.00072 with a standard deviation of 0.001.

2.6 CTD data processing

Further processing of the CTD data (completed in MATLAB) required both the salinity data from the bottle samples and the SBE35 temperature data. Subsequent to the processing using the Seabird Electronics' "SBE Data Processing" software version 5.37b (see Section 2.3) further processing was done using Matlab scripts primarily written by Karen Heywood/Mike Meredith and modified for use on JR097 and JR139. the most important changes are that all use of the functions ds_ptemp and ds_salt have been removed. No use has been made of IPTS-68 temperatures, instead all calculations are done using version 3.0 of the CSIRO seawater toolbox using ITS-90 temperatures.

The matlab routines are applied as follows:

- *ctdread139* reads the data stored in the *139_0[nn]facl.cnv* file into MATLAB matrices by invoking *cnv2mat.m* routine, and names them accordingly. Output is of the form *139_0[nn].cal*.

- *offpress2.m* enables the inputting of an offset pressure (0db used for Jr139) and sets variables to missing if pumps were not operational. Output is of the form *139_0[nn].wat*.

- *spike.m* This checks for, and sets to *NaN*, large single point spikes in conductivity, temperature, fluorescence, transmittance and oxygen. It uses the despiking routine dspike.m. The resulting file is *139_0[nn].spk.*

- *interpol.m* The programme finds any data set to *NaN* in any of the temperature, conductivity, fluorescence, transmittance and oxygen variables, and interpolates across them to produce a continuous data set. The output file is *139_0[nn].int*. At this point we have 24 Hz data for the up and down cast. We then need the bottle salinity data to calibrate conductivity, however interim versions of the data were always created so that we could look at the uncalibrated data quickly.

- *makebot.m* reads the SeaBird *139_0[nn].bl* file and the *139_0[nn].int* to create a bottle file of the form *bot0[nn].sal*. CTD data corresponding to the bottle firings are derived as the median values between the start and stop scans given in the *.bl* file. Temperature on the IPTS-90 scale is derived (used for input to CSIRO seawater routines), and salinity and potential temperature calculated using *sw_salt.m* and *sw_ptmp.m*. Warnings are written if large standard deviations in the CTD data corresponding to the bottle firings are obtained.

- *samplsal.m* loads the excel spreadsheet (*Salinity_Master_jr139_2.xls*) of conductivity ratios for each sample and each standard and calculates bottle salinity based on cell temperature, K15 value, and the conductivity ratio of the sample and standards. Missing samples are represented as NaNs. Output is of the form *sal0[nn].mat*.

- *addsal.m* reads the *bot0[nn].sal* file and adds the sample salinity. Output is of the form *bot0[nn].sal*.

- *setsalflag.m* sets a flag to zero for instances where the standard deviation of any of the conductivity or temperature data (from either sensor) at the bottle firing levels is greater than 0.001. Output is of the form *bot0[nn].flg*.

- *salcal.m* calculates the adjustment to nominally calibrated CTD salinity required to get the best fit to bottle data. Calls the *sw_cndr.m* routine to calculate conductivity from the bottle salinities at the temperature and pressure of the corresponding CTD salinities.

- *salcalapp.m* applies the derived offsets (for JR139 a single correction was applied to all casts) to the CTD conductivities, calculates salinity, potential temperature, and potential densities. Output is of the form *ctd0[nn].var* and *bot0[nn].cal* .

- *splitcast.m* divides the CTD cast into an upcast and downcast, with the dividing point being determined by the maximum value of pressure. Output is of the form *ctd0[nn].var.dn* and *ctd0[nn].var.up* .

- *ctd2db.m* reads the downcast profile and derives 2 dbar averages of all properties. Output is of the form *ctd0[nn].2db*.

2.7 CTD Calibration

Opportunities for CTD data calibration and comparison include internal checks between primary and secondary sensors, comparison with salinity samples, and comparison with the SBE35.

N.B. Subsequent to cruise JR139 queries arose about the CTD configuration file and the CT sensor calibrations. The following is an excerpt from the preliminary cruise report by Povl Abrahamsen (EPA) for JR151 which followed on from JR139:

"The ship's Seabird Electronics 9/11+ CTD system was used on the cruise. ……… Note that this configuration does not correspond to the .CON file provided by AME and used during data acquisition. The new file has been named JR151_postproc.CON. The calibration supplied by NOC for the primary temperature sensor was invalid, therefore new coefficients were calculated"

EPA has provided us with the correct calibration data hence all CTD casts have been reprocessed at NOC following the processing steps outlined above prior to this calibration stage. The correct configuration file for JR139 data is ***JR151_postproc2.CON***. The values given in table 2.4 are correct.

An initial comparison was made of 166 bottle closures at 2000 m or deeper (avoiding the steep gradients in salinity and temperature within the upper part of the water column) which had a low measurement standard deviation.

For these comparisons the notation T1, T2, C1, C2, botC1, botC2 and T35 is used for primary and secondary temperature and conductivity sensors, conductivities from bottle salinities and SBE35 respectively.

$$T_1 - T_2 = -1.1360e\text{-}004 \pm 0.0016\ °C$$

$$T_1 - T_{35} = 9.4889e\text{-}005 \pm 8.7271e\text{-}004\ °C$$

$$T_2 - T_{35} = -3.4521e\text{-}004 \pm 9.0667e\text{-}004\ °C$$

$$C_1 - C_2 = 0.0032 \pm 0.0013\ \text{mmho cm}^{-1}$$

$$botC_1 - C_1 = 0.0105 \pm 0.0019\ \text{mmho cm}^{-1}$$

$$botC_2 - C_2 = 0.0139 \pm 0.0019\ \text{mmho cm}^{-1}$$

On this basis it was decided not to calibrate the temperature sensors but to investigate the conductivity calibrations further. The primary temperature sensor should be used for further studies.

On investigating the conductivity calibrations it was found that the calibrations from 2005 gave poorer agreement with the sample bottle conductivities than the calibrations from 2003.

The following correction was applied to match the primary conductivity sensor data to the bottle conductivities: This was estimated by regressing the 2005 calibration onto the 2003 calibration data and then finding the constant offset between the CTD data and the bottle samples for the 166 selected bottle samples.

P1=0.99983786570038;
P2=0.01988392173772;
P3=-0.00205284186322;

C_1=P1* C_1+P2+P3;

This now gives the following comparison:

$$\mathbf{botC_1 - C_1 = -2.7295e\text{-}004 \pm 0.0025\ mmho\ cm^{-1}}$$

The secondary conductivity sensor has NOT been calibrated

The primary conductivity sensor (and derived variables) should be used for further studies.

Figures 2.1 to 2.4 show the calculated salinity, temperature, geostrophic velocity (relative to the deepest common level) and potential temperature-salinity plots associated with the data.

station number	lat ˚S	lat min	lon ˚W	lon min	nominal depth
1	61	03.00	54	35.23	400
2	60	58.86	54	37.80	600
3	60	51.02	54	42.66	1000
4	60	49.99	54	43.30	1500
5	60	47.97	54	44.55	2500
6	60	40.00	54	49.49	3100
7	60	20.00	55	01.88	
8	60	00.00	55	14.28	
9	59	40.00	55	26.67	
10	59	20.00	55	39.07	
11	59	00.00	55	51.47	
12	58	41.00	56	03.24	
13	58	22.00	56	15.02	
14	58	03.00	56	26.79	
15	57	44.00	56	38.57	
16	57	25.00	56	50.35	
17	57	06.00	57	02.12	
18	56	47.00	57	13.90	
19	56	28.00	57	25.67	
20	56	09.00	57	37.45	
21	55	50.00	57	49.23	
22	55	31.00	58	01.00	
23	55	12.86	58	12.24	3500
24	55	10.25	58	13.86	3000
25	55	07.27	58	15.71	2500
26	55	04.18	58	17.62	2000
27	54	57.66	58	21.67	1500
28	54	56.62	58	22.31	1000
29	54	55.34	58	23.10	600
30	54	40.00	58	32.61	250

Table 2.1: Definitive station positions for Drake Passage section (from Bacon et al., 2003).

JR 139 CTD Stations. The three lines for each station represent the start, maximum depth and end of the station. Depth (m) is the EA600 value. Wout is Wire Out (m),, the maximum length of winch cable deployed for each station. Pmax is maximum pressure (dbar) for each station. Numbered notes are displayed at the end of this table. **Note that test stations are not listed**.

Station	Day JDAY	Time hh:mm:ss	Latitude deg, min	Longitude deg, min	Depth (m)	Wout	Pmax	Alt Notes	Raw data FileName
001	341	06:48:00	54^0 39.99’ S	58^0 32.66’ W	391	370	-	-	139_007.dat
	341	07:06:00	54^0 39.99’ S	58^0 32.64’ W	391			Note 1	
	341	07:21:00	54^0 39.99’ S	58^0 32.65’ W	391				
002	341	09:09:00	54^0 55.43’ S	58^0 23.10’ W	554	530	-	-	139_008.dat
	341	09:26:50	54^0 55.43’ S	58^0 23.11’ W	550			see Note 1	
	341	09:47:30	54^0 55.43’ S	58^0 23.10’ W	553				
003	341	10:15:51	54^0 56.57’ S	58^0 22.31’ W	1096	-	-	-	139_009.dat
	341	10:43:00	54^0 56.59’ S	58^0 22.33’ W	1100			see Note 1	
	341	11:15:25	54^0 56.59’ S	58^0 22.31’ W	1105				
004	341	13:54:20	54^0 57.67’ S	58^0 21.68’ W	1616	1580	-	-	139_010.dat
	341	14:34:30	54^0 57.66’ S	58^0 21.69’ W	1618			Note 2	
	341	15:19:30	54^0 57.66’ S	58^0 21.68’ W	1615				
005	341	16:18:35	55^0 04.17’ S	58^0 17.55’ W	2087	2084	-	-	139_011.dat
	341	17:08:42	55^0 04.17’ S	58^0 17.56’ W	2088			see Note 2	
	341	17:59:00	55^0 04.17’ S	58^0 17.56’ W	2082				
006	341	18:38:45	55^0 07.24’ S	58^0 15.69’ W	2542	2490	2541	8.9	139_012.dat
	341	19:39:05	55^0 07.25’ S	58^0 15.70’ W	2537				
	341	20:42:12	55^0 07.24’ S	58^0 15.71’ W	2543				
007	341	21:19:20	55^0 10.24’ S	58^0 13.92’ W	2975	2966	3034	11.6	139_013.dat
	341	22:25:26	55^0 10.25’ S	58^0 13.86’ W	2989				
	341	23:35:34	55^0 10.24’ S	58^0 13.85’ W	2987				
008	342	00:20:24	55^0 12.85’ S	58^0 12.23’ S	3823	3879	3961	Note 3	139_014.dat
	342	01:36:00	55^0 12.84’ S	58^0 12.24’ S	3818				
	342	03:11:00	55^0 12.84’ S	58^0 12.24’ S	3829				
009	342	05:12:30	55^0 31.15’ S	58^0 00.91’ W	4208	4200	-	11	139_015.dat
	342	06:32:30	55^0 31.15’ S	58^0 00.90’ W	4208				
	342	08:09:00	55^0 31.15’ S	58^0 00.90’ W	4230				
010	342	10:14:35	55^0 49.99’ S	57^0 49.24’ W	4733	4715	-	-	139_016.dat
	342	11:45:42	55^0 49.99’ S	57^0 49.24’ W	4735				
	342	13:34:17	55^0 49.99’ S	57^0 49.22’ W	4746				
011	342	15:50:00	56^0 08.97’ S	57^0 37.48’ W	3395	Note 4	3448.48	8.4	139_017.dat
	342	17:03:00	56^0 08.96’ S	57^0 37.48’ W	Note 4				
	342	18:21:00	56^0 08.96’ S	57^0 37.48’ W	3389				
012	342	20:26:00	56^0 28.55’ S	57^0 25.47’ W	3877	3729	3809	8.0	139_018.dat
	342	21:42:00	56^0 28.87’ S	57^0 25.45’ W	3715				
	342	23:07:00	56^0 28.65’ S	57^0 25.43’ W	3736				
013	343	01:25:00	56^0 46.99’ S	57^0 13.85’ W	3121	3267	3315	23.2	139_019.dat
	343	02:27:23	56^0 46.30’ S	57^0 13.21’ W	3329				
	343	03:39:00	56^0 45.34’ S	57^0 11.94’ W	3385				
014	343	05:55:00	57^0 04.03’ S	57^0 02.17’ W	4250	4120	-	12.6	139_020.dat
	343	07:13:18	57^0 05.81’ S	57^0 01.86’ W	4220				

