National Oceanography Centre

Cruise Report No. 10

RRS *James Clark Ross* Cruises JR265 and JR254D
27 NOV – 24 DEC 2011
Part 1: The Drake Passage hydrographic
repeat section SR1b

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DOCUMENT DATA SHEET

ABSTRACT

This report describes the 17th complete occupation of the Drake Passage CTD section, established during the World Ocean Circulation Experiment as repeat section SR1b. It was first occupied by National Oceanography Centre (previously IOSDL and then SOC) in collaboration with the British Antarctic Survey in 1993, and has been re-occupied most years since then. Thirty two full depth stations were performed during JR265: two test stations, and all 30 of the nominal stations for the SR1b Drake Passage section. An initial result is that the estimated total transport measured across the section was 133 Sv which compares well to an average transport measured from the 16 previous UK cruises of 135 Sv (standard deviation of 7 Sv).

In conjunction with the hydrographic cruise, a "Waves Aerosol and Gas Exchange Study" (WAGES) intensive observation cruise JR245D was also carried out. WAGES involves continuous measurement of the air-sea turbulent fluxes of CO_2, sea spray aerosol, momentum and sensible and latent heat fluxes, plus directional sea-state and whitecap parameters using systems installed on the ship in May 2010. In addition to the continuous measurements, a number of intensive observation periods (IOPs) have been carried out by WAGES staff on board the ship. These involve deployments of a spar buoy to measure wave breaking and an aerial camera system to measure whitecap fraction. The activities of JR254D are summarised here, but are described in detail in a separate cruise report. Cruise JR264 was carried out by NOC-L staff at the same time as JR265 and JR254D. JR264 is also the subject of a separate cruise report.

The CTD was an underwater SBE 9 *plus* unit equipped with the following sensors: dual temperature and conductivity sensors, a pressure sensor encased in the SBE underwater unit, a SBE-43 oxygen probe, an Aquatracka MKIII fluorometer, a transmissometer, an upward-looking downwelling PAR sensor, and an altimeter. A downward-looking LADCP (RDI Workhorse Monitor 300 kHz) was deployed on all stations. Various underway measurements were obtained, including navigation, VM-ADCP, sea surface temperature and salinity, water depth and various meteorological parameters. A practical aim during this cruise was to update the detailed guides for each of the hydrographic data streams which were first written during JR195 in 2009. The hydrographic data analysis was performed using "MSTAR", a suite of Matlab programs developed at NOCS by Brian King and used on the *JCR* for the first time during JR195.

KEYWORDS

Acoustic Doppler Current Profiler, ADCP, air-sea flux, Antarctic Circumpolar Current, cruise 265 2011, CTD observations, Drake Passage, gas exchange, *James Clark Ross*, JR265, LADCP, lowered ADCP, sea-spray aerosol, SOLAS, Southern Ocean, SR1b, Valkyrie, vessel-mounted ADCP, WAGES, wave breaking, waves, whitecap, WOCE, World Ocean Circulation Experiment

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SHIP'S PERSONNEL

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Simon D Evans	2nd Officer
Ben P Thompson	3rd Officer
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1. OVERVIEW

Margaret Yelland

1.1 Introduction and background.

The research cruises JR265 and JR254D began from Mare Harbour, Falkland Islands, on the morning of the 27th November 2011 and finished at Stanley, Falkland Islands, on the 24th December 2011. The objective of JR265 was to perform a CTD section across Drake Passage (Figure 1.1), repeating the measurements made during previous research cruises for the purpose of long-term monitoring. The aim of JR254D was to deploy a wavebreaking buoy (Pascal et al., 2011) and an aerial whitecap camera system in a range of wind speed and sea state conditions. WAGES activities are summarised in this cruise report, but are described in detail in a separate report (Yelland, 2012a). A third cruise, JR264, was run by staff from NOC-Liverpool with the aim of recovering and deploying various Bottom Pressure Recorders which have been deployed across Drake Passage and elsewhere on the Antarctic Peninsular for more than 20 years. NOC-L also serviced various tide gauges in the Falkland Islands and along the Antarctic Peninsular. JR264 is described in detail in a separate cruise report (Morales Maqueda, in prep).

1.1.1 WAGES.

JR254D was one of a series of Intensive Observation Periods (IOPs) for the Waves Aerosol and Gas Exchange Study (Yelland, 2012a). The aim was to deploy the novel spar buoy developed at NOC-S to measure wave breaking and whitecap fraction, along with an aerial camera system to capture the whitecap coverage across a wider spatial area. These deployments take place during cruises which are manned by members of the WAGES team. As part of WAGES the *JCR* was instrumented in the summer of 2010 with: the autonomous air-sea interaction system "AutoFlux" (Yelland et al., 2009b) to measure the air-sea fluxes of CO_2, sea-spray aerosol, momentum and sensible and latent heat; a WAVEX directional wave radar system; a webcam mounted on the bridge to capture whitecap fraction. These systems measure continuously. Previous IOPS and the continuous measurements are described in Yelland (2012b). WAGES activities during JR254D are summarised here and are described in detail in a separate cruise report (Yelland, 2012a)

1.1.2 Hydrographic Section.

As described by Bacon and Cunningham (2005), the World Ocean Circulation Experiment established a repeat hydrographic section across Drake Passage and designated it SR1. This section was first occupied by the R/V Meteor in 1990 (Roether et al., 1993). Subsequently, the section was moved eastwards to lie on a satellite ground track with the northern end on the south side of Burdwood Bank, south of the Falkland Islands, and the southern end off Elephant Island at the tip of the Antarctic Peninsula. This revised section location was designated SR1b and was first occupied by the R/V Polarstern in 1992 (Gersonde, 1993). The first UK occupation of SR1b took place on RRS Discovery later the same year using SeaSoar (a profiler which undulates between the surface and ~400 m) (Turner, 1993; Read et al., 1993) only i.e. no CTD profiles.

Between that time and the present there have been 16 UK (NOCS/BAS) complete occupations of SR1b at nearly one section per year, all with full-depth CTDs and, since 1996, with full depth LADCP also. See Table 1.1 for a list of cruises, dates and references. The scheduling of the cruises usually makes use of the BAS logistical requirement to re-supply the base at Rothera at the start of the austral summer, hence all bar two have taken place on the RRS *James Clark Ross* (*JCR*).

year	start date	end date	designator	LADCP	cruise report
1992	11/11/1992	17/12/1992	D198 - SeaSoar only	N	Turner, 1993
1993	20/11/1993	18/12/1993	JR0a or JR00_1	N	Bacon and Cunningham 2005
1994	13/11/1994	12/12/1994	JR0b or JR00_2	N	Bacon and Cunningham 2005
1996	13/11/1996	07/12/1996	JR16	Y	Bacon and Cunningham 2005
1997	17/12/1997	08/01/1998	JR27	Y	Bacon and Cunningham 2005
1999	12/02/2000	16/02/2000	JR47	N	Bacon and Cunningham 2005
2000	21/11/2000	14/12/2000	JR55	Y	Cunningham, 2001
2001	19/11/2001	17/12/2001	JR67	Y	Bacon et al., 2002
2002	18/12/2002	02/01/2003	JR81	Y	Bacon et al., 2003
2003	27/11/2003	17/12/2003	JR94	Y	Hawker et al., 2005
2004	01/12/2004	19/12/2004	JR115	Y	Sparrow et al., 2005
2005	5/12/2005	12/12/2005	JR139	Y	Stansfield et al., 2008
2006	7/12/2006	15/12/2006	JR163	Y	Williams et al., 2008
2007	29/11/2007	8/12/2007	JR193	Y	Hamersley and Quartly 2010a
2008	Dec 2009	Dec 2009	JR194	Y	Hamersley and Quartly 2010b
2009	3/2/2009	3/3/2009	JC031	Y	McDonagh et al., 2009
2009	18/11/2009	29/11/2009	JR195	Y	Yelland et al., 2009a
2010 **	6/11/2010	10/12/1020	JR240	Y	Maksym, CTD 030-023, 007
2010 **	9/4/2011	25/4/2011	JR276	Y	Watson, CTD 020-007
2011	27/11/2011	25/12/2011	JR265	Y	This report, Yelland 2011

*Table 1.1: List of UK occupations of Drake Passage section, WOCE designation SR1b (adapted from Bacon and Cunningham, 2005). Notes: "Year" is the year of the start of the relevant southern season. "LADCP" shows which cruises carried that instrument (JR115 experienced some technical difficulties with the LADCP). All occupations aimed to occupy the station positions (see Section 2) shown in Figure 1.1. D198 was occupied with an undulating profiling instrument, SeaSoar, with no full-depth CTDs. ** indicates the two partial occupations which took place in late 2010 and early 2011 to replace the cancelled 2010 JR242 cruise.*
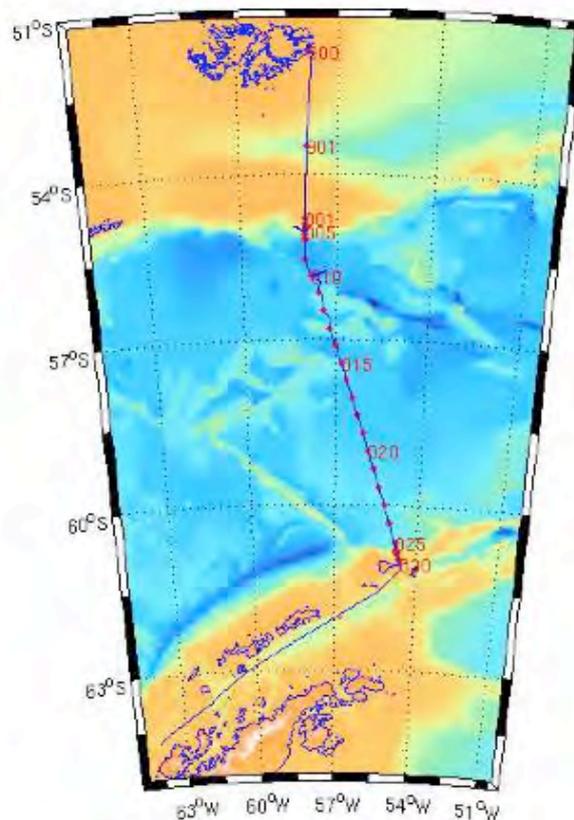
Figure 1.1: The CTD section across Drake Passage. Red dots indicate the position of the CTD stations: for clarity, only some stations are numbered.

In 2010 the planned hydrographic section (JR242) was cancelled at short notice due to problems with the Dash-7 aircraft. The plan had been to fly the science team in to Rothera and perform the section northbound. The scientists on the preceding cruise JR240 (Maksym, in prep.) were due to fly out from Rothera on the same aircraft but had to stay on board the *JCR* back to Stanley: they performed the southernmost 9 CTD sections on their way north (stations 030 to 023 inclusive from Table 2.1 below, plus station 007 from the "standard" section list, see Yelland, 2009a). A subsequent cruise JR276 in April 2011 performed 14 CTD casts in the northern end of the section, from station 020 to about 007 (see Table 2.1), omitting the 6 most northerly stations due to lack of time (Watson, in prep).