	343	08:38:00	57^0 05.46’ S	57^0 01.43’ W	4128				
015	343 343 343	10:44:00 11:53:00 13:09:00	57^0 24.94’ S 57^0 24.47’ S 57^0 24.01’ S	56^0 50.34’ W 56^0 49.18’ W 56^0 47.86’ W	3465 3452 3841	3460	3505	16	139_021.dat
016	343 343 343	15:14:00 16:28:00 17:46:00	57^0 44.01’ S 57^0 44.85’ S 57^0 43.76’ S	56^0 38.41’ W 56^0 37.51’ W 56^0 36.08’ W	3648 3614 3737	3611	3690	10.3	139_022.dat
017	343 343 343	19:45:00 21:05:00 22:44:00	58^0 03.01’ S 58^0 03.02’ S 58^0 03.01’ S	56^0 26.78’ S 56^0 26.81’ S 56^0 26.93’ S	3994 3985 3996	3936	4031	10	139_023.dat
018	344 344 344	00:44:20 02:02:00 03:23:00	58^0 22.00’ S 58^0 22.91’ S 58^0 21.92’ S	56^0 15.02’ W 56^0 14.69’ W 56^0 14.68’ W	3929 3916 3927	-	3959	7.5	139_024.dat
019	344 344 344	09:25:00 10:37:00 11:53:19	58^0 41.07’ S 58^0 41.06’ S 58^0 41.06’ S	56^0 03.27’ W 56^0 03.27’ W 56^0 03.27’ W	3764 3784 3791	3725	3809	9	139_025.dat
020	344 344 344	13:59:29 15:11:00 16:41:00	59^0 00.02’ S 59^0 00.80’ S 59^0 00.95’ S	55^0 51.36’ W 55^0 51.36’ W 55^0 51.36’ W	3812 3800 3799	3764	3825	7.6	139_026.dat
021	344 344 344	18:40:00 19:53:00 21:13:00	59^0 20.01’ S 59^0 20.00’ S 59^0 20.01’ S	55^0 39.04’ W 55^0 39.00’ W 55^0 39.04’ W	3773 3798 3785	3731	3812	9.1	139_027.dat
022	344 345 345	23:22:00 00:30:00 01:49:00	59^0 40.02’ S 59^0 40.01’ S 59^0 40.00’ S	55^0 26.64’ W 55^0 26.65’ W 55^0 26.66’ W	3714 3718 3715	3658	3730	8.4	139_028.dat
023	345 345 345	03:49:00 04:50:00 06:08:00	59^0 59.98’ S 60^0 00.11’ S 60^0 00.40’ S	55^0 14.29’ W 55^0 14.27’ W 55^0 14.24’ W	3540 3541 3535	3485	3550	8.6	139_029.dat
024	345 345 345	08:08:00 09:14:00 10:22:34	60^0 19.97’ S 60^0 19.97’ S 60^0 19.97’ S	55^0 01.91’ W 55^0 01.91’ W 55^0 01.92’ W	3480 3423 3477	3415	3487	10.5	139_030.dat
025	345 345 345	12:35:08 13:35:55 14:43:55	60^0 40.01’ S 60^0 39.92’ S 60^0 39.82’ S	54^0 49.49’ W 54^0 48.93’ W 54^0 48.36’ W	3135 3119 3115	3070	3128	8.5 Note 5	139_031.dat
026	345 345 345	15:42:27 16:37:00 17:39:00	60^0 47.94’ S 60^0 47.91’ S 60^0 47.86’ S	54^0 44.57’ W 54^0 43.92’ W 54^0 43.12’ W	3312 2718 2442	2686	2737	8	139_032.dat
027	345 345 345	18:03:03 18:45:00 19:31:00	60^0 49.99’ S 60^0 49.99’ S 60^0 49.98’ S	54^0 43.32’ W 54^0 43.07’ W 54^0 42.76’ W	3715 - 1670	1617	1643	8.2	139_033.dat
028	345 345 345	22:01:00 22:28:00 22:58:00	60^0 51.04’ S 60^0 51.04’ S 60^0 51.03’ S	54^0 42.81’ W 54^0 42.80’ W 54^0 42.79’ W	1011 1004 1006	1041	1057	9.9	139_034.dat
029	346 346 346	00:04:00 00:21:00 00:43:00	60^0 58.89’ S 60^0 58.88’ S 60^0 58.88’ S	54^0 37.80’ W 54^0 37.79’ W 54^0 37.80’ W	601 601 601	567	577	10	139_035.dat
030	346 346 346	01:27:50 01:42:16 01:58:30	61^0 02.93’ S 61^0 02.93’ S 61^0 02.93’ S	54^0 35.30’ W 54^0 35.30’ W 54^0 35.30’ W	377 378 379	354	360	9.0	139_036.dat

Note 1: Altimeter not working

Note 2: Altimeter replaced, but still not working.

Note 3: Altimeter reading 99.7m at start.

Note 4: Wireout and depth at bottom not recorded.

Note 5: Echo sounder highly variable: depth uncertain.

Table 2.2: Summary of JR139 CTD deployments

Sensor	Serial Number	date last calibrated
SBE 32 Water Sampler	0173	n/a
Paroscientific Digiquartz pressure transducer	89973	03/06/05
Primary SBE 4C conductivity sensor	042248	23/06/05
Primary SBE 3 plus temperature sensor	03P2705	23/06/05
Primary pump SBE 5 T submersible pump	2371	16/02/99
Secondary SBE 4C conductivity sensor	042255	23/06/05
Secondary SBE 3 plus temperature sensor	03P2709	23/06/05
Secondary SBE 5 T submersible pump.	2395	15/03/99
Tritech PA200 Altimeter	2130.26993	28/01/00
Seabird SBE 43 Oxygen sensor	0242	31/05/05
MKIII Aquatracka Flourometer	088216	21/06/04
Chelsea Seatech Wetlab Cstar Transmissometer	CST-846DR	29/03/05
Deep Ocean Standards Thermometer SBE 35	3538936-0051	29/10/05

Table 2.3: JR139 CTD configuration with sensor instrument numbers.

Date: 08/14/2006
ASCIIfile:
C:\Docs\JR139\data_jr139\data_jr139\ctd\raw\jr151_postproc2.CON
Configuration report for SBE 911/917 plus CTD

Frequency channels suppressed : 0
Voltage words suppressed : 0
Computer interface : RS-232C
Scans to average : 1
Surface PAR voltage added : No
NMEA position data added : No
Scan time added : No

1) Frequency channel 0, Temperature

Serial number : 2705
Calibrated on : 23 June 2005
G : 4.39116570e-003
H : 6.55180780e-004
I : 2.66756260e-005
J : 2.79799280e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency channel 1, Conductivity

Serial number : 2248
Calibrated on : 23 June 2005
G : -1.04528000e+001
H : 1.42350000e+000
I : 1.40363000e-005
J : 9.88784000e-005
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency channel 2, Pressure, Digiquartz with TC

Serial number : 89973-0707
Calibrated on : 03-June-05
C1 : -4.925971e+004
C2 : -2.136250e-001
C3 : 9.435710e-003
D1 : 3.900400e-002
D2 : 0.000000e+000
T1 : 2.983458e+001
T2 : -3.883229e-004
T3 : 3.262440e-006
T4 : 3.429810e-009
T5 : 0.000000e+000
Slope : 1.00012000
Offset : -0.85200
AD590M : 1.277500e-002
AD590B : -9.391460e+000

4) Frequency channel 3, Temperature, 2

Serial number : 32709
Calibrated on : 23 June 2005
G : 4.34975000e-003
H : 6.45646000e-004
I : 2.31166000e-005
J : 2.14499000e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

5) Frequency channel 4, Conductivity, 2

Serial number : 42255
Calibrated on : 23 June 2005
G : -1.03015500e+001
H : 1.41606900e+000
I : -3.05972000e-003
J : 2.99775900e-004
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

6) Voltage channel 0, Free

7) Voltage channel 1, Free

8) Voltage channel 2, Fluorometer, Chelsea Aqua 3

Serial number : 88216
Calibrated on : 21 June 2004
VB : 0.387000
V1 : 2.014200
Vacetone : 0.396800
Scale factor : 1.000000
Slope : 1.000000
Offset : 0.000000

9) Voltage channel 3, Free

10) Voltage channel 4, Transmissometer, Chelsea/Seatech/Wetlab CStar
Serial number : CST-846DR
Calibrated on : 29 Mar 2005
M : 21.3083
B : -1.2998
Path length : 0.250

11) Voltage channel 5, Free

12) Voltage channel 6, Altimeter

Serial number : 2130.2701
Calibrated on :
Scale factor : 15.000
Offset : 0.000

13) Voltage channel 7, Oxygen, SBE

Serial number : 0242
Calibrated on : 31 May 2005
Soc : 3.8740e-001
Boc : 0.0000
Offset : -0.4865
Tcor : 0.0011
Pcor : 1.35e-004
Tau : 0.0

Table 2.4: JR139 CTD calibration coefficients.

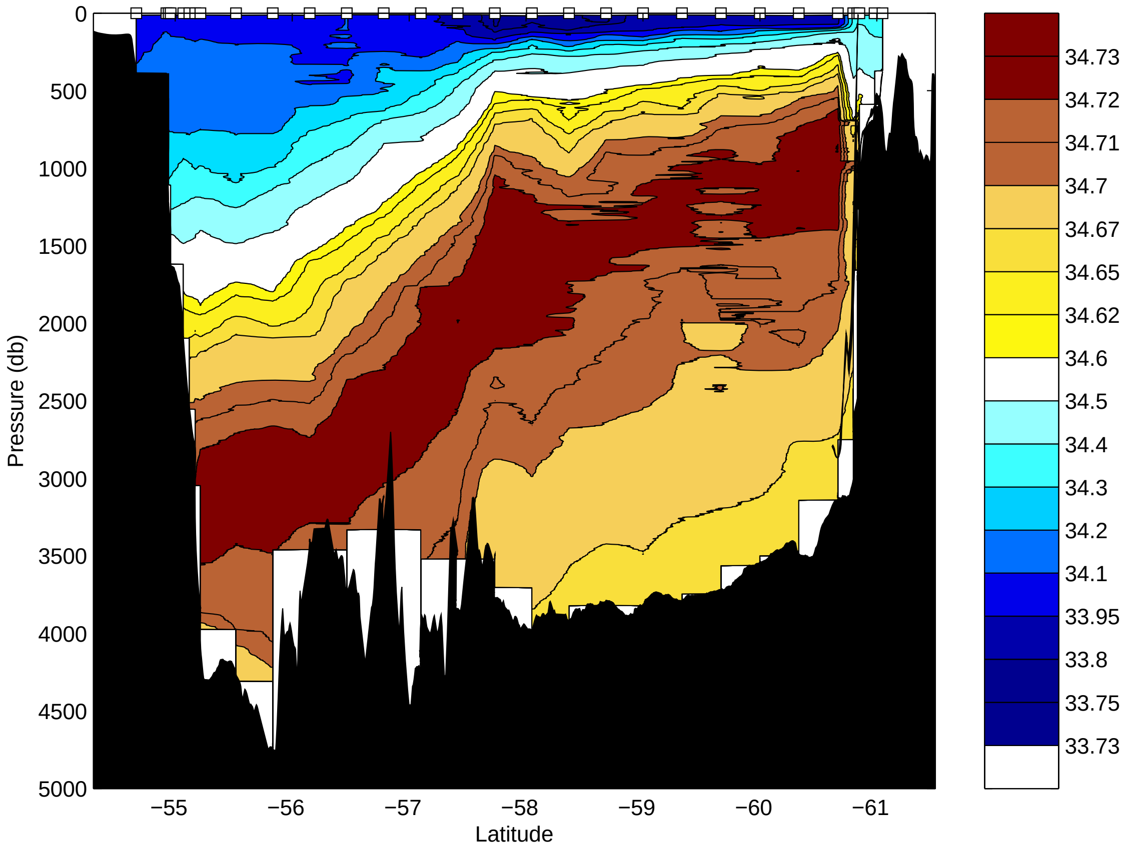

Figure 2.1: Contour plot of salinity for SR1b section across Drake Passage. The section is plotted from north (left hand side) to south (right hand side). The x and y axes are latitude and pressure (db) respectively. Bathymetry data is uncorrected data from the ships Simrad 500 system. Station locations are indicated as open squares on the upper x-axis.