It should be noted that the northernmost 9 CTD stations carried out during JR265 followed a line directly north-south along 58° West, similar in position to those used by McDonagh (2009) and Watson (in prep), rather than the "standard" CTD location used in most of the previous occupations of the section (e.g. Yelland, 2009a).

This report will describe each major hydrographic data stream in turn. Each data stream was the primary responsibility of one science team member: CTD, Vikki Frith; LADCP and VMADCP, Penny Holliday; underway data (meteorology, navigation, echosounder etc), Helen Snaith; salinometer operations, Margaret Yelland.

A practical aim during this cruise was to update the detailed guides written during JR195 (Yelland, 2009a) for each data stream, including how to set the systems up, operations while on station or underway, initial examination of data to ensure that the systems are working correctly, through to data analysis to the level required for a cruise report. Much of the data analysis was performed using "MSTAR", a suite of Matlab programs developed at NOCS by Brian King and used on the *JCR* for the first time during JR195. Some of these detailed guides are included in the main body of the report, whereas others are included as appendices.

Unless stated otherwise, times are given in GMT. Jday of 1.5 represents 1200 GMT on 1st January: the same date and time is given by a decimal day of 0.5. Jday is used in this report, but some data outputs include a decimal day time stamp.

1.2 Scientific Objectives

1.2.1 JR265 Hydrographic section

Drake Passage is the narrowest passage through which the Antarctic Circumpolar Current (ACC) flows, and thus is a convenient location for making measurements across the entire ACC. The objective of this section is to look at changes on interannual to decadal scales. The key objectives for the JR265 CTD section across Drake Passage 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 thus identify the significant water masses;

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

The overall aim of WAGES is to improve the parameterisations of the air-sea fluxes and to understand their dependence on sea-state, wave breaking and whitecap fraction. The aim of the IOPs is to deploy the buoy and aerial camera systems in a wide range of wind speeds and sea states, and in both short fetch and open-ocean conditions. JR254D had 48 hours of dedicated ship time. In addition to this the aim was to deploy the buoy and balloon systems during the deeper CTD stations whenever conditions allowed.

1.3 Cruise Narrative

1.3.1 Mobilisation period, 24th-27th November.

The JR265 and JR254D science teams (Figure 1.2) travelled south on the RAF flight from Brize Norton on the 20th November, and arrived at the Falkland Islands on the evening of the 21st November. The teams were met by BAS personnel and transferred to accommodation in Stanley. The arrival of the *JCR* was delayed by bad weather and the science team did not get access to the ship in Mare Harbour until the 24th November, leaving two full days to mobilise prior to sailing on the morning of the 27th, day 331. BAS AME mobilised the hydrographic equipment in good time to train the hydrographic team prior to the ship sailing. During the mobilisation period the WAGES team worked hard to ensure that as much as possible was ready before the ship sailed. A major problem was found with one of the fundamental WAGES sensors on arrival at the ship: the housing of the MotionPak sensor (which measures the ship-induced motion at the flux sensors on the foremast platform) had leaked and the sensor had stopped working a few days previously. Seth Thomas (BAS AME) worked flat out to build new interface circuit boards for this sensor in time for the ship departure from Mare Harbour.

Figure 1.2. The JR265 and JR254D science team (aka "the Valkyries") arriving at Rothera. Left to right: Helen, Vikki, Robin, Sarah, Mairi, Mags, Penny.

1.3.2 WAGES studies and Drake Passage section, 27th November - 5th December.

During the hydrographic team worked 12 hour watches (8 til 8 local time), with Snaith and Fenton taking the night shift and Holliday and Frith taking the day shift. This worked well, since the deck crew and winch drivers worked the same watches. The WAGES team and the NOC-L team worked as appropriate to fit the other science work around the CTD section.

Below is a short day-by-day account of scientific operations and weather conditions. All times stated in this cruise report are GMT unless specified otherwise. Notes on wind speed, sea state and ice conditions are courtesy of the bridge scientific log (see Appendix A.1) and the bridge weather observations (Appendix A.2). Section 2 gives details of the nominal, and actual, positions and depths of the CTD stations.

27th November, jday 331.

JCR departed Mare Harbour 0900 local, 1200 GMT, and headed eastwards to perform a 12 hour short fetch study for WAGES. Once on station did a shallow (50 m) **test CTD** at station 900 (with Pudsey the mascot on the frame) then a 12 hour **WAGES buoy deployment 1** at short fetch from 1200 to 2400 local, including **balloon deployment 1** during which the altimeter was lost. The VM-ADCP was set to bottom tracking mode during the fetch study. SWATH was turned on prior to the start of the CTD section proper.

28th November, jday 332.

Deep **test CTD** to about 2300 m at CTD station 901. During this second text dip the CTD frame carried one of the NOC-L microcats for calibration prior to deployment with the NOC-L BPR. Three 15 min stops at 1500, 1000, and 500 m depths were made for this purpose. **CTDs 001 and 002** were done: some time was spent locating the correct depths since the northern part of the CTD section was moved east to longitude 58° W

29th November, jday 333

CTDs 003 to 009 again involved some hunting for the correct depths. A short SWATH survey was done to find a good location for the 1100 m depth deployment of the northern NOC-L **BPR**. Once located CTD 004 done prior to the BPR deployment and SWATH was turned off (0245 GMT) since it was thought that it may interfere with the VM-ADCP. **1st Argo** float 4900 deployed after CTD 007. **WAGES buoy deployment 2** was done during CTD 008. After CTD 008 the LADCP beam 3 was found to be weak. The LADCP model WHM300-i-ug306, S/N 14443 was swapped for WHM300-i-ug301, S/N 15060 in time for dip 009. **WAGES buoy deployment 3** took place during CTD 009. The IRIDIUM unit on the buoy was not sealed properly so became flooded and never recovered.

30th November, jday 334

Pudsey went on strike for the day. The ship was in position for CTD 010 in the early hours but the wire came off the roller at the very start of the deployment and the CTD was brought back on deck. A strong current combined with large seas and a strong wind led to the decision to wait for conditions to improve: station 010 is the deepest of the section and was thought to be at or near the Sub-Antarctic Front and was therefore thought important to complete. The conditions did not improve overnight and the forecast was bad, so **WAGES buoy deployment 4** was begun at about 1100 GMT.

1st December, jday 335

The WAGES buoy was recovered at around 1300 GMT. The large waves encountered while the buoy was being hauled in caused the 4 rods at the base to bend and the buoy to lie horizontally in the water. The top half of the buoy tore away and the IRIDIUM unit, flashing light and camera mounted on the upper part were lost, but the bottom half of the buoy along with the data logger and current meter were recovered successfully. Once the buoy was recovered the

JCR steamed back on station and **CTD 010** was performed. Since the swell was still large the CTD was sent straight down from 13 m rather than brining it back to the surface before performing the cast.

2nd December, jday 336.

CTDs 011 to 15. The **2nd ARGO** float (S/N 4901) was deployed after CTD 011. During CTD 012 the altimeter became noisy and intermittent and a big transmissometer spike implied that the CTD may have touched the bottom although on recovery it was found to be completely undamaged and only a smudge of mud was found on the base of the frame. **WAGES buoy deployment 5** took place during CTD 013 and the altimeter was swapped out after that station was completed. **WAGES buoy deployment 6** and **balloon deployment 2** were performed during CTD 014 and the **3rd ARGO float** (4902) was deployed immediately afterwards. The *JCR* did about 30 minutes of circuits and bumps for engine testing on the way to CTD 015 during which **WAGES buoy deployment 7** and **balloon deployment 3** took place.

3rd December, jday 337.

CTDs 016 - 020. The 4th ARGO float (4903) was deployed after CTD 017. **WAGES buoy deployment 8** was done during CTD 020. The **5th ARGO** float (4999) was deployed after CTD 020.

4th December, jday 338.

CTDs 021 – 026. CTD 021 was accompanied by several whales (possibly humpbacks) in the distance, and a lone chinstrap penguin close to the ship. **6th ARGO** float 4998 deployed after CTD 023. *JCR* spent about 30 minutes doing engine checks. **WAGES buoy deployment 9** done during CTD 024, with Pudsey as passenger. At the start of CTD 025 the pumps were very slow switching on. They were tested after the cast and were OK. – pump was tested after the cast and seemed to be ok, so left on. **WAGES buoy deployment 10** and **balloon deployment 4** (with Pudsey) were done during CTD 025. CTD 026 had three 15 minutes stops at 1500 m, 1000 m and 500 m to allow calibration of the other NOC-L microcat.

5th December, jday 339.

CTDs 027 – 030. NOC-L team deployed APEX float before start of CTD 027. With 1580 m of wire out and an EO600 depth of 1630 m the altimeter had still not kicked in (which it should at about 100 m off the bottom). The cast was stopped while Johnnie switched the EM122 on briefly to check the depth. This gave a reading of 1778 m, so the cast was continued: the altimeter detected the bottom when there was about 1640 m wire out and the cast stopped at a depth of 1729 m. Given the under-read on the EA600 on the previous cast, the EM122 was switched on briefly to check the depth before the start of CTD 028: depths agreed within 20 m so the EM122 was switched off and the cast was carried out as normal. NOC-L then deployed and recovered BPRs from the deep (2000 m) and shallow (1000 m) sites: they also deployed a FETCH mooring but this surfaced again unexpectedly and was recovered. The last two CTD stations were then done and all completed by about 1230 local time.

1.3.3 Antarctic Peninsular, 6th - 13th December.

At the end of the CTD section it was decided to postpone both the attempted recovery of the NOCL-L MYRTLE system and the NOC-L visit to Vernadsky (to maintain the tide gauges there) until the *JCR* was on passage northbound. This decision was made in order to arrive on time in Rothera on the 8th December so that three of the JR265 and JR254D science teams could catch their scheduled flight northwards on the DASH-7. Unfortunately on the 6th December it was decided that the DASH had to leave on the 7th, a day early, due to unforeseen circumstance. The *JCR* continued down the west side of the peninsular and arrived at Rothera at 0700 local time on the 8th. Rothera relief was completed on time and the ship sailed on the 11th. Sea-ice prevented the ship landing any people at Vernadsky, but on the evening of the 13th the NOC-L

tide gauge equipment and instructions (in Russian) were landed on the shore with the aid of some skilful ship parking by the Master, a fishing rod wielded by Mark Robinshaw and two of the staff of Vernadsky hauling on a rope.

1.3.4 Antarctic Peninsular to Stanley, 14th - 24th December.

On the way north from Vernadsky to King George Island **WAGES buoy deployment 11** was done off the coast of Livingston Island in the early hours of the 15th December (jday 349). The forecast was for strong winds from the west or north so the deployment was done about 2 nm off the coastline that runs from SW to NE. In the event the winds proved to be rather light and variable. Collected two passengers from Jubany base King George Island.