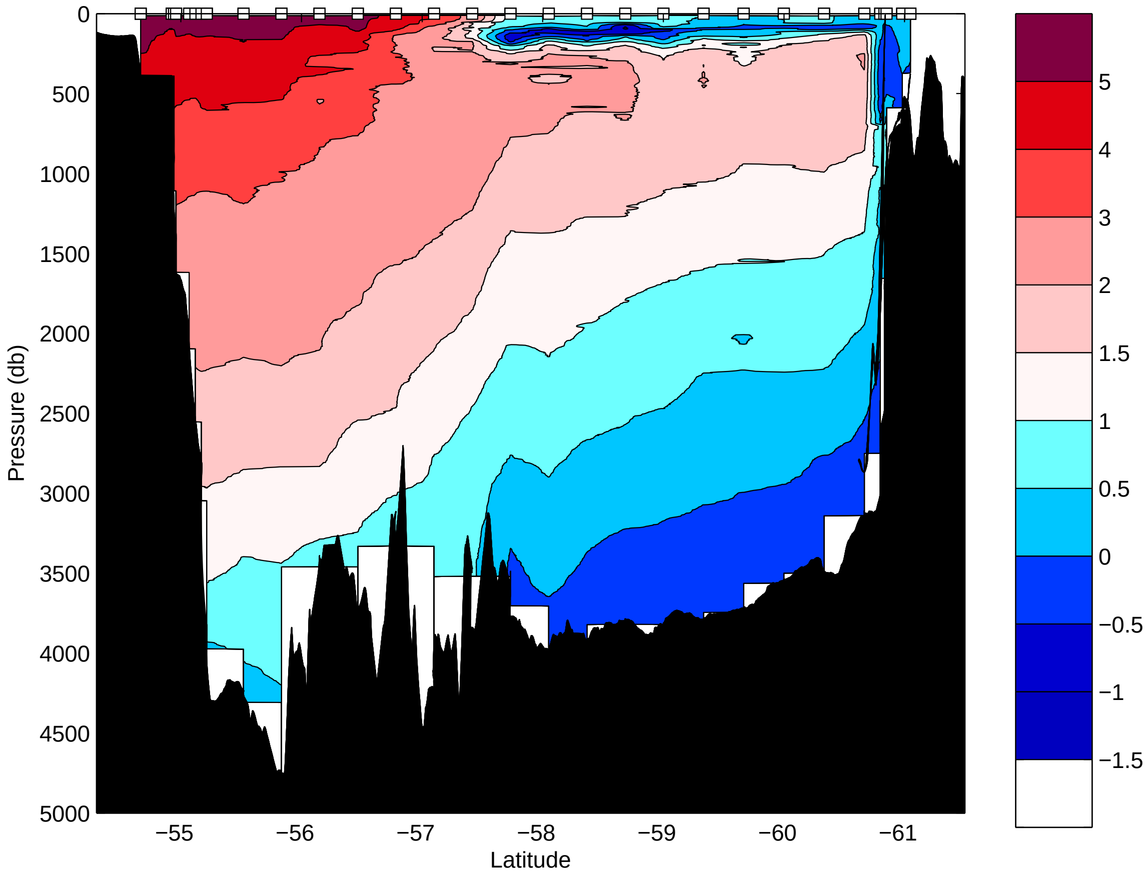

Figure 2.2: Contour plot of potential temperature (°C) for SR1b section across Drake Passage. The section is plotted from north (left hand side) to south (right hand side). The x and y axes are latitude and pressure (db) respectively. Bathymetry data and station locations are as in Figure 2.1.

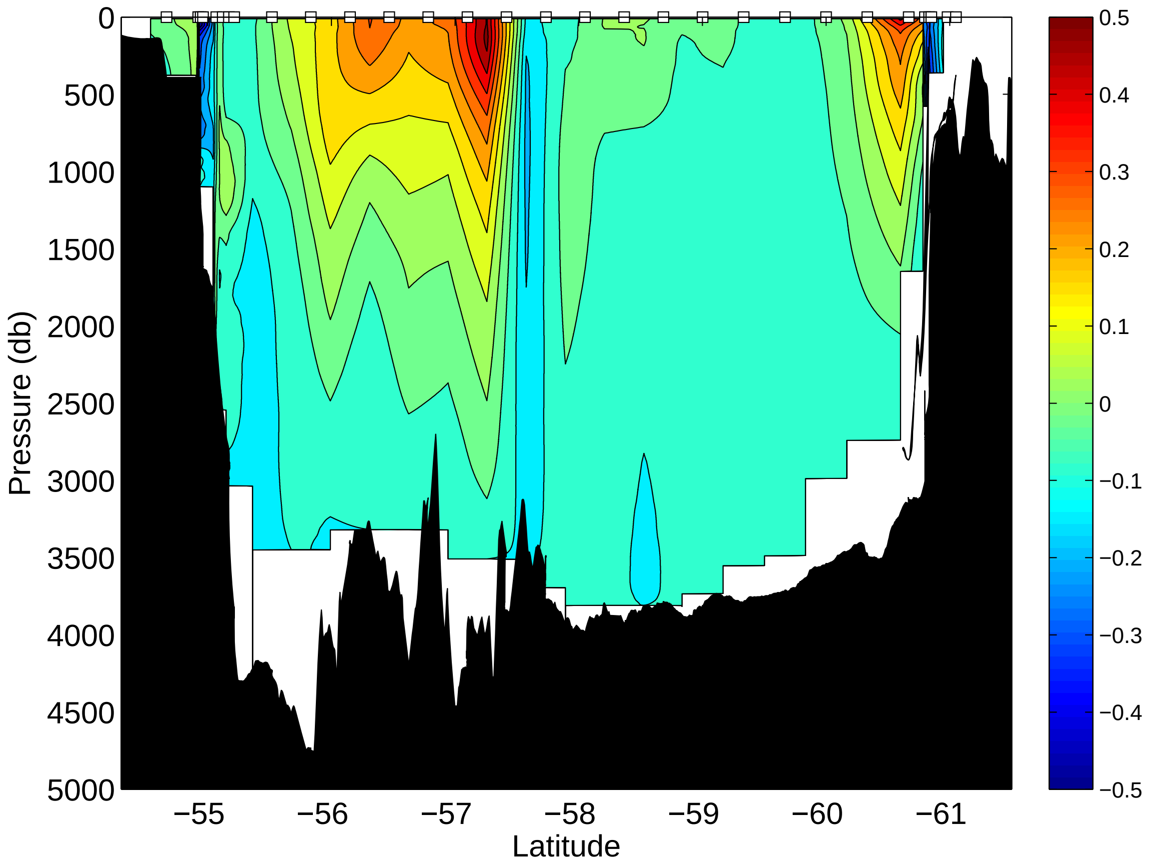

Figure 2.3: Contour plot of geostrophic velocity (m s^{-1}) for SR1b section across Drake Passage. The geostrophic velocity was calculated from adjacent hydrographic stations referenced to the deepest common level (DCL). Bathymetry data and station locations are as in Figure 2.1.

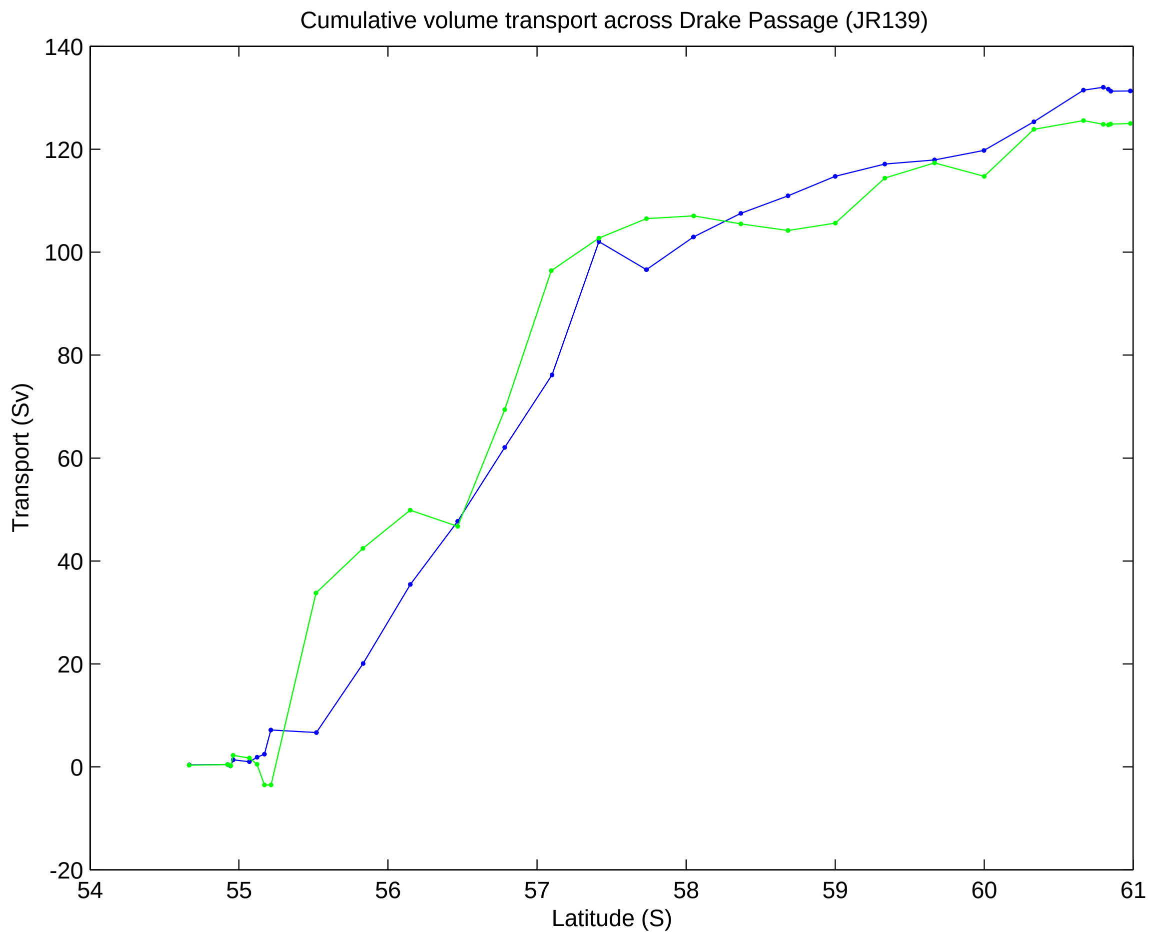

Figure 2.4: Baroclinic transport referenced to the deepest common level for JR139 (the blue line) and JR115 (the green line). Net transport for JR139 is 131.3 Sv which is higher than JR115 last year (124.9 Sv), but less than the average of 135.8 Sv from the annual record (1993-2005) (Adam Williams pers. comm..).

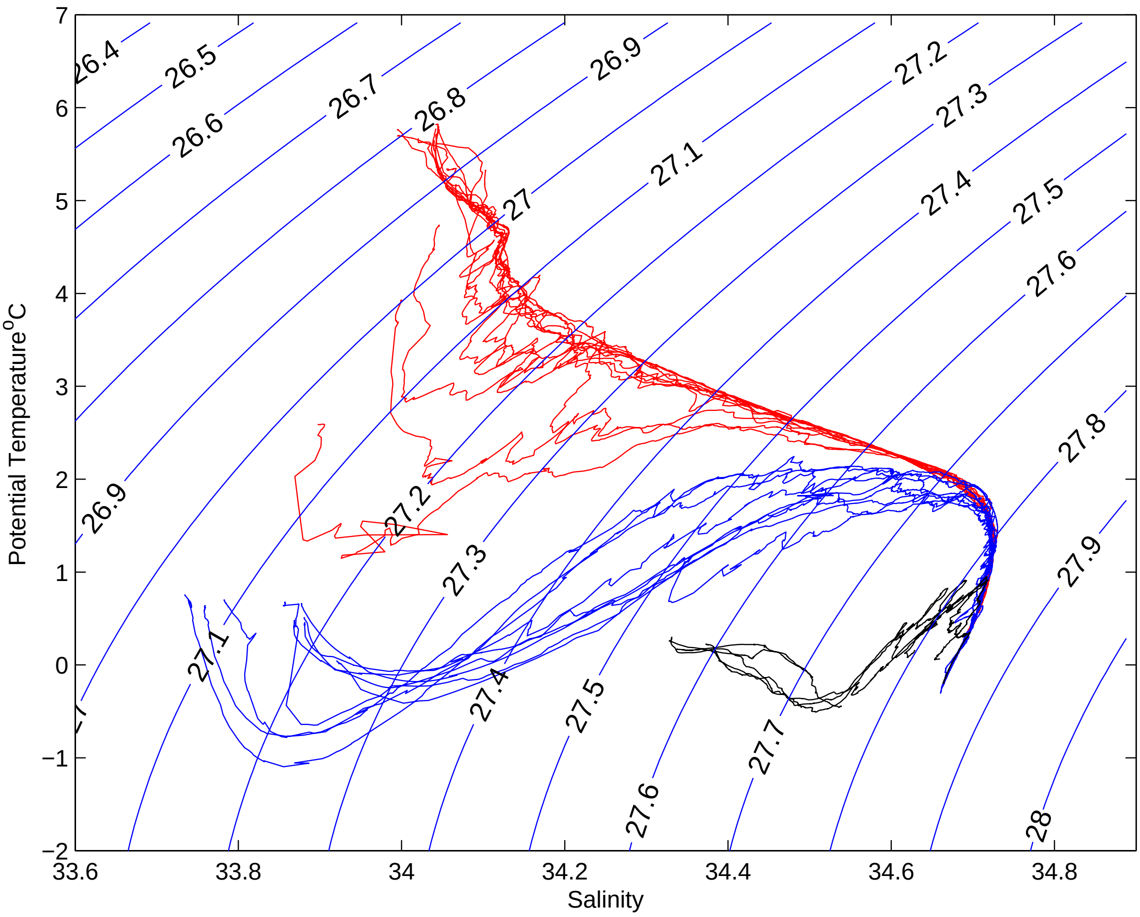

Figure 2.5: Potential temperature / salinity plot for the JR139 SR1b Drake Passage section. Stations to the north and south of the Polar Front are represented in red and blue, respectively. Stations to the south of the Continental boundary marking the southernedge of the ACC, on which Antarctic Continental Shelf waters were observed, are represented in black..