The *JCR* arrived at the NOC-L MYRTLE site in the early hours of the 16th. MYRTLE responded to pings but did not release, so triangulation and SWATH surveys were done to get an accurate position for any future recovery attempt. On the way from the MYRTLE site towards Signy the *JCR* stopped to recover the NOC-L APEX float that was deployed (free drifting) earlier on the 5th December. Once this was on board the NOC-L SONAR bell (a gel sphere designed to be a target) was deployed to 1500 m but failed to show up on the EA600. The *JCR* then continued towards Signy. The wind was from astern, i.e. a bad direction for flux measurements so the pump for the new Licor-7200 was turned off to get null ("shrouded") data. On arrival at Signy on the morning of the 18th it was too windy to transfer people ashore in the small boats, so **WAGES buoy deployment 12** was done for about 7 hours (1100 to 1800 local time, with the LICOR pump turned back on) until the wind dropped enough to get people ashore. *JCR* headed to Cape Geddes overnight and arrived on the morning of the 18th. While people were transferred ashore the old LICOR 7500 was shrouded and the pump for the new LICOR turned off again, and the inlet taped over. The ship then headed back to Signy again, arriving around 16:30 local time the same day. The ship had to stay at Signy while technical staff worked on the new V-SAT system, so on the 19th the science teams had the chance of a walk to Gourlay Point to see Adelie and Chinstrap colonies. Ship sailed evening of the 19th and headed towards Bird Island via the Lewthwaite Strait. Arrived Bird Island around 1300 local on the 21st. No run ashore because of danger from fur seals and the need to make the visit a short one, so ship departed about 15:30 local and headed for Stanley. One short stop was made on the morning of the 22nd for another test of the NOC-L Sonar bell and a short CTD dip so that the BAS AME staff could test the software changes made at the end of the cruise that were necessary to implement the updated Seasave and SBE Data Processing software (version 7). *JCR* arrived in Stanley on the afternoon of the 24th.

2. CTD

Vikki Frith

2.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used to record vertical profiles of the temperature and salinity of the water column. Two test stations, one shallow (900) and one deep (901) were carried out before starting the Drake Passage transect. They allowed us to test the equipment and sensors' configuration. Thirty stations were occupied across the Drake Passage SR1b transect. The locations of the nominal stations across Drake Passage are listed in Table 2.1. The actual locations of the stations occupied during JR265, alongside the water depth and other information, are listed in Table 2.2. Bad weather led to a 45 hour break in science between stations 009 and 010.

Additional details are given in Appendix B: B.1 gives details on pre-sailing setup and mobilisation; B.2 the bottle file formats; B.3 SeaBird instrument calibration; B.4 calibration details contained in the SeaBird Configuration file; B.5 a detailed explanation of the MSTAR processing that is summarised in Section 2.6.

Station	Lat, °S	Lat, min	Lon, °W	Lon, min	Depth, m	est time on station (hh:mm)	distance **to next** station (nm)	est. time **to next** station (hh:mm)
900					50	0:30	10	1:00
901	53	30.0	58	04.36	2300	2:30	70.2	6:06
1	54	40.00	58	00.0	250	0:30	15.4	1:20
2	54	55.34	58	00.0	600	0:30	3.3	0:17
3	54	58.6	58	00.0	1000	0:50	1.6	0:10
4	55	0.39	58	00.0	1500	1:10	12	1:00
5	55	04.20	58	00.0	2000	1:30	3.1	0:15
6	55	07.26	58	00.0	2500	1:40	2.9	0:15
7	55	10.16	58	00.0	3000	2:00	2.7	0:14
8	55	12.86	58	00.0	3700	2:30	18.2	1:34
9	55	31.00	58	00.0	4200	2:50	20.2	1:45
10	55	50.00	57	49.23	4800	3:00	20.2	1:45
11	56	09.00	57	37.45	3400	2:20	20.1	1:45
12	56	28.00	57	25.67	3800	2:30	20.1	1:45
13	56	47.00	57	13.90	3200	2:00	20.1	1:45
14	57	06.00	57	02.12	3700	2:30	20.1	1:45
15	57	25.00	56	50.35	3700	2:30	20.1	1:45
16	57	44.00	56	38.57	3400	2:00	20.1	1:45
17	58	03.00	56	26.79	3900	2:30	20	1:44
18	58	22.00	56	15.02	3800	2:30	20	1:44
19	58	41.00	56	03.24	3800	2:20	20	1:44
20	59	00.00	55	51.47	3800	2:20	21	1:50
21	59	20.00	55	39.07	3800	2:20	21	1:50
22	59	40.00	55	26.67	3600	2:10	21	1:50
23	60	00.00	55	14.28	3500	2:10	21	1:50
24	60	20.00	55	01.88	3400	2:00	21	1:50
25	60	40.00	54	49.49	3100	2:00	8.4	0:44
26	60	47.97	54	44.55	2500	1:30	2.1	0:11
27	60	49.99	54	43.30	1500	1:00	1.1	0:05
28	60	51.02	54	42.66	1000	0:50	8.2	0:43
29	60	58.86	54	37.80	600	0:30	4.3	0:22
30	61	03.00	54	35.23	400	0:30	4.6	0:24

*Table 2.1: Nominal station positions for Drake Passage CTD section (the right hand three columns show the estimates of distance and times as used by the bridge). NOTE that stations 001 to 009 have been moved to lie along 58 W: the positions for these stations are approximate and needed to be adjusted to get the correct depth (see Table 2.2). Instructions given to the bridge stated that **for the shelf edge stations, i.e. 1 - 8 and 25 - 30 inclusive, the station should be at a position where the depth is within 100 m of the nominal depth. For stations 9 - 24 inclusive, the position should be within 0.5 nm of the nominal position**.*

CTD stn	Date	Time hh:mm GMT	Jday	Lat. °S	Lat. (min)	Lon. °W	Lon. (min)	Wire out (m)	CTD max pressure (db)	True wind (m/s)
900	27/11/11	15:42	331.654	51	47.22	57	52.56	45	46	3.2
901*	28/11/11	13:14	332.551	53	27.70	57	56.79	2350	2389	9.88
1	28/11/11	22:01	332.917	54	47.34	57	59.76	250	254	9.83
2	28/11/11	23:32	332.981	54	54.54	57	59.64	608	617	12.6
3	29/11/11	01:59	333.083	54	58.80	57	58.50	1075	1090	10.8
4	29/11/11	03:59	333.166	54	59.94	57	59.82	1490	1514	13.9
5	29/11/11	05:48	333.242	55	02.34	57	59.88	2025	2061	18.5
6	29/11/11	11:50	333.493	55	05.70	57	59.94	2450	2495	12.2
7	29/11/11	14:43	333.613	55	09.42	58	00.06	3000	3060	14.5
8**	29/11/11	17:45	333.740	55	12.00	57	59.40	3550	3622	16.2
9**	29/11/11	22:49	333.951	55	31.32	58	01.26	4200	4295	16.2
10	01/12/11	20:11	335.841	55	49.92	57	48.72	4720	4829	13.1
11	02/12/11	02:10	336.090	56	08.70	57	35.76	3489	3556	8.5
12***	02/12/11	06:52	336.286	56	27.90	57	25.14	3663	3739	13.2
13**	02/12/11	11:43	336.488	56	47.04	57	13.14	3267	3325	8.4
14**	02/12/11	16:28	336.686	57	06.06	57	01.26	3870	3951	3.3
15**	02/12/11	21:47	336.908	57	24.96	56	49.56	3475	3546	3.1
16	03/12/11	02:18	337.096	57	43.98	56	38.58	3459	3532	5.3
17	03/12/11	07:02	337.293	58	03.06	56	26.76	3933	4022	8.1
18	03/12/11	11:44	337.489	58	22.02	56	15.00	3876	3963	1.9
19	03/12/11	16:21	337.681	58	41.04	56	03.24	3730	3811	9.5
20**	03/12/11	21:01	337.876	59	00.00	55	51.48	3752	3833	8.8
21	04/12/11	01:41	338.070	59	19.98	55	39.06	3736	3813	6.5
22	04/12/11	06:10	338.257	59	40.02	55	26.64	3654	3733	6.7
23	04/12/11	10:37	338.442	60	00.00	55	14.28	3478	3552	5.0
24**	04/12/11	15:25	338.642	60	19.98	55	01.92	3420	3491	6.4
25**	04/12/11	19:48	338.825	60	39.84	54	48.30	3060	3115	4.1
26*	04/12/11	22:44	338.947	60	47.94	54	44.58	2530	2577	8.5
27	05/12/11	02:34	339.107	60	49.98	54	43.32	1729	1758	14.9
28	05/12/11	04:01	339.167	60	51.00	54	42.66	978	993	15.6
29	05/12/11	14:23	339.599	60	58.86	54	37.80	570	578	8.9
30	05/12/11	15:35	339.649	61	03.00	54	35.22	345	350	5.9

*Table 2.2: Actual CTD stations carried out during JR265. The time (GMT) and positions given for each station correspond to the time and position of the ship when the CTD was at the bottom of each cast. * CTD carried NOC-L microcats for calibration prior to deployment with BPR. Calibration required three 15 minute stops at 1500, 1000 and 500 m wire-out during the ascent. ** WAGES buoy deployed during CTD. *** Altimeter noisy: CTD may have touched bottom. Altimeter swapped out after station 013.*

2.1.1 Problems and significant events during operations

• On stations 901 and 026 the CTD was stopped for three 15 minute periods at 1500 m, 1000 m and 500 m to allow the NOC-L microcat calibrations.

• WAGES buoy deployments were carried out at several stations, shown in Table 2.2. At these stations the buoy was deployed before the CTD and brought in before the CTD finished coming up.

• Bad weather stopped CTD deployments from 21:35 on 29/11 to 18:41 on 01/12. The first few deployments after were not brought back to the surface before descending.

• The altimeter was changed after station 013 due to noisy readings. On station 012 the CTD may have touched the bottom.

2.2 Configuration

A 24-bottle BAS CTD frame was used throughout the cruise. The CTD frame was equipped with a SBE 32 Carousel Water Sampler, configured with 24 12-litre Ocean Test Equipment ("Niskin") bottles, connected to an SBE 9 *plus* CTD, controlled and powered by an SBE 11 *plus* deck unit. The Niskin bottles (98.5 cm high) were mounted vertically 15 to 20 cm above the sensors. The distance measured between the pressure sensor and the top / bottom of the bottles was 114 cm / 15.5 cm. An SBE-35 high precision temperature sensor was attached vertically on one side bar of the frame approximately level with the water bottles. This provided independent 8-second average temperature measurements each time a bottle was fired.

The underwater SBE 9 plus unit was equipped with the following sensors: dual temperature and conductivity sensors, a pressure sensor encased in the SBE underwater unit, a SBE-43 oxygen probe, an Aquatracka MKIII fluorometer, a transmissometer, an upward-looking downwelling PAR sensor, and an altimeter. The altimeter was changed after station 013 due to increasingly noisy readings. Table 2.3 gives details of sensors, serial number and calibration date. The mapping between sensors and voltage or frequency channels remained the same throughout. A report of the CON file settings used for JR265 is listed in Appendix B.1.

For all stations a self-logging downward-looking LADCP was attached to the main CTD frame (see section 3 of this report for detail of LADCP operations). The frame was equipped with a fin to reduce rotation of the package underwater.