3. LADCP

Kate Stansfield, Nuno Nunes

3.1 Introduction

Cruise JR139 was the seventh cruise to use a RDI Workhorse WH300 ADCP (WH) unit. A single 300 kHz RDI WH unit (DWH; serial number 4908) was deployed in a downward facing position mounted off-centre at the bottom of the CTD frame. A fin was added to the CTD frame to reduce spinning.

Between stations, each ADCP was usually connected to a controlling PC in the Underway Instrument Control (UIC) room through a serial cable for delivery of pre-deployment instructions and post-deployment data retrieval. The battery package was recharged after each deployment, by connection to a charging unit in the UIC room via a power lead.

3.2 JR139 LADCP configuration files

A single configuration was used for all stations. Each station consisted of a single down- and upcast without pause except for bottle firing. For such stations the priority is to obtain the best possible current estimates despite package motion and a short observation period for each part of the water column. As is usual for this purpose, the ADCPs were operated with 16 large (10 m) bins and short ensembles (1 ping per ensemble; average 1 ping/second). The command file 4908_M2.cmd is provided below.

4908_M2.cmd

```
CR1
CF11101
EA0
EB0
ED0
ES35
EX11111
EZ0111111
LW1
LD111100000
LF500
LN16
LP1
LS1000
LV250
SM1
SA001
SI0
SW5000
TE00:00:01.00
TP00:01.00
CK
CS
;
;Instrument         = Workhorse Sentinel
;Frequency          = 307200
;Water Profile      = YES
;Bottom Track       = NO
;High Res. Modes    = NO
;High Rate Pinging  = NO
;Shallow Bottom Mode= NO
;Wave Gauge         = NO
;Lowered ADCP       = YES
;Beam angle         = 20
;Temperature        = 5.00
;Deployment hours   = 24.00
;Battery packs      = 1
;Automatic TP       = YES
;Memory size [MB]   = 48
;Saved Screen       = 1
;
```

```
;Consequences generated by PlanADCP version 2.02:
;First cell range   = 15.15 m
;Last cell range    = 165.15 m
;Max range          = 168.26 m
;Standard deviation = 5.31 cm/s
;Ensemble size      = 468 bytes
;Storage required   = 38.56 MB (40435200 bytes)
;Power usage        = 67.62 Wh
;Battery usage      = 0.2
;
; WARNINGS AND CAUTIONS:
; Lowered ADCP feature has to be installed in Workhorse to use selected option.
; Advanced settings has been changed.
; Expert settings has been changed.
```

3.3 Instructions for LADCP deployment and recovery during JR139

This set of instructions is based on the LADCP section of the JR67 cruise report (Bacon et al., 2002). It can be used in conjunction with the LADCP log sheet included in the present report.

Deployment

Connect the communication and battery leads for both instruments. The DWH should be connected to the com1 port and the UWH to the com2 port.

Downward looking Workhorse (DWH) LADCP

1. If the batteries have been recharged, switch off the battery charge unit and check battery voltage. This step was generally carried out before the deployment procedure was started.

2. In the controlling PC, run **BBTALK** and open a window for COM1. Press <F3> to create a log file in which all subsequent BB-related BBTALK output will be stored. Enter filename of the form *c:\directory…\ jr139_##.txt* (where *##* is the station number).

3. Press <END> to wake up the DWH. If the connection fails, check that the communications lead is properly connected at the DWH end.

5. Set the Baud rate to 115200 to allow faster upload of the file on recovery.

6. Check the DWH clock against the scientific clock. The DWH clock does not keep good time. Type *TS?* <ENTER> for a time in the form *YYMMDDhhmmss*. Reset the DWH clock to the scientific clock time by typing *TSYYMMDDhhmmss* <ENTER>.

7. Check the available memory of the DWH by typing *RS?* <ENTER>. If insufficient

memory is available, clear it by typing *RE ErAsE* <ENTER>. The memory should only be cleared after all data has been transferred to the UNIX system and checked.

8. Type PA <ENTER> to run diagnostic checks. Note that the Receive Path (PT3) and Bandwidth (PT6) tests may fail if the WH is not in water. Other tests should pass.
7. Press F2 then select the DWH configuration file. The DWH is now ready for deployment.

9. Press F3 to stop the log file.

10. Remove the power/data cable attached to the instrument on the frame and insert the blanking plug. Secure the blanked cable end to the CTD frame to avoid damage or strain.

Ensure that entries 1-4 have been filled in in the log sheet as the deployment is carried out. This also helps ensure that no steps are omitted. The DWH should now be pinging.

Recovery
Remove blanking plug and attach the communication and charger cables, using fresh water and absorbent paper to minimise their exposure to salt water.

1. Run **BBTALK**. Select *COM1* for the DWH (master) and press <END> to wake up the LADCP. Use the adjacent COM2 window for the UWH and press <END> to wake up the LADCP.

2. Check battery voltage and switch on charger if necessary. Though this step can generally be left to the end for the workhorse type ADCPs.

3. Set the Baud rate to 115200 to allow faster upload of the file on recovery.

4. Check the number of deployments by typing *RA?* <ENTER>. Then transfer the data to the PC. Go to *file*, *recover recorder.* Select the *c:\directory…\master* for the DWH as the destination for the recovered file. This can take ten minutes or more with large files. Once the data are transferred the WH should be powered down by typing *CZ* <ENTER>.

5. Rename the default filenames to *c:\directory…\jr139m##.000* for the DWH.

6. Note the file size down, and transfer the files by FTP or a zip disc to the *unix* system . The program WINADCP on the LADCP PC can be used to check the number of ensembles and whether the data recovered looks initially reasonable. The data are now ready for processing.

Occasionally the rather elderly LADCP PC would crash. The reason for this was never ascertained, but a more modern PC should be acquired for the next cruise.

LADCP log sheet: – JR97

CTD CAST		Date:		JDAY	
Lat:		Long:		Depth:	

LADCP Deployment / Recovery Log Sheet

Pre-Deployment (Comms. and Charge leads should be in place)

In BBTALK:	MASTER	SLAVE
1. Log file name (F3)	.txt	.txt
2. Time check (TS?) and time correction if necessary	: :	: :
3. Memory unused (RS?) and erase if necessary (RE ErAsE)	Mb	Mb
4. Run tests (PA)		

5. Battery Voltage | V | (max. 52V) measure across charger

Deployment

6. MASTER deployment time, from master clock | : : |

Recovery

In BBTALK

7. Time of stopping MASTER logging | : : | Stop SLAVE

8. Battery Voltage | V | Measure on charger

Data Transfer

In BBTALK	MASTER	SLAVE
9. Number of deployments (RA?)		
10. Default filename	-RDI- .000	-RDI- .000
11. Renamed file	m.000	s.000

In BBLIST	MASTER	SLAVE
12. File size	***Kb***	Kb
13. Number of ensembles		

16. Comments

Figure 3.1: LADCP logsheet.

3.5 LADCP data processing

Nuno Nunes

LADCP data was processed following the instructions laid out in the JR115 cruise report (Sparrow and Hawker, 2005). The required directory structure and environment variables were mostly set up prior to the cruise, and processing scripts edited accordingly (BAK at NOC?). However, troubleshooting forced a detailed revision of scripts in order to gain an understanding of the data flow (and more importantly, of no-flow). To provide help in similar circumstances, a few *readme* files were sprinkled over relevant directories. The following instructions are basically those in last year's report, with only a few changes. When changing directory, it may be useful to check if a *readme* file exists, as the information therein could save a lot of time.

3.5.1 Initial Data Processing

The initial steps of data processing on JR139 were as follows:

(i) Log onto one of the UNIX machines as pstar, password pstar.
You must be logged on to jruh to get access to the matlab licence

(ii) *cd ladcp* (ensures you're in the correct directory)
setup jr115matlab (set up matlab)
source LADall (set up paths)

(iii) *cd proc*
cd Rlad
j139_links (creates links to the raw LADCP files Jr139NNN.000 named 139mNNN.000, which linkscript expects to find; written solely to avoid editing linkscript directly)
linkscript (checks the raw LADCP data; there should be a raw file called 139mNNN.000. Linkscript will make a symbolic link from jNNN_02.000 to the real raw file. We use _02 for compatibility with other cruises when there is more than one LADCP. The convention adopted on CD139 was that 02 is a downlooking WH.).

(iv) *cd proc*

perl –S scan.prl NNN_02 (allows the user to check the start and end times for the downcast and upcast. The duration of the downcast and upcast should be similar. The minimum and maximum depths should also be checked).

(v) *putpos2 NNN 02* (collects start and stop times, positions, and gets the magnetic variation correction using a matlab routine. Updates stations.asc and magvar.tab. Note that if you run this more than once for the same station then you should go into these files and delete the invalid entry. You may wish to check the files for duplicates, test file entries, etc. before you proceed.)

(vi) *perl –S load.prl NNN_02* (loads data into the CODAS database, correcting for magvar.tab. It is very important that this step is only done once. If you need to do it again, for example if you discover an error in step 5, then you must delete the database files first. In JR139 these are found in proc/casts/jNNN_02/scdb).

(vii) *perl –S domerge.prl –c0 NNN_02* (merge single pings into long shear profiles)

(viii) *cd Rnav*

setup files for retrieving location data from ship's navigation streams; see readme file for more detailed instructions. For JR139, data from the NMEA GPS stream (more equipment details here?) was used.

updatesm.exec (updates a navigation file and calls matlab)

cd proc

(ix) The data can be plotted and checked using the following commands:

plist = NNN.02 (sets the station and cast number – always 2 – to process. This is a decimal number in matlab)

do_abs (generates five plots showing the various velocity components and information about the sensor such as its heading, tilt and angle).

3.5.2 Secondary Processing (absolute velocities)

Once the CTD has been processed as far as a 1Hz file the absolute velocities can be calculated in the following manner: This was done as a post-processing exercise back at NOC by Brian King as there was insufficient time on the ship to produce a full set of CTD 1Hz data files.

(i) In UNIX:

cd proc

cd Rctd (copy your CTD 1Hz files into this directory)

ctd1hz_links (creates links so ctd_in can find the files)

(ii) In Matlab:

cd to proc/Pctd (Matlab doesn't seem to be able to use the $cdpath shell variable to find its way around, so you will have to use pwd liberally)

ctd_in(NNN,02)

cd to proc/Fitd (as above)

plist = NNN.02 (set the station and cast - always 2 – numbers)

fd (check vertical velocities from CTD (line) and LADCP (x) agree)

(iii) In UNIX:

cd proc

perl –S add_ctd.prl NNN_02 (add the CTD data to the CODAS database)

perl –S domerge.prl –c1 NNN_02 (merge the ping profiles using the CTD data)

(iv) In Matlab:

plist = NNN.02

do_abs (When the velocity profiles are plotted they should be a similar shape to the profiles at the end of the 'first look' data processing, but with a mean velocity, so that the U and V velocities have a mean offset).

3.6 Problem cases

The start and end times (explicit?) for the station 1 (cast 7) downcast and start time for the upcast from the LADCP datafile (as reported by scan.prl) don't match those recorded in the CTD log sheet; strangely, the end times for the upcast do agree.

Stations 10, 15 and 17 (casts 16, 21 and 23) experienced computer crashes mid-cast so the CTD data were stored in two separate files. This caused problems for generating the 1Hz data files for merging with the LADCP. In addition for Station 17 (cast 21) for at least part of the cast the CTD seemed to have been told to sample at a slower rate (3Hz instead of 24Hz). This also impacted the generation of the 1Hz data files.

Figure 3.3 shows the section perpendicular velocity structure across Drake Passage, which makes an interesting comparison with the geostrophic velocities calculated from the CTD data and shown in Figure 2.3.

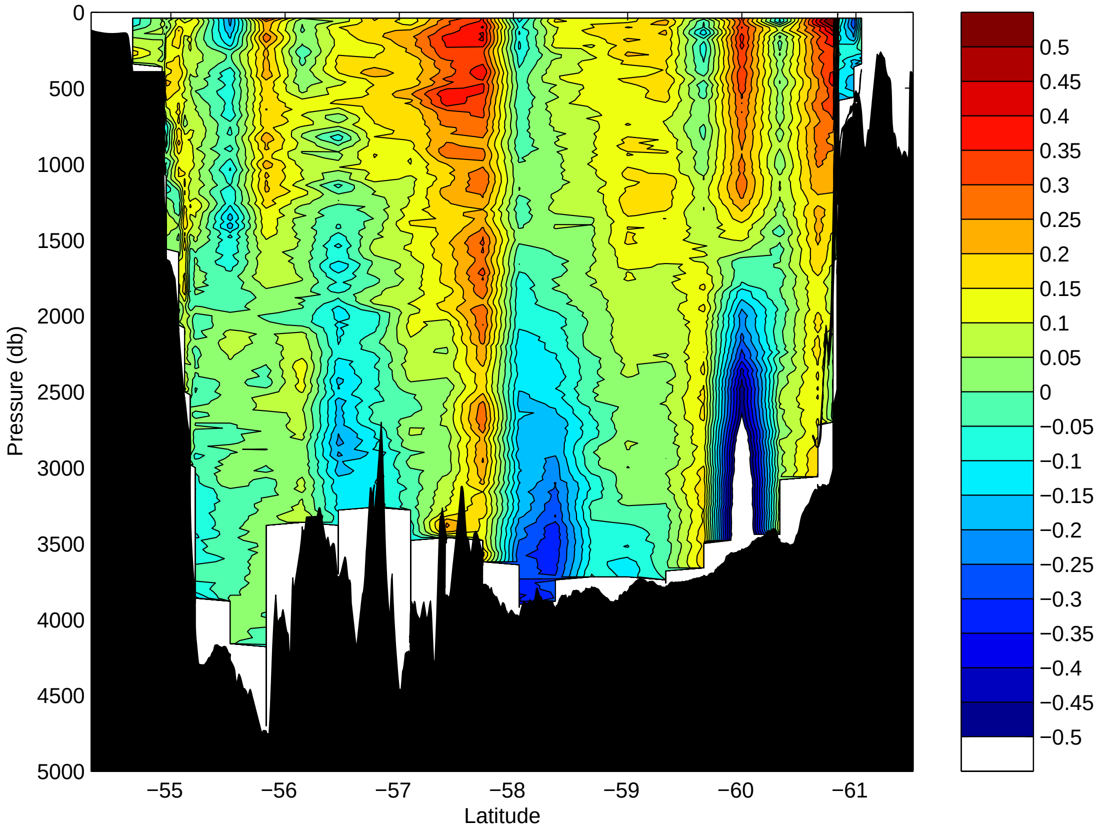

Figure 3.3: The section perpendicular velocity (m s^{-1}) field from LADCP data across Drake Passage. The major features observed in the geostrophic velocity field (Figure 2.3) are also seen here.

4. VM_ADCP

Vessel-mounted Acoustic Doppler Current Profiler (VM-ADCP)

Mike Meredith

4.1 Introduction

RRS James Clark Ross had a 75 kHz RD Instruments Ocean Surveyor (OS75) ADCP installed during August 2005, replacing the old 150 kHz RDI unit that had seen many years of service. The OS75, in principle, is capable of profiling to deeper levels in the water column, and can also be configured to run in either narrowband or broadband modes. As such, it represents a useful advance in the science capability of the *JCR*. Initial trials on JR133 (24-29 August 2005) were promising, but it is clear that skill with the use of the instrument and data processing will improve as further experience is acquired. It should be noted that the bulk of the work getting to grips with the OS75 on the *JCR* has thus far been conducted by Dr. Deb Shoosmith, who provided extremely useful advice prior to and during JR139.

4.2 Instrument and configuration

The OS75 unit is sited in the transducer well in the hull of the *JCR*. This is flooded with a mixture of 90% de-ionised water and 10% monopropylene glycol. With the previous 150 kHz unit, the use of a mixture of water/antifreeze in the transducer chest required a post-processing correction to derived ADCP velocities. However, the new OS75 unit uses a phased array transducer that produces all four beams from a single aperture at specific angles. A consequence of the way the beams are formed is that horizontal velocities derived using this instrument are independent of the speed of sound (vertical velocities, on the other hand, are not), hence this correction is no longer required.

The OS75 transducer on the *JCR* is aligned at approximately 60 degrees relative to the centre line. This differs from the recommended 45 degrees. Prior to JR139, there was some confusion concerning the transducer depth, for which an approximate value of 6.5m had been assumed during the trials cruise (JR133). Shortly after sailing for JR139, the hull depth was measured by Robert Patterson (Chief Officer), and found to be 6.47m. Combined with a value for the distance of the transducer behind the seachest window of 100-200mm and a window thickness of 50mm, this implies a transducer depth of 6.3m. This is the value assumed for

JR139, but note that the ship was very heavily laden during this cruise, and for other cruises it may be shallower.

During the trials cruise, it was noted that the OS75 causes interference with most of the other acoustic instruments on *JCR*, including the EM120 swath bathymetry system. To circumvent this, the ADCP pinging was synchronised with the other acoustic instruments using the SSU, however this acts to reduce the pingrate. As noted by Dr. Sophie Fielding, when in deep water the swath can take 20 to 30 seconds from ping to end of listening, as a result this means the ADCP only pings once every 25 or so seconds. A further problem is that the ADCP appears to "time out" every other ping when it has to wait a long time between pings (i.e when running in deep water alongside the EM120). This results in it rebooting and waking the ADCP instrument up every other ping, which simply exacerbates the problem. A fix is promised by BAS AME, but requires a firmware upgrade from RDI which is not presently available. To circumvent these problems, only the single-beam echosounder (EA600) was run alongside the OS75 during JR139.

The heading feed to the OS75 is the heading from the Seapath GPS unit. This differs from the previous ADCP setup on *JCR*, which took a heading feed from the ship's gyrocompass and required correction to GPS heading (from Ashtech) in post-processing.

4.3 Configuration

The OS75 was controlled using Version 1.42 of the RDI VmDas software. The logging PC also had Version 1.13 of the RDI WinADCP software installed and running, to act as a realtime monitor of data. The OS75 ran in three modes during JR139: broadband (with bottom-tracking on), narrowband (with bottom-tracking on) and narrowband (with bottom-tracking off). Broadband profiling was enabled with sixty-five 8 meter bins, using a blanking distance of 8m. (Note that this blanking distance is larger than the 2m initially used by the RDI technician during the trials cruise. This change was adopted following advice from Dr. Mark Inall and Dr. Deb Shoosmith, who voiced concerns over the quality of data in the top bin). Narrowband profiling with bottom-tracking on was enabled with sixty-five 16 meter bins, and with bottom-tracking off with seventy 16 meter bins. Narrowband profiling was also enabled with an 8 meter blanking distance. The time between pings was set to 2 seconds, again following advice from Dr. Deb Shoosmith. Salinity at the transducer was set to zero, and Beam 3 misalignment was set to 60.08 degrees (see above discussion). The full configuration files for each of the modes used are given in Appendix A.

4.4 Outputs

The ADCP writes files to a network drive that is samba-mounted from the Unix system. (Should the network fail, there is an alternative write path to the local ADCP PC hard drive to preserve data until the link is restored). When the Unix system is accessed (via samba) from a separate networked PC, this enables post-processing of the data without the need to move files.

Output files are of the form JR139_XXX_YYYYYY.ZZZ, where XXX increments each time the logging is stopped and restarted, and YYYYYY increments each time the present filesize exceeds 10 Mbyte.

ZZZ are the filename extensions, and are of the form:-

.N1R (NMEA telegram + ADCP timestamp; ASCII)
.ENR (Beam coodinate single-ping data; binary)
.VMO (VmDas configuation; ASCII)
.NMS (Navigation and attitude; binary)
.ENS (Beam coordinate single-ping data + NMEA data; binary)
.LOG (Log of ADCP communication and VmDas error; ASCII)
.ENX (Earth coordinate single-ping data; binary)
.STA (Earth coordinate short-term averaged data; binary)
.LTA (Earth coordinate long-term averaged data; binary)

4.5 Post-processing of data

OS75 data were processed on JR139 using Matlab code originated by IFM Kiel. This was adapted by Dr. Mark Inall and Dr. Deb Shoosmith for use with the *JCR* system. The master file for the processing is "OS75_JCR_FINAL.m", which calls a lengthy sequence of routines to execute the following steps:-

1) Read RDI binary file with extension .ENX and ASCII file with extension .N1R into Matlab environment.

2) Remove missing data and data with bad navigation

3) Merge Seapath attitude data with single-ping ADCP data.

4) Correct for transducer misalignment and velocity scaling error (calculated during first run-through of code, applied during second)

5) Derive ship velocity from Seapath navigation data

6) Perform quality control on data, such that four-beam solution is only permitted. Other screening is performed based on maximum heading change between pings, maximum velocity change between pings, and the error velocity.

7) Average data into ensembles of pre-defined length (120 seconds for JR139)

8) Calculates transducer misalignment and velocity scaling error (computation done on first run-through of code, to be applied during second)

9) Velocities from depths deeper than 86% of the bottom-tracking depth are set to missing.

10) Determine absolute velocities from either bottom-track ship velocity or Seapath GPS (usually the latter).

4.5.1 Output Files

Final data are stored in Matlab format. Filenames are of the form:-

1) JR139_000_000000_A_hc.mat, where A is the highest number of the user-incremented files. (This is the number that VmDas increments every time logging is stopped and restarted). This contains structured arrays “c” (ensembled-averaged data), and “b” (absolute velocities)

2) JR139_00A_00000Bd.mat, where A is as above, and B is the number VmDas increments every time filesize exceeds 10 Mbyte. This contains single-ping data in structured array “d”.

3) JR139_00A_00000Bd_ATT.mat. As (2), but containing ship’s attitude data rather than ADCP data.

4) JR139_00A_000000_ATT.mat. As (3), but for the whole section of data in the user-incremented series A

4.6 JR139 Data

Using data from an extended period of bottom tracking on the Antarctic Peninsula continental shelf (approximately 4.5 days, during 10 Dec 2005 to 15 Dec 2005), values for the misalignment angle and velocity scaling factor were derived, and applied to all the data. These were phi = -0.050 and A = 1.016 respectively.

Data along the main Drake Passage section collected during JR139 are shown in Figure 5.1. The high (and vertically coherent) velocities associated with the ACC fronts in the northern and central Passage are evident, coinciding with property-derived indicators of the Subantarctic Front and Polar Front. Toward the southern end of the passage, there are indications of relatively narrow features with velocities sometimes opposing the eastward flow of the ACC. These are possibly barotropic eddy features, such as are often observed in this location. It can be seen that, in narrowband mode, the OS75 routinely sampled down to depths of around 800-1000, well in excess of the old 150 kHz ADCP that was operated from *JCR.* This was undoubtedly helped by the calm seas that were encountered on JR139.