Sensor	Manufacturer	Model	Serial Number	Calibration date
Pressure	SBE	SBE-9+	0771	20/07/2010
Conductivity – primary	SBE	SBE-04	1912	25/06/2010
Conductivity – secondary	SBE	SBE-04C	041912	25/06/2010
Temperature – primary	SBE	SBE-03	4874	25/06/2010
Temperature – secondary	SBE	SBE-03	2191	23/06/2010
Oxygen	SBE	SBE-43	0242	21/01/2009
Fluorometer	Chelsea Technologies Group Ltd.	Aquatracka MkIII	0088-3598C	09/11/2009
Transmissometer	WETLabs	25cm pathlength C-Star	CST-846DR	16/02/2011
PAR sensor	Biospherical Instruments Inc.	QCD-905L4S	7274	23/03/2011
Altimeter (Station 900-013)	System Technologies	PA200/20-6K8	7742.163162	30/05/2007
Altimeter (Stations 014-030)	System Technologies	PA200/20-6K8	2130.26993	03/12/2008
High Precision Temperature	SBE	SBE 03Plus	03P2191	23/06/10

Table 2.3: Details of the sensors model, serial numbers and calibration status.

The mapping between sensors and voltage channels was found to be as follows:
V0 ---------- PAR
V1 ---------- empty
V2 ---------- fluorometer
V3 ---------- empty
V4 ---------- transmissometer
V5 ---------- empty
V6 ---------- oxygen
V7 ---------- altimeter

2.3 Deployment

The CTD was deployed from the mid-ship's gantry. The deck unit was turned on before the CTD was moved. The deployment procedure was to start data-logging on deck with the pressure noted on the log sheet. The CTD was deployed and lowered to 10 m of cable out. The pumps were automatically water activated and should come on 60 seconds after the CTD is in the water, on station 025 the pumps took around 5 minutes. After a 3 minute soak, the package was raised to just below the surface and then continuously lowered at a speed of about 60 m/min to a nominal 10 m above the seabed. Due to large swell on station 010 the CTD was taken straight down after the pumps activated.

Three bottles were fired 30 seconds after reaching the bottom of the downcast, with a 10 second wait between each bottle firing to allow for power recharge of the firing mechanism and the 8-second reading from the SBE-35 temperature probe. Subsequent Niskin bottles were fired during the upcast, with identical waiting times. The detailed procedure for CTD casts used during this cruise is given in Section 2.4 below. Bottles were fired at 3 to 6 depths, with 2 bottles fired at each depth. Water was only sampled for salinity analysis to calibrate the conductivity sensors, so sampling depths were therefore selected according to the shape of the salinity profile, avoiding strong gradients.

Data-logging was stopped when the CTD was back on deck, but the deck unit left on for the first stage of processing.

Log sheets for CTD deployments and salt sampling operations are given in Appendix D.

2.4 Data acquisition

The CTD data were logged via the deck unit to a 1.4 GHz P4 PC, running *Seasave Win32 version 5.30b* (Sea-Bird Electronics Inc.) for data acquisition. The software allows numerical data to be listed to the screen in real time, together with several graphs of various parameters. The file naming convention was adapted to match the filename structure expected by the MSTAR processing routines.

Four files were created by the software module for each station:

> *ctd_jr265_NNN.dat* — a binary data file
>
> *ctd_jr265_NNN.CON* — an ASCII configuration file containing calibration information
>
> *ctd_jr265_NNN.HDR* — an ASCII header file containing the sensor information
>
> *ctd_jr265_NNN.BL* — a file containing the data cycles at which a bottle was closed on the rosette

where NNN refers to the CTD cast number. These files were saved directly to the PC's hard disk under D:\data\jr265.

2.4.1 Pre-cast procedure

• In CTD annexe:

> o Set up CTD, ensuring bottles are ready for firing, all taps are closed (pulled out), all air valves closed.
>
> o Make sure salt crate and plastic bottle stoppers are ready.

• In CTD operation / winch control room:

> o Fill in a CTD Cast log sheet (Appendix D) with lat, long, time, etc.;
>
> o **Prepare the CTD salt sampling log sheet (Appendix D);**

Setup of Seasave for data acquisition:

    • Start seasave.exe

    • Check water sampler configuration under **Configure**>**Water Sampler Configuration**;

    • Check instrument configuration under **Configure**>**New Style Instrument Configuration**> **Select instrument configuration**: select the correct con file under /data/jr265/config/jr265.CON;

    • Check depth of water from the main echosounder (EA600 on JR265;

    • Setup the display window by right click over plot, 'setup', 'modify display params'. Set-up full depth plots of primary temp, conductivity, salinity and oxygen; and 300 sec of primary temp minus secondary temp, primary conductivity minus secondary conductivity and altimeter.

    • Set depth range on plots;

    • Ensure other ranges (temp, cond etc.) are suitable for location;

    • Check the PC clock – adjust to GMT if required;

    • Switch on the SBE911plus Deck Unit (red button);

    • Click **RealtimeData**> **Start Acquisition**

    • Select correct CON file for the cruise and enter output data filename (e.g. ctd_jr265_NNN);

    • Start Acquisition with the CTD still on deck;

    • Check deck pressures in the real-time display window;

    • If station depth > 100 m, check that altimeter reading is about 100 m at surface. Altimeter readings start 100 m from bottom.

2.4.2 Procedure for the cast

    • The winch should be zeroed (by the winch operator) when the CTD is just in the water;

    • Lower CTD to <u>10 m for 3 minutes</u>;

    • 60 s after immersion – check pumps are on (0010 changes to 0011 on Deck Unit). The pump comes on approximately 1 minute after the CTD enters the water. If conductivity frequency drops below 3500Hz, the pump will stop and delay will start again.

    • Bring CTD back to near surface;

    • Lower CTD at reasonably constant speed (e.g. 60 m/min) to 10 m above seabed;

    • Monitor SeaSave display for unusual features, <u>with close attention to the ALTIMETER</u>;

    • When altimeter height start decreasing, tell winch driver 90 m to go;

    • Check altimeter height and wire out reading: Wire_out + altimeter_reading = depth_to_go

    • Underwater Unit error may be indicated by alarm on Deck Unit – ok if occasional but if persistent then problem with the termination – call the technician;

    • When altimeter starts reading, call out distance from the bottom and stop at 10 m though higher depending on sea state and/or bottom slope;

    • At bottom, <u>wait for 10-15 s for things to settle</u>;

    • Go to **View**>**Fire**>**Bottle Control** to bring up the bottle firing window;

• Close the first bottle. Red light will come on briefly. <u>Wait for a further 10 s for SBE35 to capture (if set to 8 sec) and bottle firing power to recharge;</u> fire other 2 bottles as required and using the same waiting routine;

   • Fill in the Cast log sheet (Appendix D) with appropriate pressure, temp and sal values;

   • Up to next depth, fire 3 bottles (allows for 2 missing bottles), following the waiting times as above: 10-15 s after arriving at firing depth and 24 s after closing each bottle;

   • Continue up to surface firing bottles at chosen depths, and filling in Cast Logsheet;

   • Fire all remaining bottles at the surface;

   • Complete Cast Logsheet.

   • <u>DO NOT SWITCH THE DECK UNIT OFF until the SBE35 data are downloaded </u>(see next section).

   • Click **RealtimeData**> **Stop Acquisition**

2.4.3 Immediate post-cast operations.

Niskin bottle sampling protocol:

Go down to CTD bay with salt sampling log sheet (Appendix D) to sample salt;

Do sampling without gloves.

Before sampling, put just enough clean plastic inserts into a little cup or clean plastic bag.

Use a clean piece of blue-roll and between use leave it on a clean, dry surface (eg the logsheet, not on a salty aluminium box or chair)

1. Empty sample bottle, giving it a good shake as you do so.
2. Open tap by pressing with fingers, not the sample bottle (you can chip or break the bottle on the metal pin)
3. Rinse the bottle 3 times: each time half-fill with water, give it a shake and empty completely. Use the last rinse to pour over the NISKIN tap to rinse it of surface water or drips from the frame.
4. Fill the bottle by holding in the water stream (not against the tap)
5. Fill to halfway up the shoulder of the bottle
6. Rinse the black cap in the water stream
7. Dry the outside of the bottle neck (NOT the inside)
8. Put clean plastic insert in neck. Do NOT rinse the insert. Make sure it is pressed all the way in – if it wont go in, use another one.
9. Dry the inside of the black lid, do it up and place the bottle the right way up in the crate (unused bottles should be upside down).
10. Write salinity bottle numbers in log sheet against CTD Niskin bottle numbers;
11. When the crate is full, place it in the Bio Lab (next to salinometer) and make a note of the date and time on the logsheet.

2.5 SBE Data processing

   SBE data processing was carried out in two phases. Immediately after the cast the data were processed using SeaBird Data Processing routines on the CTD logging PC; SeaTerm was used to save the bottle files. The data were then copied to the ship's network drive and on to the

NOCS Linux Sun workstation NOSEA2 for further processing using the MSTAR processing routines.

On the CTD logging computer: **SBE Data Processing software version 7.21d** was used for initial processing as soon as the cast was finished, by running the following:

1) Data Conversion to convert the raw frequency and voltage data to engineering units as appropriate by applying the manufacturer's calibrations stored in the CON file and save both downcast and upcast to an ASCII format file.

Input File: ctd_jr265_NNN.dat

Output File: ctd_jr265_NNN.cnv

2) Align CTD to align the oxygen sensor in time relative to pressure. To find the optimum setting for the oxygen measurement the deep test station 901 was used (see Appendix B.1).

Input File: ctd_jr265_NNN.cnv

Output File: ctd_jr265_NNN_a.cnv

3) Cell Thermal Mass to correct the pressure and conductivity . The SeaBird recommended settings of alpha = 0.03 and 1/beta = 7.0 were used on both primary and secondary conductivities.

Input File: ctd_jr265_NNN_a.cnv

Output File: ctd_jr265_NNN_actm.cnv

SeaTerm version 1.59 was used to communicate with the SBE35 and save the bottle files. The deck unit must be switched on. 'Connect' allowed the CTD data from the deck unit to be accessed. 'Capture' allowed the data to be saved.

Output File: jr265_NNN.cap

Three command were used:

dc to record calibration coefficients

ds to record the time, date and status

dd to record the data

Click 'capture' to stop saving data.

Before disconnecting from the SBE35 'samplenum=0' was used to clear the data. Check time on the SBE35 clock. Accurate time makes merging the data with CTD bottle data easier. To check/reset time do:

ds   - check clock is accurate compared to GPS time – if not reset by:

ddmmyy=311109

hhmmss=123000   (for example)

NOTE: both date and time must be set together. It is not possible to execute the time command only.

After disconnecting the deck unit was switched off.

BAS_SVP was used to copy the processed files from D:\data\jr265 to U:\data\jr265, the ship's network drive, inputting the cruise name and station number as prompted.

2.6 MSTAR Data Processing

The CTD stations were processed using NOCS MatLab-based MSTAR processing routines (see Appendix B.5 for more details).

   • **do_265copyctdfiles** (/local/users/pstar/cruise/data/ctd) was used to copy the data from the ship's network drive to the NOCS Sun workstation NOSEA2. The station number in this file was altered for each station.

   • MatLab was opened and '**m_setup**' used to setup the environment for mexec processing.

The MSTAR processing was split into several phases. '**ctd_all_part1**' included the following:

   • **msam_01** creates an empty sam file sam_jr265_NNN.nc (make sure that the list of variable contains the expected channels);

   • **mctd_01** reads in 24Hz CTD data into ctd_jr265_NNN_raw.nc;

   • **mctd_02** renames SeaBird variable names and creates ctd_jr265_NNN_24hz;

   • **mctd_03** averages data to 1Hz (output to ctd_jr265_NNN_1hz.nc) and calculates derived variables (output to ctd_jr265_NNN_psal.nc);

   • **mdcs_01** creates empty dcs file which will store information about start, bottom and end of good data in CTD file;

   • **mdcs_02** populates dcs file with data to identify bottom of cast.

The second phase consisted of running '**mdcs_03**' and manually input the scan number corresponding to the start of good downcast data and the end of good upcast data, therefore excluding any measurements taken in air. A list of scan number, pressure and salinity was produced allowing the scan number aligning with the start of downcast and end of upcast to be found.

Phase 3 routines grouped under '**ctd_all_part2**' ran the following:

   • **mctd_04** extract downcast data from psal file using index information from dcs file; sort, interpolate gaps and average to 2db (output to ctd_jr265_NNN_2db.nc);

   • **mdcs_04** merge positions of start, bottom and end cast from navigation file into dcs file;

   • **mfir_01** read in information from SeaBird .bl file and create netCDF fir file;

   • **mfir_02** merge time from ctd file onto fir file using scan number (output to fir_jr265_NNN_time.nc);

   • **mfir_03** merge CTD upcast data onto fir file;

   • **mfir_04** paste CTD fir data into sam file and output to sam_jr265_NNN.nc;

   • **mwin_01** creates win file which will hold winch data and extracts times from start and end of 1Hz ctd file;

   • **mwin_03** merge winch wire out data onto fir file;

   • **mwin_04** paste winch fir data into sam file;

   • **mdcs_05** apply position from dcs_*_pos file to set of files.

If ctd_all_part2.m was run before the processed navigation file was available then mdcs_04, mdcs_05 and mctd_04 were run again using one script (ctd_all_part3.m). This populates the position fields and recalculate depth from pressure.

Phase 4 consisted of adding the bottle salinity data, first the bottle salts files were copied into the folder: ctd/BOTTLE_SALTS. Then the following were run:

- **convert_sal_ascii** on all crates to produce sal_jr265_NNN.csv files;
- **msal_01_jr195** to read bottle salinities;
- **msal_02_original** to paste salinities into sam file;
- **msam_02_jr195** to calculate residuals botpsal-upsal1 and botpsal-upsal2.

The latter three scripts were used because more recent versions of msal_01, msal_02 and msam_02 were not compatible with the bottle salinity file format.

The final files from the initial processing carried out on board were, for each station:

- **ctd_jr265_NNN_24hz.nc,** a 24Hz time series for the full cast, all variables;
- **ctd_jr265_NNN_psal.nc,** a 1 Hz time series for the full cast, all variables;
- **ctd_jr265_NNN_2db.nc,** a 2 db file of the downcast with all variables;
- **sam_jr265_NNN.nc,** a bottle sam file containing upcast data at bottle firing time and bottle salinity data;
- **jr265_cordep.txt,** containing corrected water depth data extracted from the LADCP processed files for each cast.

2.7 Calibrations

2.7.1 Pressure

Pressures on deck were logged at each start and end of cast. No correction was required.

2.7.2 Temperature

Initial comparison was made between the primary and secondary sensors. The agreement between the two sensors was excellent, the mean difference and one standard deviation were

T1-T2 $= 0.000007 \pm 0.000288$ °C

2.7.3 Salinity

Initial comparisons were made between the conductivities, and derived salinities, from the primary and secondary conductivity sensors, the agreement was good. Mean differences and one standard deviation between the primary and secondary sensors were as follows:

C1-C2 $= 0.0071 \pm 0.0022$ mS/cm

S1-S2 $= 0.0088 \pm 0.0008$ PSU

At the end of the cruise, when the salinity bottle samples had all been merged into the sample files and residuals calculated (see Phase 4 in section 2.6 above), the final salinity calibration was made (S1 and S2). First visually examine the differences between the bottle and CTD salinity, plotting the residuals against pressure and time to look for any trends and outliers. This is most easily done by appending all the residual files into one mstar file (mapend). Outliers are samples with large differences that can be caused by mistakes in files, or samples

from high salinity gradient regions (where the bottle may not be sampling the same water as the CTD), but are often due to contaminated samples. (A "large difference" might be greater than ± 1 standard deviation from the mean). You might typically find 2 to 4 outliers per 100 samples, and those can be excluded from the analysis. It is also common for there to be higher variability in the residuals in water shallower than 1000m where the salinity gradients tend to be higher. If the scatter is significant above 1000m it can be useful to use only the deeper samples to obtain a calibration, but it is better to pick shallow sampling depths where gradients are lowest, in order to make use of the full range of salinities measured.

On JR265 a total of 153 samples were taken, of which up to 7 were considered outliers. Plots showed that there were no trends with pressure or time, just a simple offset for each conductivity cell. Prior to calibration the statistics were:

S1: mean (botpsal – upsal1) ± SD = 0.0027 ± 0.0008 (150 of 153 samples)

S2: mean (botpsal – upsal2) ± SD = -0.0060 ± 0.0012 (146 of 153 samples)

Salinity calibrations are best carried out by actually calibrating conductivity, which has the added benefit of taking care of any pressure effects. To do this, the conductivity of the bottle samples need to be derived and the conductivity residuals calculated and examined. Again, no trends were found in the residuals, just a simple offset for each cell. The calculation of bottle sample conductivity and residuals was carried out in a matlab script do_stuff.m

Prior to calibration the statistics were:

C1: mean (botc – ucond1) ± SD = 0.00234 ± 0.00096 (150 of 153 samples)

C2: mean (botc – ucond2) ± SD = -0.00500 ± 0.00133 (146 of 153 samples)

therefore an offset of 0.0023 was applied to cond1, and -0.0050 applied to cond2 in the 24 Hz files (after saving the original as a back-up) and new PSAL1 and PSAL 2 calculated (do_morestuff.m).

- Next re-run the following (grouped into ctd_all_part4):
  - o mdcs_05
  - o mctd_03
  - o mctd_04
  - o mfir_03
  - o mfir_04
  - o msam_02

msam_02 re-creates the residual files for each station, so they can be appended into a new summary file and the statistics for the calibrated salinities calculated. If you have done the calibration correctly, the new means should be zero and the standard deviations similar to the pre-cal values.

For JR265, after conductivities were calibrated and salinity recalculated, the statistics were:

calibrated S1: mean (botpsal – upsal1) ± SD = 0.0000 ± 0.001 (150 of 153 samples)

calibrated S2: mean (botpsal – upsal2) ± SD = 0.0002 ± 0.001 (147 of 153 samples)