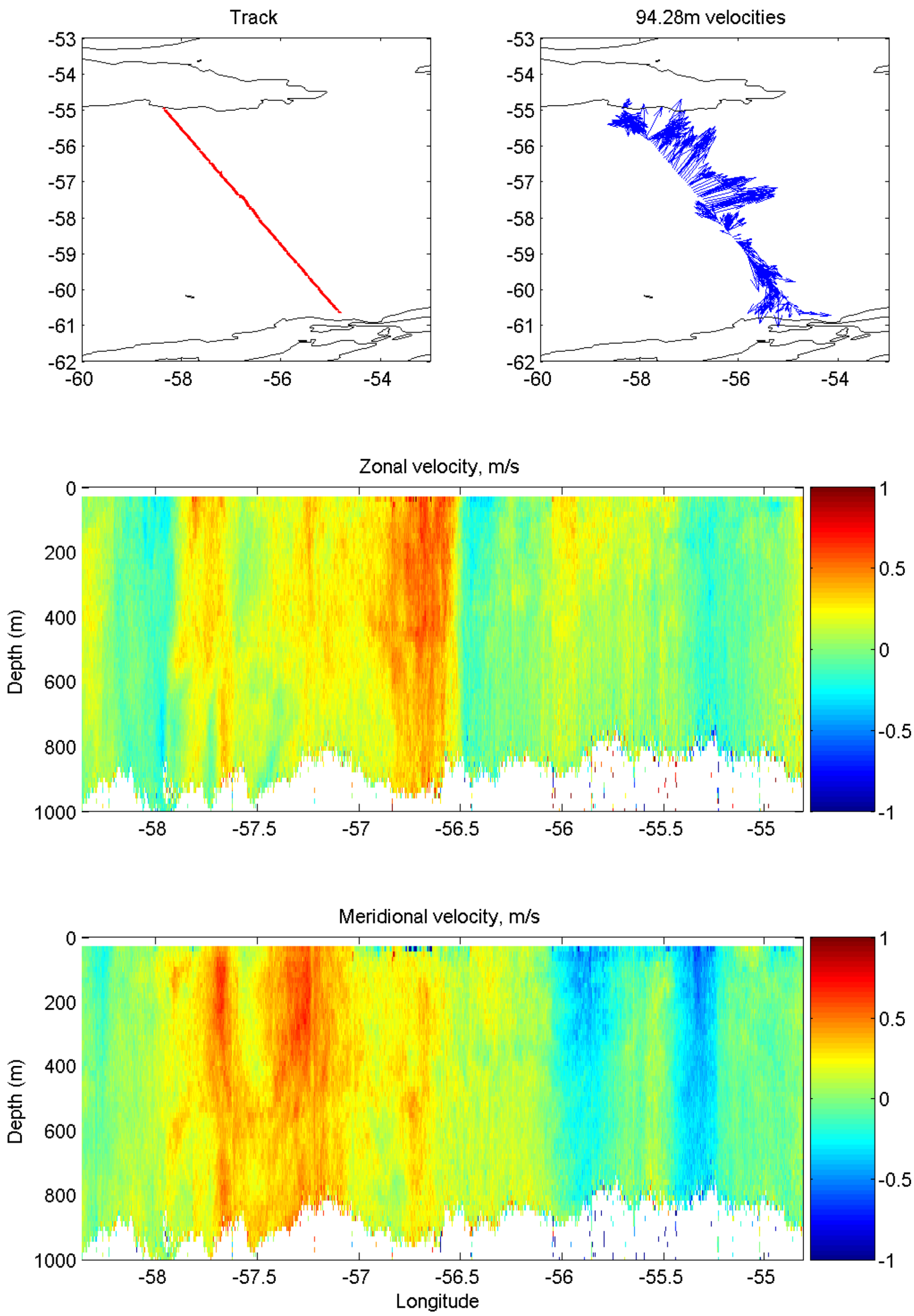

Figure 4.1: VM-ADCP data. Top left: track across main Drake Passage section. Top right: velocity vectors from 94m depth from OS75 ADCP. Middle: Zonal velocity as a function of Longitude and Depth along this line. Bottom: As for middle, but for meridional velocity

4.7 VM_ ADCP Configuration Files used on JR139.

4.7.1 Broadband profiling with bottom-tracking enabled:-

```
;---------------------------------------------------------------------
---------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    High resolution, short range profile(broadband)  500
m
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g.
courier).
; Modified Last: 28August2005
;---------------------------------------------------------------------
--------/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other
commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for broadband single-ping profile mode (WP), sixty five (WN) 8
meter bins (WS),
; 8 meter blanking distance (WF), 390 cm/s ambiguity vel (WV)

; Switch off Narrowband NP0
NP0
nn60
```

```
ns800
nf200

; Switch on Broadband  WP1

WP001
WN065
WS800
WF0800

WV390

; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX)
BP01
BX12000


; output velocity, correlation, echo intensity, percent good
WD111100000

; Two seconds between bottom and water pings
TP000200

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication
options
TE00000300

; Set to calculate speed-of-sound, no depth sensor, external synchro
heading
; sensor, no pitch or roll being used, no salinity sensor, use
internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
```

```
EA6008

; Set transducer depth (decimeters) [= 6.5m on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

; save this setup to non-volatile memory in the ADCP
CK
```

4.7.2 Narrowband profiling with bottom-tracking enabled:-

```
;---------------------------------------------------------------------
---------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    low resolution, Long range profile(Narrowband)  1000
m
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g.
courier).
; Modified Last: 28August2005
;---------------------------------------------------------------------
--------/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other
commands in
; this file, so that it is not made permanent by a CK command.
```

```
cb611

; Set for narrowband single-ping profile mode (NP), sixty five (NN)
16 meter bins (NS),
; 8 meter blanking distance (NF), 390 cm/s ambiguity vel (WV)

; Switch Narrowband ON  NP1
NP1
nn65
ns1600
nf0800


; Switch Broadband  OFF  WP0

WP000
WN065
WS800
WF0200

WV390

; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX) (decimeters)
BP01
BX12000


; output velocity, correlation, echo intensity, percent good
WD111100000

; Two seconds between bottom and water pings
TP000200

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication
options
TE00000300
```

```
; Set to calculate speed-of-sound, no depth sensor, external synchro
heading
; sensor, no pitch or roll being used, no salinity sensor, use
internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
EA6008

; Set transducer depth (decimeters) [= 6.5m on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

; save this setup to non-volatile memory in the ADCP
CK
```

4.7.3 Narrowband profiling with bottom-tracking disabled:-

```
;-------------------------------------------------------------------
---------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    low resolution, Long range profile(Narrowband)  deep
water
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g.
courier).
; Modified Last: 28August2005
```

```
;-----------------------------------------------------------------------
--------/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other
commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for narrowband single-ping profile mode (NP), seventy (NN) 16
meter bins (NS),
; 8 meter blanking distance (NF), 390 cm/s ambiguity vel (WV)

; Switch Narrowband ON   NP1
NP1
nn70
ns1600
nf0800



; Switch Broadband  OFF   WP0

WP000
WN065
WS800
WF0200

WV390

; Disable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX)

; Bottom track OFF
BP00
BX12000
```

```
; output velocity, correlation, echo intensity, percent good
WD111100000

; Two seconds between bottom and water pings
TP000200

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication
options
TE00000300

; Set to calculate speed-of-sound, no depth sensor, external synchro
heading
; sensor, no pitch or roll being used, no salinity sensor, use
internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
EA6008

; Set transducer depth (decimeters) [= 6.5m on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

; save this setup to non-volatile memory in the ADCP
CK
```

5. UNDERWAY

Mike Meredith and Mags Wallace

5.1 Underway Data Logging

Throughout the Drake Passage section data was recorded onto the oceanlogger system. This data was passed to the Shipboard Computer System (SCS).

The underway sensors are summarised in Section 6.1.2. Meteorological data were measured by instruments on the forward mast, and surface layer oceanic parameters were measured using the ships uncontaminated water supply.

Recording of underway data began at 00:00 on day 339 over Burdwood bank and was stopped during the afternoon of day 343 when the sea-ice became too thick. The data presented in this section is for the southbound leg across the Drake Passage (jdays 337 to 343).

5.1.2 Underway Sensors:

Oceanlogger:

SeaBird Electronics SBE45 CTD, s/n 4524698-0018, calibrated 5/3/04

Turner Designs 10-AU Fluorometer, s/n 6465RTX

Met. Data:

Photosynthetically Active Radiation 1, Parlite Quantum Sensor, Kipp & Zonen, s/n 030335, calibrated 4/7/03

Photosynthetically Active Radiation 2, Parlite Quantum Sensor, Kipp & Zonen, s/n 010224, calibrated 1/11/04

Transmissometer 1, Proto1 SPLite, Kipp & Zonen, s/n 032374, calibrated 30/6/03

Transmissometer 2, Proto1 SPLite, Kipp & Zonen, s/n 011403, calibrated 22/10/01

Air temperature/humidity 1, Chilled Mirror Hygrometer MBW, PM-20251/1, Temperature Sensor Pt100, PM-20252/1, s/n 28552 023, calibrated 30/05/03

Air temperature/humidity 2, Chilled Mirror Hygrometer MBW, PM-20251/1, Temperature Sensor Pt100, PM-20252/1, s/n 18109 036, calibrated 12/12/00

Anemometer

Navigational data

Hull-mounted Simrad EA500 Hydrographic 12Khz Echosounder (transducers located approximately 5m below the water level).

Ashtec ADU2 GPS: antenna 1 used to determine the ships position; antennae 2-4 used to determine roll, pitch and yaw.

Ashtec GLONASS GG24 (accurate to ~15 m).

Sperry Mk 37 Model D Gyrocompass (subject to an inherent error and can oscillate for several minutes after a turn).

Seatex GPS (Seapath 200)

GPS NMEA

5.2 Underway Data Processing

Data: users/pstar/mmm/nav, users/pstar/mmm/oceanlog, users/pstar/mmm/sim500

Navigational, oceanlogger and meteorological data were processed in Unix and Matlab using modified versions of programs developed by Mike Meredith for the August 2004 Charles Darwin cruise CD160. Data were initially read into the Unix system, then transferred to Matlab, where the bulk of the processing and plotting was carried out.

Navigation

`get_nav` Calls the scripts `get_gyro`, `get_bestnav`, `get_gpsash`, `get_gpsglos`, `get_gpsnmea`, `get_seatex` and `get_tsshrp`, which invoke the RVS `listit` command to retrieve 24 hours of gyrocompass, bestnav, Ashtec (ADU2), Ashtec Glonass (GG24), GPS NMEA, Seatex and tsshrp (heave, roll and pitch) data, corresponding to JDAY XXX, and write to ascii files “gyro.XXX”, “bestnav.XXX”, “gpsash.XXX”, “gpsglos.XXX”, “gpsnmea.XXX”, “seatex.XXX” and “tsshrp.XXX”

Gyrocompass

`loadgyro.m` Matlab code to read "gyro.XXX", arrange into structure arrays and name accordingly. Saves output as "gyroXXX.mat". Produces a rough plot of heading against time, for quick check of data completeness and integrity.

`gyroall.m` Matlab code to append "gyroXXX.mat" to the master file "gyro_all_jr139.mat"

Bestnav

`loadbestnav.m` Matlab code to read "bestnav.XXX", arrange into structure arrays and name accordingly. Saves output as "bestnavXXX.mat". Produces a rough plot of ship's position over the 24 hour period, for quick check of data completeness and integrity.

`bestnavall.m` Matlab code to append "bestnavXXX.mat" to the master file "bestnav_all_jr139.mat"

Ashtec

`loadgpsash.m` Matlab code to read "gpsash.XXX", arrange into structure arrays and name accordingly. Saves output as "gpsashXXX.mat". Produces a rough plot of ship's position over the 24 hour period, for quick check of data completeness and integrity.

`gpsashall.m` Matlab code to append "gpsashXXX.mat" to the (raw data) master file "gpsash_all_jr139.mat"

GPS/ NMEA

`loadgpsnmea.m` Matlab code to read "gpsnmea.XXX", arrange into structure arrays and name accordingly. Saves output as "gpsnmeaXXX.mat". Produces a rough plot of ship's position over the 24 hour period, for quick check of data completeness and integrity.

`gpsnmea_all.m` Matlab code to append "gpsnmeaXXX.mat" to the master file "gpsnmea_all_jr139.mat"

Seatex

`loadseatex.m` Matlab code to read “seatex.XXX”, arrange into structure arrays and name accordingly. Saves output as “seatexXXX.mat”. Produces a rough plot of ship’s position over the 24 hour period, for quick check of data completeness and integrity.

`seatex_all.m` Matlab code to append “seatexXXX.mat” to the master file “seatex_all_jr139.mat”

Echosounding

Simrad EA600

`get_sim500` Invokes the RVS `listit` command to retrieve 24 hours of ea600 data, corresponding to JDAY XXX, and write to an ascii file “sim500.XXX”.

`loadsim500.m` Matlab code to read “sim500.XXX”, arrange into structure arrays and name accordingly. Saves output as “sim500_XXX.mat”. Produces a rough plot of uncorrected depth over the 24 hour period.

`cleansim500.m` Loads “sim500_XXX.mat”, removes large spikes with `dspike.m`, and launches basic interactive editor for further cleaning. A second run of `dspike.m` is enabled, followed by a 101-point median filter. Discarded depths are interpolated across, and output saved to “sim500_XXXclean.mat”.

`sim500nav.m` Loads file “sim500_XXXclean.mat”, interpolates across missing values and puts data on a regular 5 second interval, from which 2 minute averages are derived. The bestnav master file “bestnav_all_jr139.mat” is loaded, and latitudes and longitudes interpolated to the times of the sim500 timestamps. A quick plot of depth along the ship’s track is produced, and data are saved to a file “sim500_XXXnav.mat”.

`sim500all.m` Load “sim500_XXXnav.mat”, and appends to master file “sim500_all_jr139.mat”

Surface meteorology and CTD

`get_underway` Calls the scripts `get_oceanlog`, `get_anemom` and `get_truewind`, which invoke the RVS `listit` command to retrieve 24 hours of underway data, corresponding to JDAY XXX, and write to ascii files “oceanlog.XXX”, “anemom.XXX” and “truewind.XXX”.