2.8 Initial results

The following figures show the data across the Drake Passage transect as a function of distance from CTD station 001 in the north to station 030 in the south. These are data prior to final quality control and calibrations. Preliminary calculations suggest that the geostrophic transport across the section was 133.0 Sv.
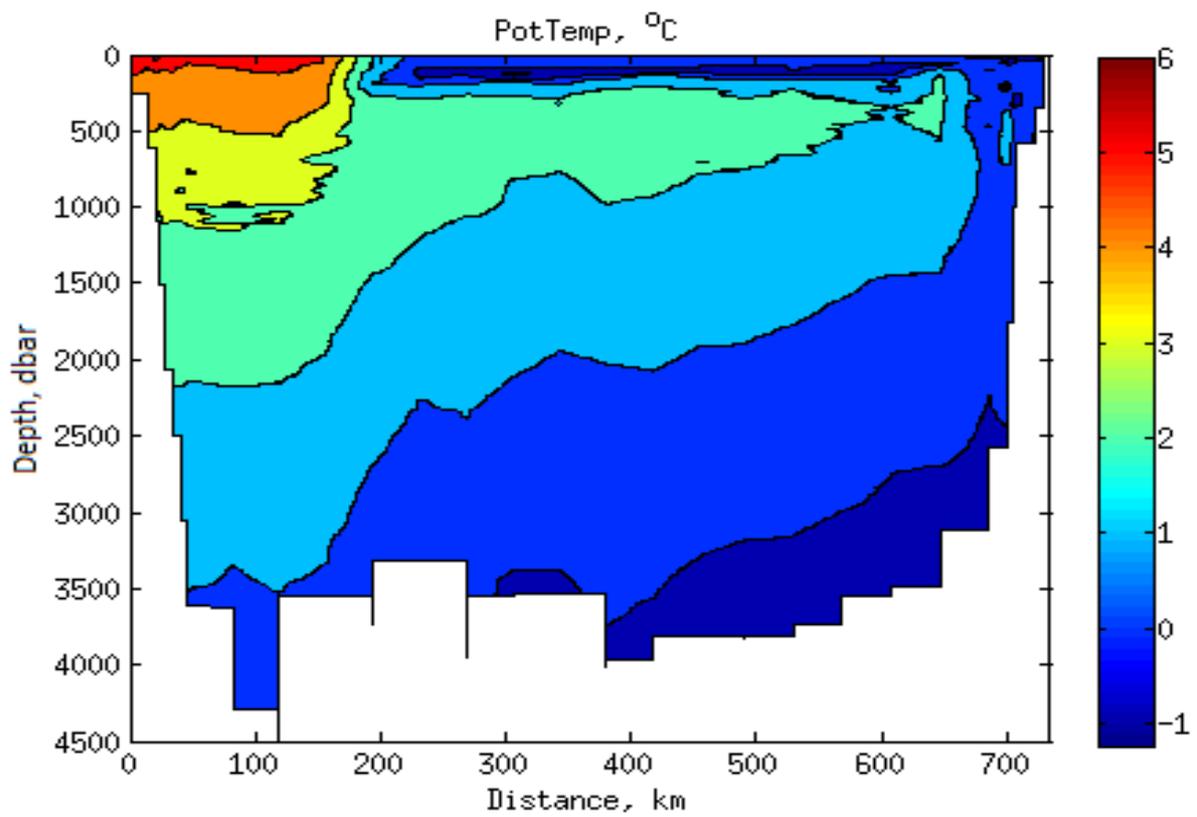
Figure 2.1: Potential temperature across JR265 Drake Passage section.
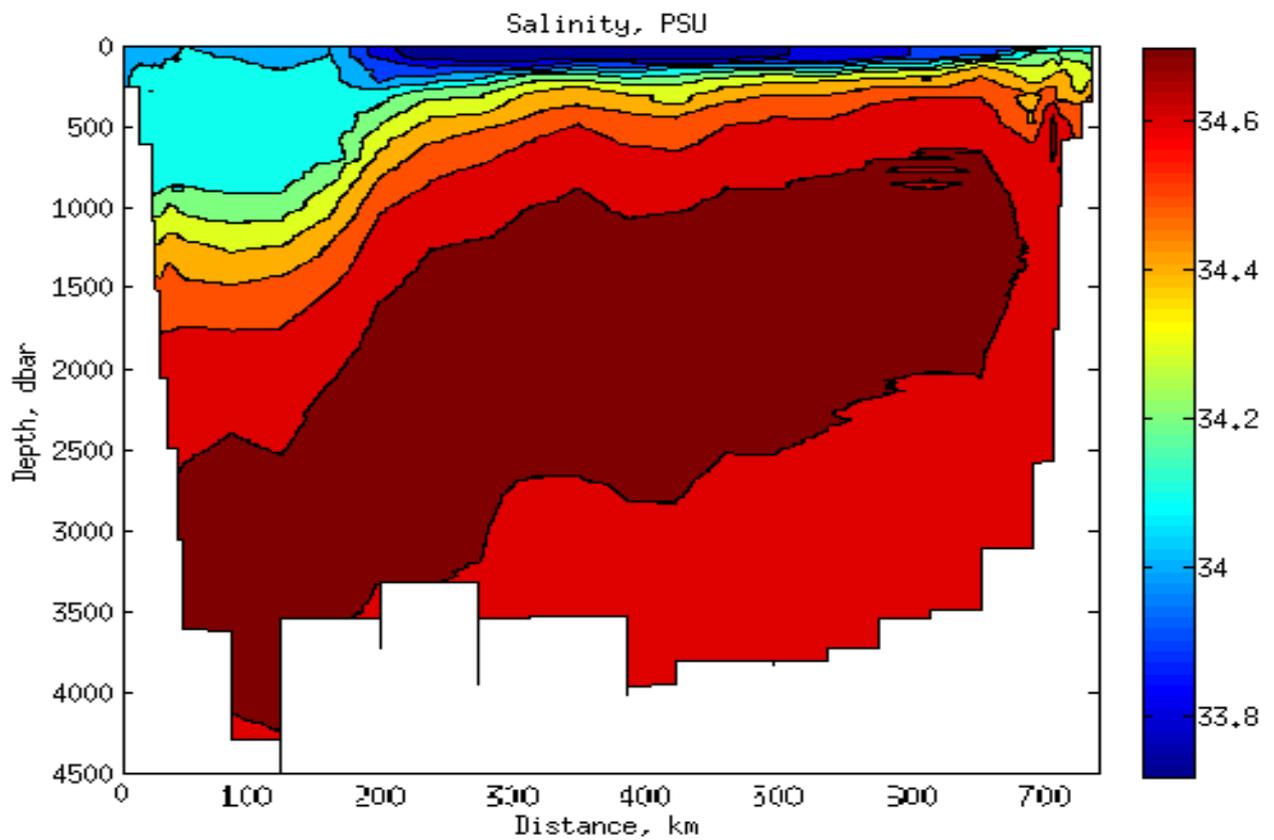
Figure 2.2: Salinity (PSU) across JR265 Drake Passage section.
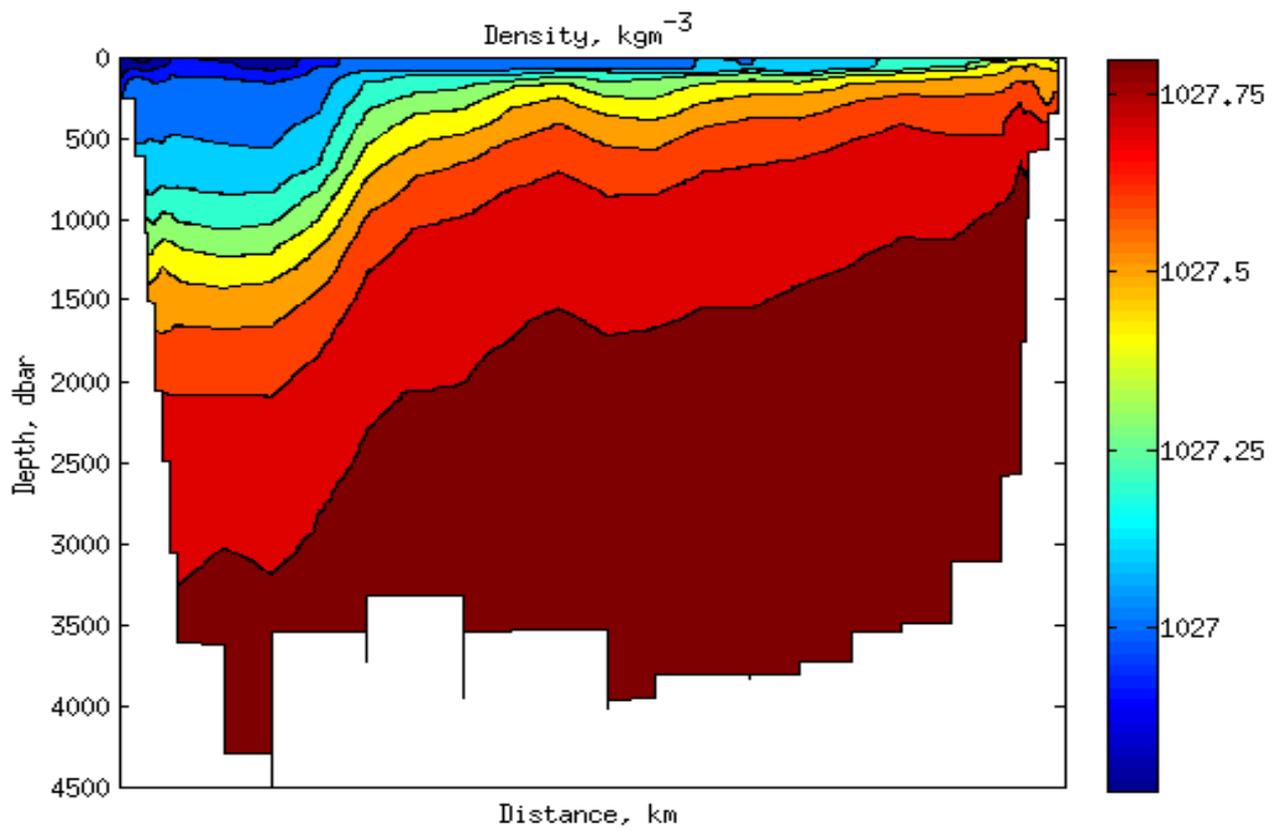
Figure 2.3: Density across JR265 Drake Passage section.
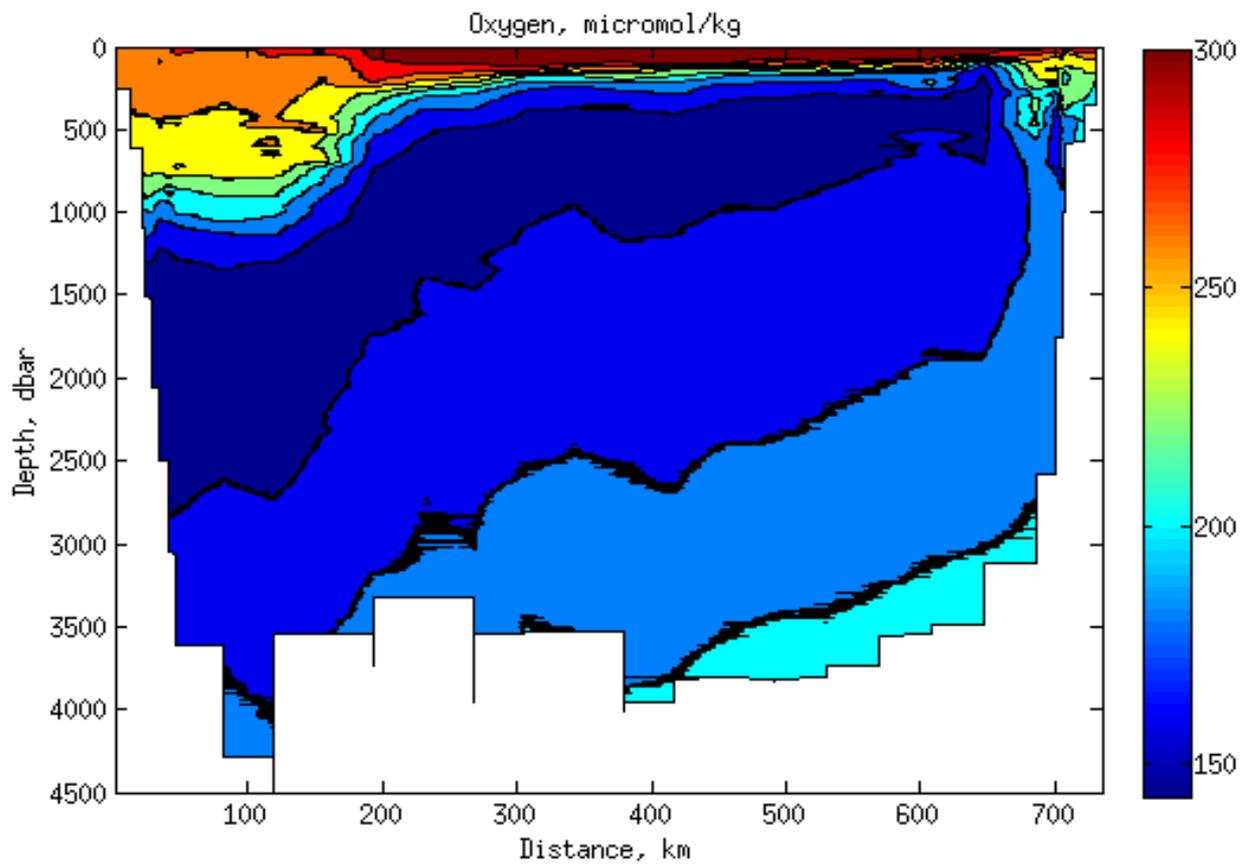
Figure 2.4: Nominally calibrated dissolved oxygen concentration (μmol/kg) across JR265 Drake Passage section.
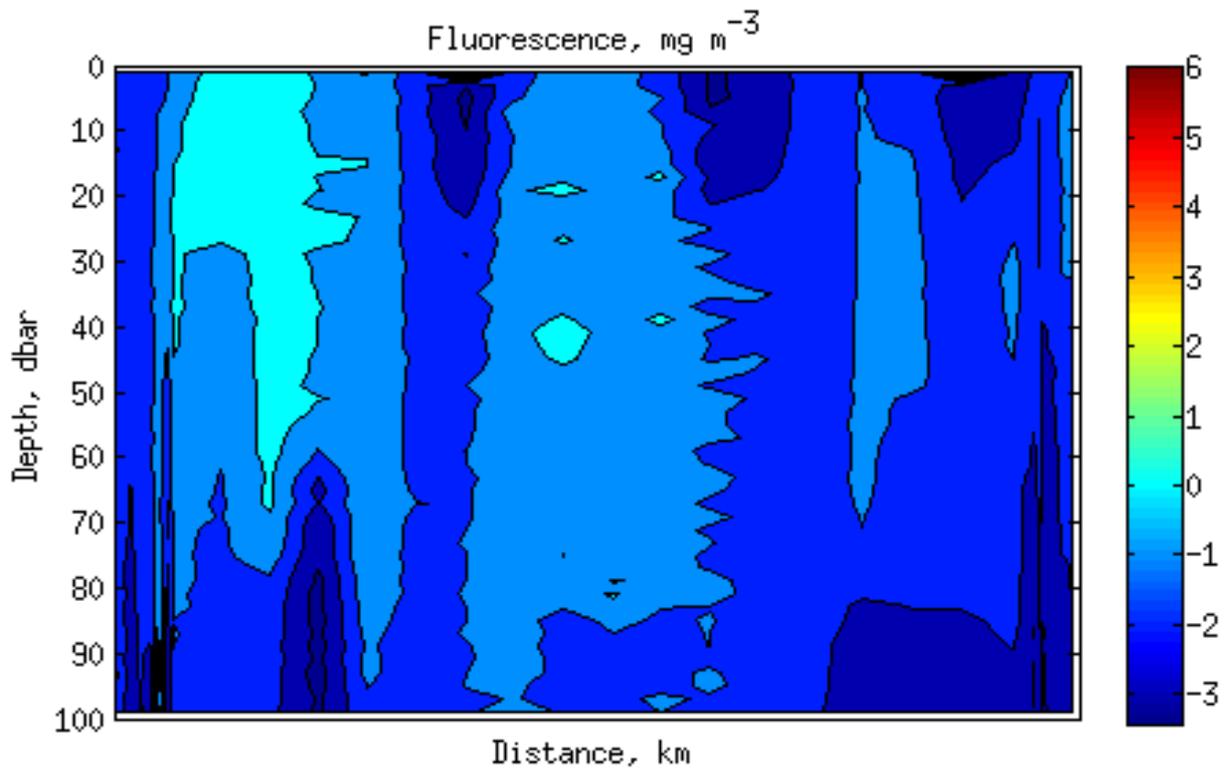
Figure 2.5: Nominally calibrated chlorophyll fluorescence (mg m^{-3}) in top 100m across JR265 Drake Passage section. The distribution shows much patchiness. No chlorophyll sample was taken during the cruise to calibrate the fluorometer against extracted chlorophyll.
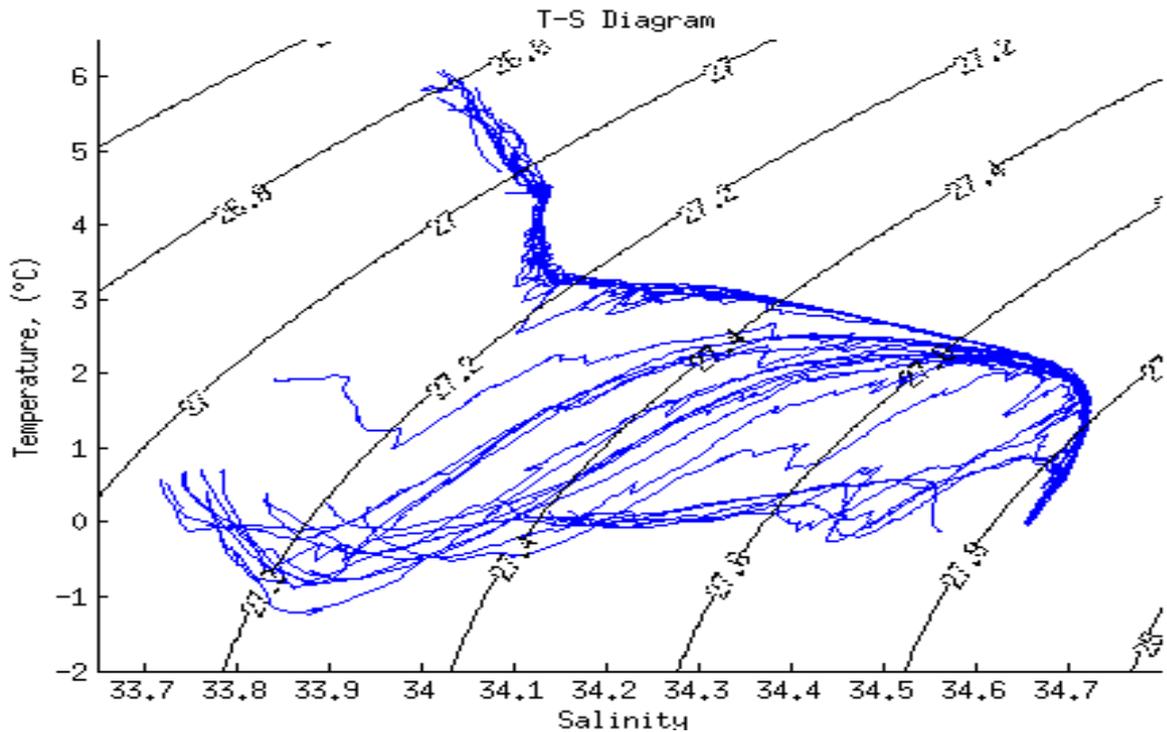
Figure 2.6: T-S plot for Drake Passage section of JR265 using data from the 2db-binned CTD profiles.
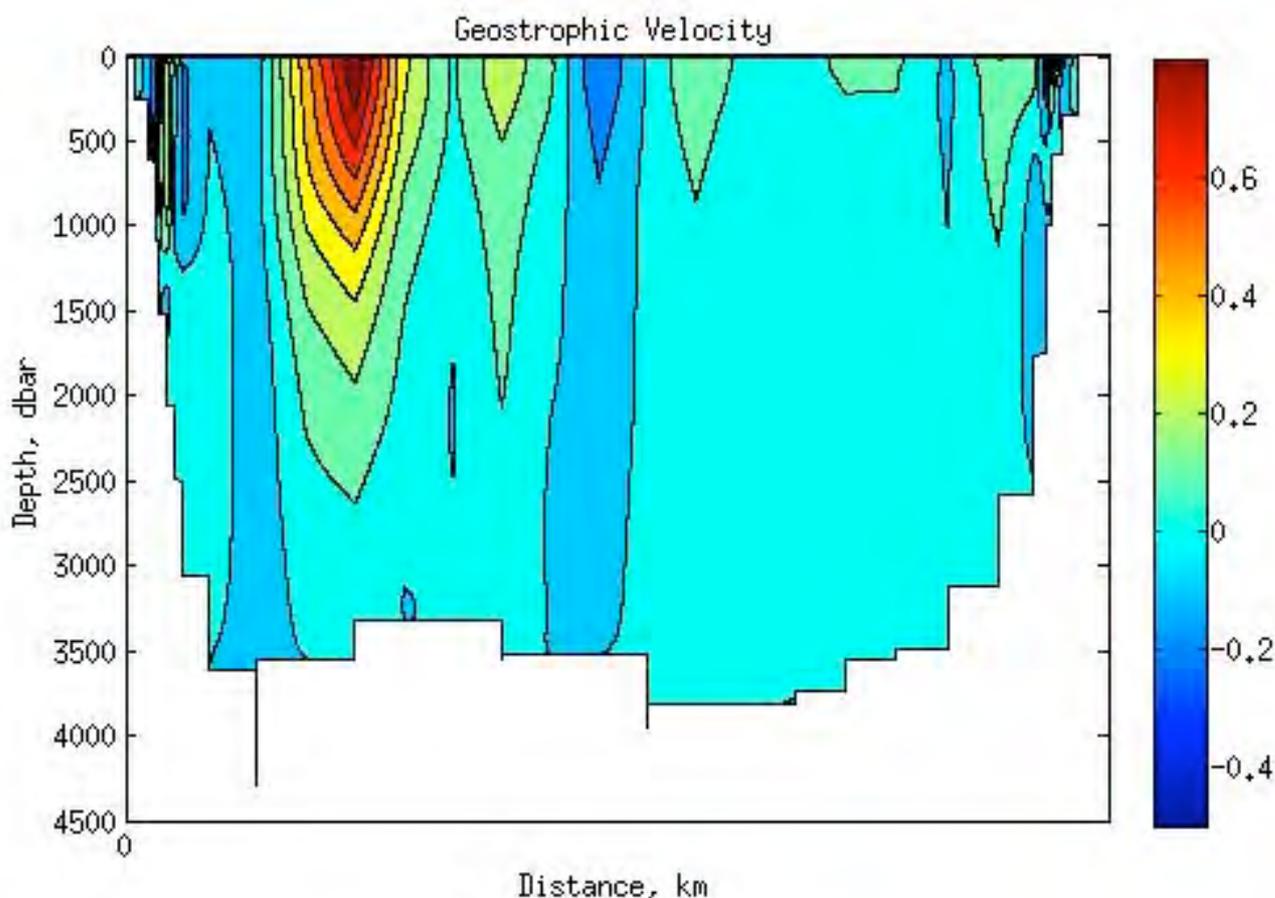
Figure 2.7: Geostrophic velocity on Drake Passage (referenced to zero at seafloor). Geostrophic transport across the section was 133.0 Sv.

3. LOWERED ACOUSTIC DOPPLER CURRENT PROFILER (LADCP)

Penny Holliday and Julian Klepacki

3.1 Introduction

The LADCP setup installed by Julian Klepacki (BAS AME) was a single RDI Workhorse Monitor 300 kHz instrument, battery pack and logging PC. Julian was responsible for charging and venting the battery pack. A single LADCP was deployed in downward-looking mode, instead of a 2-LADCP upward/downward slave/master configuration. The LADCP was connected to the controlling laptop (located in the Chemistry Lab, just forward of the water bottle annex) while the CTD was on board. Pre-deployment, the LADCP was woken up and the appropriate configuration command file was sent to start the instrument pinging before disconnecting the comms cable and blanking off the free ends. Post-recovery, the comms cable was reconnected to download the data. The data was examined in WinADCP on the PC, then run through the initial stages of the UH processing and LDEO processing routines in order to diagnose any problems promptly. As with other NOCS cruises the LADCPs were configured to have standard 10x16m bins, with one water track and one bottom track ping in a two second ensemble. Full description of the deployment and recovery procedures are provided below.

Several casts into the section we realised that the first LADCP unit, a brand new instrument from RDI Teledyne, was faulty, with a failed Beam 3 (WHM300-I-UG306, S/N 14443). The unit was replaced in the CTD frame after cast 008 (new unit WHM300-I-UG301, S/N 15060).