`loadunderway.m` Matlab code, which calls functions `loadoceanlog.m`, `loadanemom.m` and `loadtruewind.m` to read “oceanlog.XXX”, “anemom.XXX” and “truewind.XXX”, arrange into structure arrays and name accordingly. Saves outputs as “oceanlogXXX.mat”, “truewindXXX.mat” and “anemomXXX.mat”. The program also calls `cleanoceanlog.m`, which uses `dspike.m` to remove large spikes in conductivity, housing (CTD) temperature and remote (hull) temperature. Interpolates across removed points, then launches basic interactive editor for further cleaning of conductivity, housing temperature and remote temperature. Calls `ds_salt.m` to calculate surface (uncalibrated) salinity from conductivity and housing temperature. Output saved to “oceanlogXXXclean.mat”. Produces rough plots of sea surface conductivity, remote (hull) temperature and housing (CTD) temperature over the 24 hour period. Truewind, anemometer and cleaned oceanlog data are written to “underwayXXX.mat”.

`truewind_derive.m` Loads file “underwayXXX.mat” and master file “gyro_all_jr139.mat”. Interpolates gyro heading onto same time stamps as underway, and ensures that they lie in the range 0 to 360. Note that, on the JCR, the convention is that the underway wind direction is the direction the wind is blowing FROM. Real wind direction is obtained by adding underway direction to gyrocompass heading and then converted to the direction the wind is blowing TO. Underway wind speeds and (real) directions are broken into east and north velocity components and velocities are changed from knots to ms^{-1}. Ship’s velocity is derived from position fixes, and this speed and angle are converted to ship’s east and north velocities. These are interpolated to the same timestamps as the underway data. East and north components of real wind and derived by adding the east and north components of ship's velocity and wind velocity. These are converted back to true wind speed and direction, with direction forced to lie in range 0 to 360. Two direction variables are defined, one being the direction the wind is blowing to and the other being the direction the wind is blowing from. Output is file "underwayXXXtrue.mat".

`underwaynav.m` Loads file "underwayXXXtrue.mat" and master file "bestnav_all_jr139.mat", then interpolates latitude and longitude to timestamps of underway data. Produces quick plots of sea surface temperature, sea surface salinity (uncalibrated), and wind vectors along ship's track. Saves output to master file "underwayXXXnav.mat". Ensure that `truewind_derive.m` is run immediately before `underwaynav.m`.

`underwayall.m` Loads "underwayXXXnav.mat" and appends to master file "underway_all_jr139.mat". Produces quick plots of sea surface temperature, sea surface salinity and wind vectors along ship's track for the duration of the cruise to date.

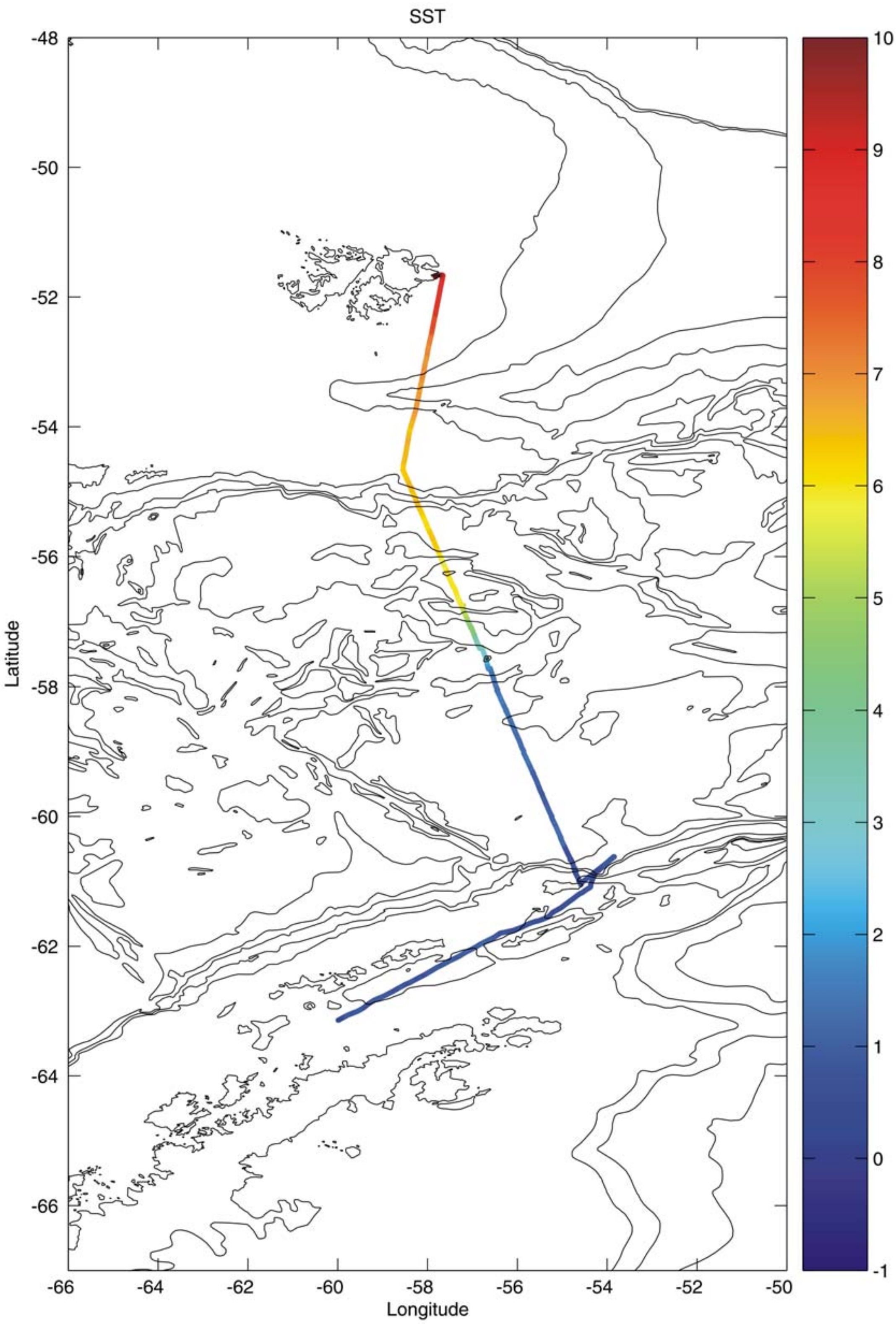

Figure 5.1: SST from oceanlogger for jdays 339-347 (water flow ceased during jday 347 due to ice so data after flow turned off set to NaNs);

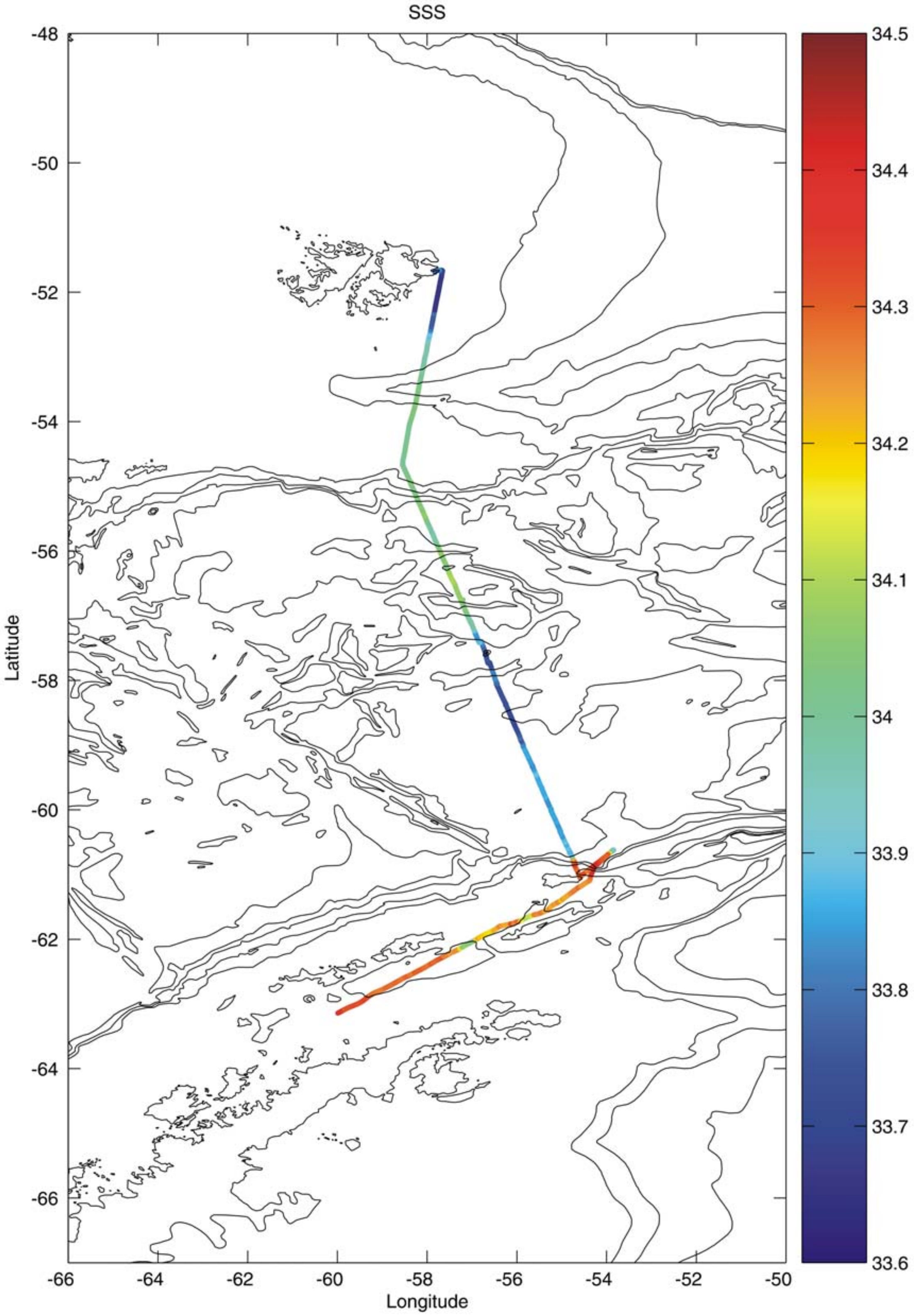

Figure 5.2: Surface salinity (uncalibrated) from oceanogger for jdays 339-347 (again, data after flow turned off set to NaNs).

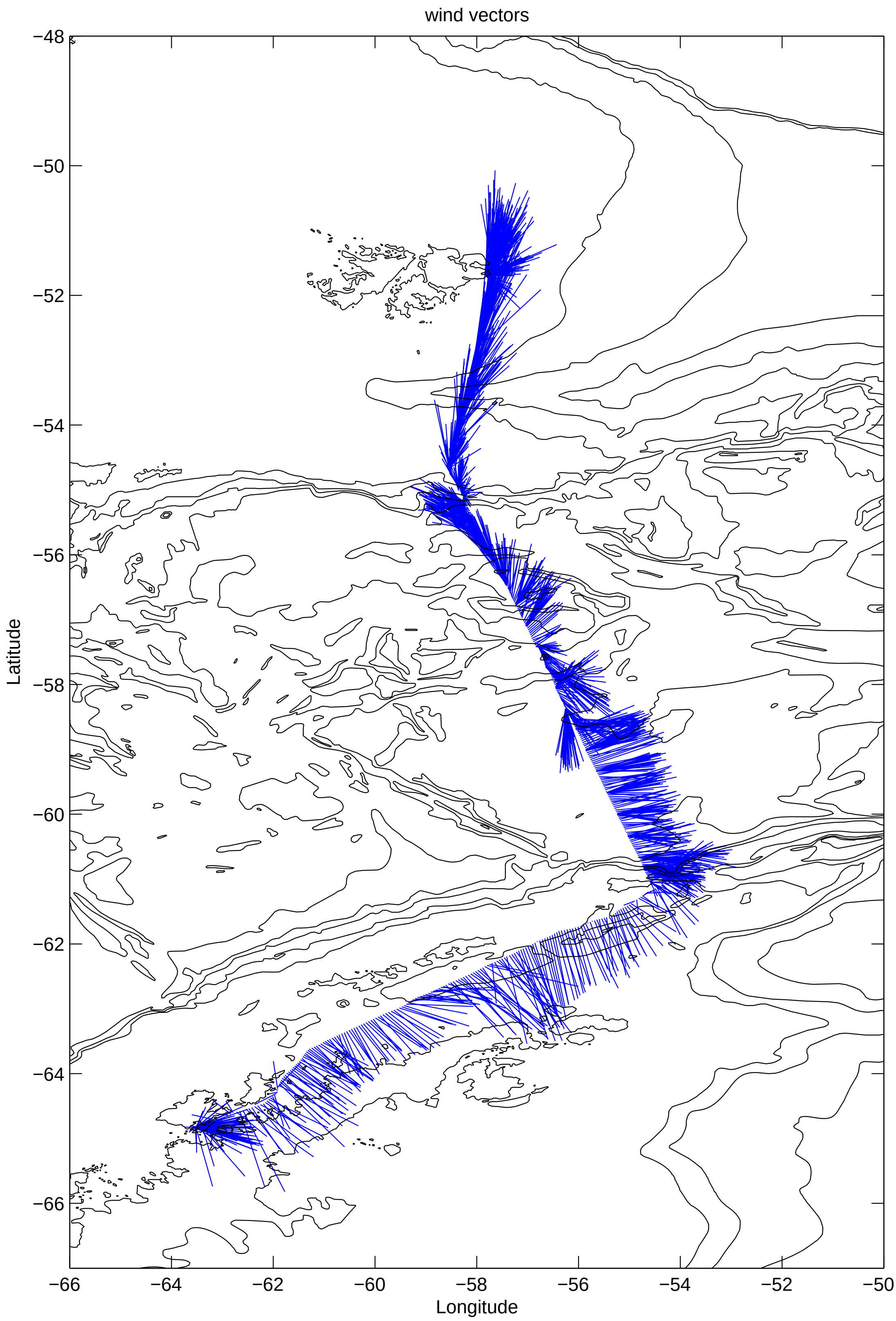

Figure 5.3: True winds derived from anemometer data and ship navigational data for jdays 339-347.

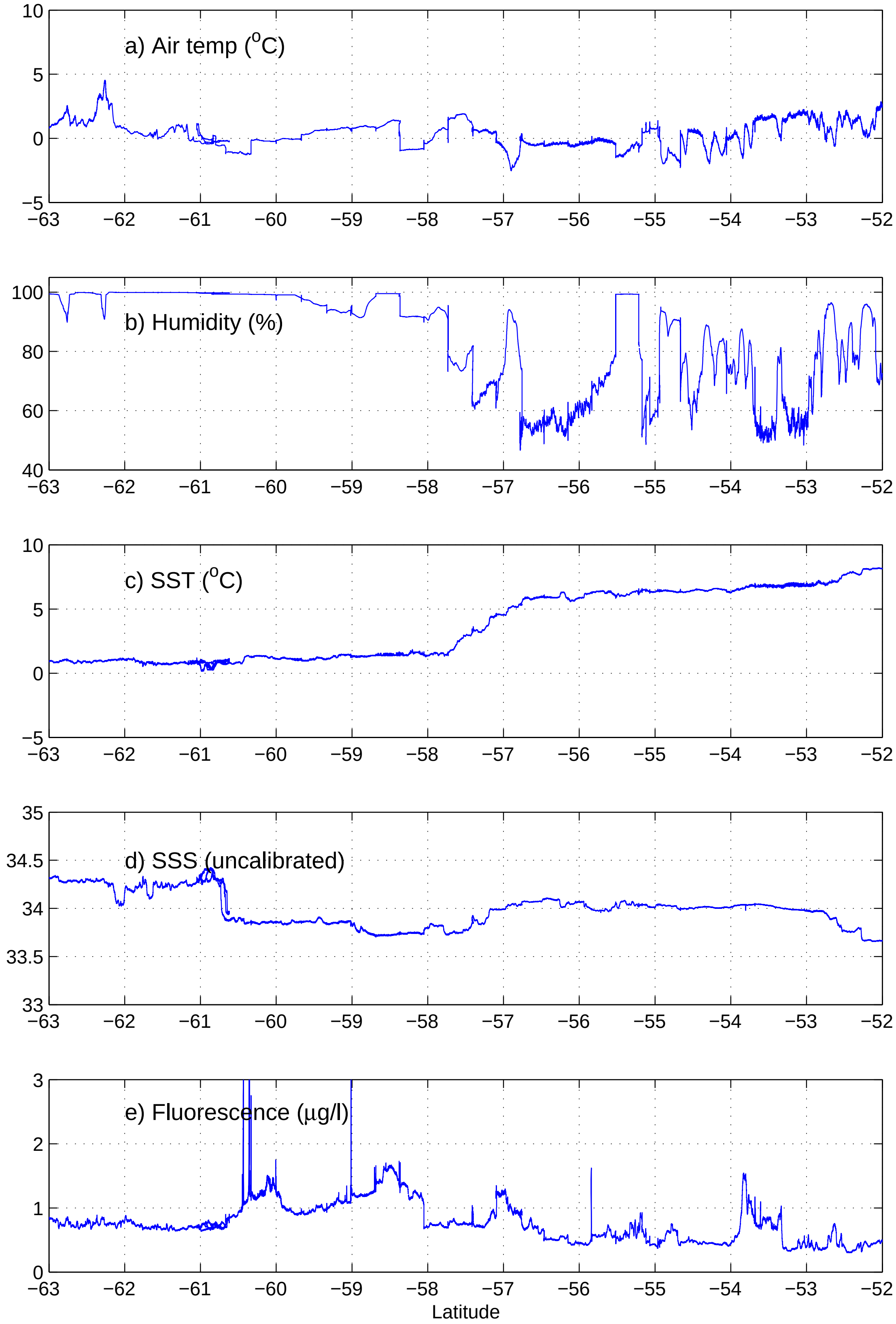

Figure 5.4: Air temperature, humidity, SST SSS and fluorescence versus Latitude. For duplicate instruments only the primary sensor data are plotted.

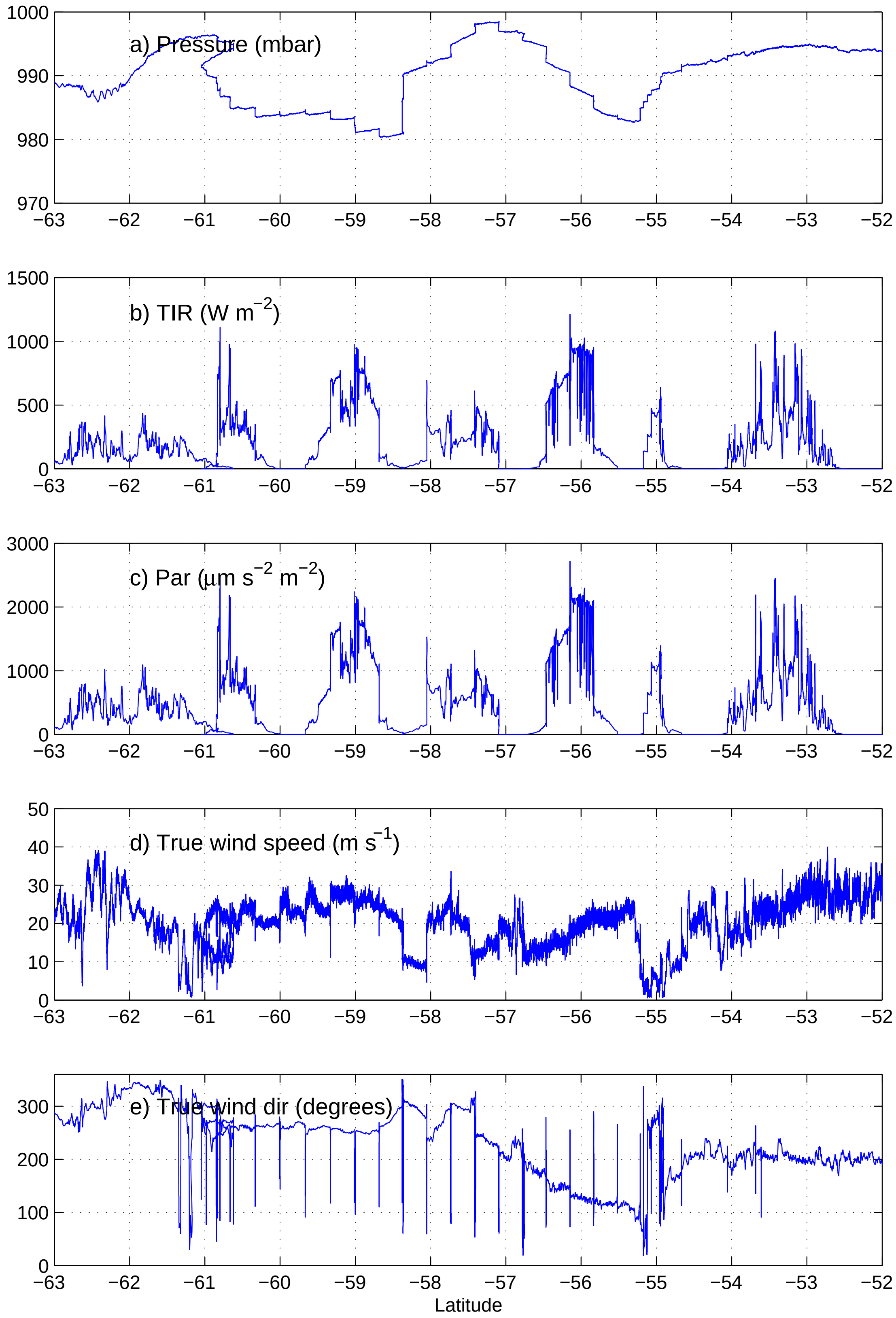

Figure 5.5: Pressure, TIR, PAR, True wind speed and True wind direction versus Latitude. For duplicate instruments only the primary sensor data are plotted.

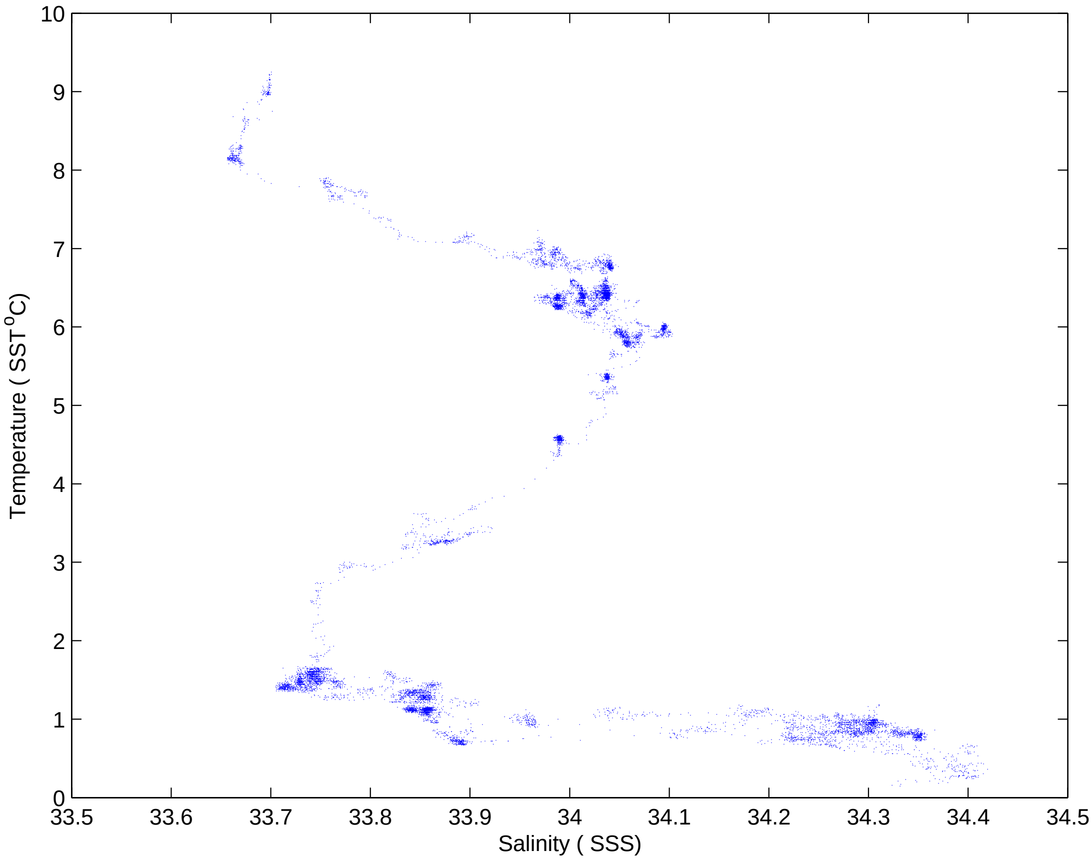

Figure 5.6: SST versus SSS (uncalibrated)

6. IT SUPPORT

No report was submitted by IT

7. TECHNICAL SUPPORT

Reproduced from Povl Abrahamsen's cruise report for JR151.

No report was submitted by ETS.

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Sparrow, M and E. Hawker, 2005: RRS *James Clark Ross* Cruise 81, 1 Dec – 19 Dec 2004. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b – Burdwood Bank to Elephant Island. Southampton Oceanography Centre, Cruise report No. 56, 80 pp.