3.2 LADCP set-up

Once ADCP(s) installed and battery charged use AME laptop to perform installation test(s) and confirm operation of unit(s). The built-in tests require the immersion of the transducer faces in water. If not, some of the tests may fail. Running the tests in air will not harm the ADCP. Read ADCP testing/BBTalk documentation (Monitor_Sentinel/RDITools Users Guide) for insight and better understanding of what follows. Any problems refer to the WorkHorse Technical Manual, Section 5, Troubleshooting. Figure 1 shows the cabling connections for LADCP star-cable. Figure 2 shows wiring pin-outs for the comms/power cable. The ADCP charger plugs into the power connector at the PC end of the comms lead. Battery voltage can be checked by turning on the charger and measuring the voltage via the two DVM leads. Due to a diode in the Star-Cable Patch-Lead, battery voltage cannot be checked directly due to reverse bias of diode.
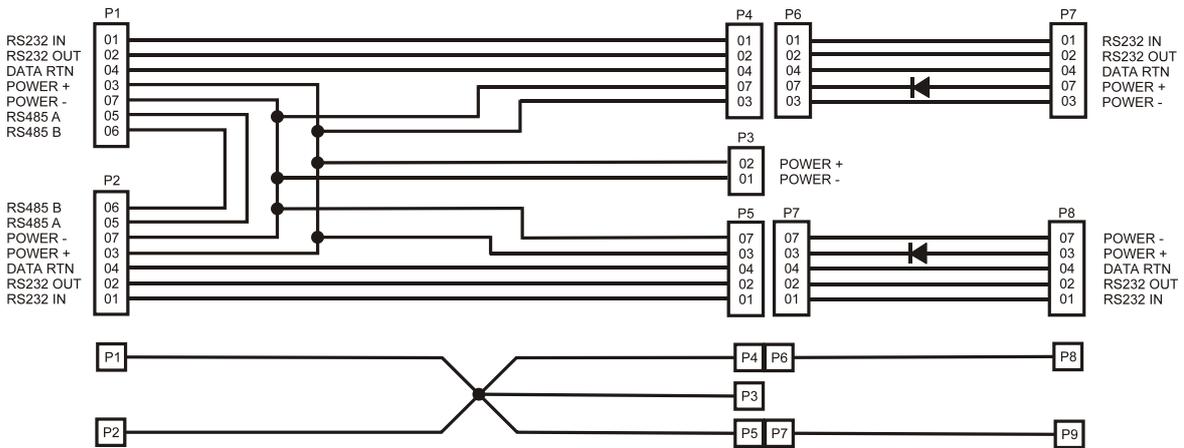
Figure 3.1. Star-Cable Connections
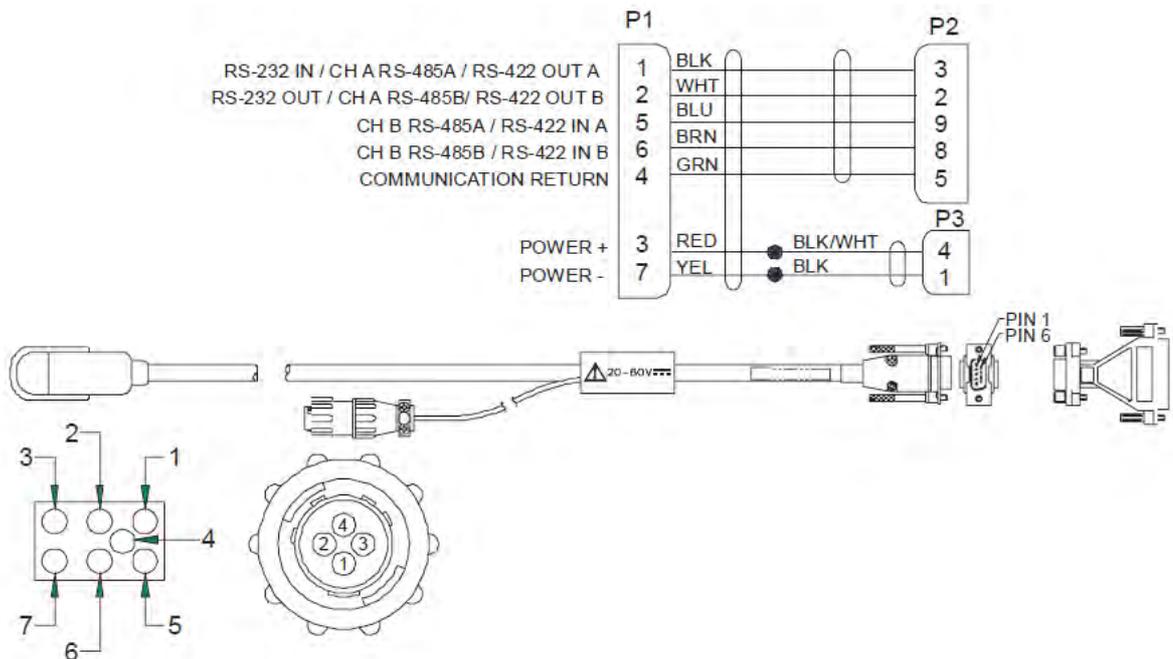
Figure 3.2. Comms/Power cable connections

The communications cable was passed through the cable duct from the bottle annex where the CTD is stored to the adjacent chemistry lab which housed the LADCP laptop and

power supply. To test the LADCPs with the comms cable connected to the star cable, we ran through the deployment and recovery routines in the BBTalk software (see below). The LADCP laptop was networked and had its time syncronised with the master clock.

The configuration command file for the downward-looking LADCP used on JR265 contained the following commands:

PS0
CR1
CF11101
EA00000
EB00000
ED00000
ES35
EX11111
EZ0011101
TE00:00:01.00
TP00:01.00
WM15
LD111100000
LF0500
LN016
LP00001
LS1000
LV250
LJ1
LW1
LZ30,220
SM1
SA001
SW05000
CK
CS

3.3 Pre-Deployment

The following steps were completed to test the LADCP and to set it pinging prior to deployment of the CTD at each station. The instructions below include notes to record items in the LADCP log sheets (Appendix D). LADCP should be started just prior to CTD deployment. Pre-deployment checks and deployment activation only takes 2 minutes or so.

• Make sure *k9NT Debug* is running on the LADCP PC and the time is set correctly synchronised to CTD PC time with NO daylight savings.

• Open *BBTalk* connection if not already connected.

• Send a *Break* (<End>) via 'B' icon to establish comms, should return:

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version ##.##
Teledyne RD Instruments (c) YYYY-YYYY
All Rights Reserved.
>

• Select test file: **File → Send Script File → PreDeployTest.rds → O.K**
(File can be found in **C:\ LADCP \ Scripts \)**

- Once file selected and accepted, a dialog box for the LOG file appears. Create log file associated with respective ADCP being tested. i.e.

  C:\ LADCP \ JR??? \ Logs \ jr???_NNN$.log

  Where **???** is the cruise number, **NNN** is the station number and **$** is either m (master), s (slave) or excluded if single LADCP.

- On clicking OK the PredeployTest script will run and a series of tests will be performed. Some tests (Bandwidth(s), Transmit/Receive) may fail due to unit being in air, this is normal. Should see initial hardware tests pass and Pitch and Roll changing when displayed during tests.

- Pay attention to *Internal Moisture* at the beginning of *PT200* test section, values beginning 9###h or 8###h are good. Lower (<7) or decreasing values indicate increasing moisture and units are ingressing water and will eventually fail. This is most likely with numerous cold, deep casts due to failing transducer potting.   Also under the *PT200* test section is a list of "RSSI high gain" values for each beam: NOTE that if one beam has a value significantly higher than the others (e.g. a few 10s greater) then this may indicate a failing beam.

- Last command of pre-deployment script sets the ADCP clock to that of the PC time synchronised to the NTP server.

- Finally, note ADCP recorder space shown as the following line;
  RS = nnn,NNN ------------- REC SPACE USED (MB), FREE (MB)

- On completion of PreDeployTest script, hit *<return>* to exit script.

- Command prompt '>' will now be available.

- Erase recorder if data storage space insufficient with: **re ErAsE** command. Otherwise leave as data backup. MAKE SURE ALL DATA BACKED UP BEFORE ERASE! On JR265 there was sufficient space for all data to be left on the hard disk.

3.4 Deployment

- On BBTalk select configuration file:

- *File → Send Script File → WHMJR265.txt → O.K.* Or press <F2> to select a configuration script file. Scripts found in; **C: \ LADCP \ Scripts **

- Do not close down BBTalk or anything before disconnecting ADCPs at CTD otherwise a character may be sent stopping ADCP acquisition.

- Check LADCP(s) is pinging: Due to location not easy to hear Master/Single ADCP pinging with much ambient noise; wind, rattling doors, gossiping etc. Often simply cannot be heard pinging prior to deployment. Sometimes the slave ADCP if used can be heard pinging easier (location), but not always. If cannot hear pinging and passed tests, have faith, deploy and all should be good.

- Disconnect comms cable(s) from star-cable at CTD. Re-connect dummy plug(s), new grease, (sparingly) if necessary. CHECK BATTERY VENT PLUG IF CHARGING CARRIED OUT! Re-install if not fitted. Making sure its clean and using some new grease (sparingly). Lock in place pinching collar cap-screw. ADCP(s) now ready to deploy.

3.5 Recovery

- Send a *Break*, **B** in BBTalk to wake up ADCP.
- Type command *cb811* to change baud rate to 115200 to minimise download time.

- Choose data file: ***File → Recover Recorder → Select File(s) → OK***. Only either ALL or single file can be selected.-
- Save in: **C:\ LADCP \ JR??? \ Data **, where **???** is cruise number.
- To speed up data recovery, check the **Disable Window Output** box. Download times at 115200 baud are approximately 3 minutes per Mb with disabled output window.
- Once data recovery complete and successful. Go to data and change file names to:
  - ***jr???_NNN$.000***
  - where ***???*** is the cruise number, ***NNN*** is the station number and ***$*** is either ***m*** (master), ***s*** (slave) or left out if single ADCP. Record default names and changes.
- At BBTalk command prompt type **cb411** to reset baud rate to 9600.
- Type **cz** to power down ADCP.
- Copy the raw files and the log files to *jrlb/legwork* (mounted on PC as E:\jr265\LADCP\).

3.6 Initial Data Quality Check

Standard pre-deployment test **PA** checks the major WorkHorse modules and signal paths. Additional tests are performed to be comprehensive prior to deployment. In some instances these are not effective because some tests fail in air even though the instrument performs fine in water. A new user may be primed to expect failures in Transmit/Receive and Bandwidth, but interpreting the other tests to spot a fault requires knowledge of subtleties within the results. Previously we had relied on diagnostic plots generated at the end of the data processing stages described below. However, with the usual busy period at the start of the cruise, it took several casts before we recognised there was a fault in the first LADCP unit. In order to avoid this making this mistake again we recommend that the user examines the data in WinADCP on the LADCP computer after every cast:

- Open WinADCP
- File Menu => Open => c:/LADCP/jr265/Data/jr265NNN.000
- This opens a graphical display of the data (see Fig 3).
  - Choose Option Menu => Chart Options => Profile
  - In dialogue box, tick boxes to select Beam Intensity and Correlation for all 4 beams
- The left hand plot shows beam intensity and beam correlation for the period of the data file that is indicated by a red-box on the top coloured contour panel (echo intensity). You can change the period by sliding the bar below the plot left or right - for example you can see how parameters change from in-air to in-water, and over the duration of the cast.
- Check Beam Intensity
  - i) in air: if one beam has much higher counts than the other three (>5) then it may be faulty. This is not a secure test though - even our good instrument showed one beam slightly higher than the other 3 in air (2-5 counts).
  - ii) in water: if one beam has consistently higher counts than the others then it is faulty (JR265 Bm 3 was 10-20 counts higher, sometimes more, especially on lower part of these plots.
- Check Beam Correlation
  - i) In air: this is not a useful test because in our faulty unit, the correlations all matched in air.
  - ii) In water: if correlations from one beam are consistently lower than the other 3 then it is faulty. In our faulty unit, the beam 3 correlations were 60-70 counts lower than the other 3. The beam correlations do vary though the duration of the cast, but if all four are consistently grouped together then there is not a problem.

Figure 3.3 shows a screen capture below of a failing unit. Beam 3 on the Intensity profile (bottom left) can be seen to have a considerable offset whilst out of water sitting on the deck.

Scrolling the time-line also shows this intensity offset, especially as depth increases. Also a poor correlation is maintained between beams. These offsets, high-counts and poor correlations are all indicative of a failing beam requiring manufacturer attention.

Read the WinADCP user manual for better insight, but really only a rudimentary knowledge is required to see if things are working properly. It is worth checking data as often as possible in this simple quick manner to monitor unit performance and performance degradation is often experienced.
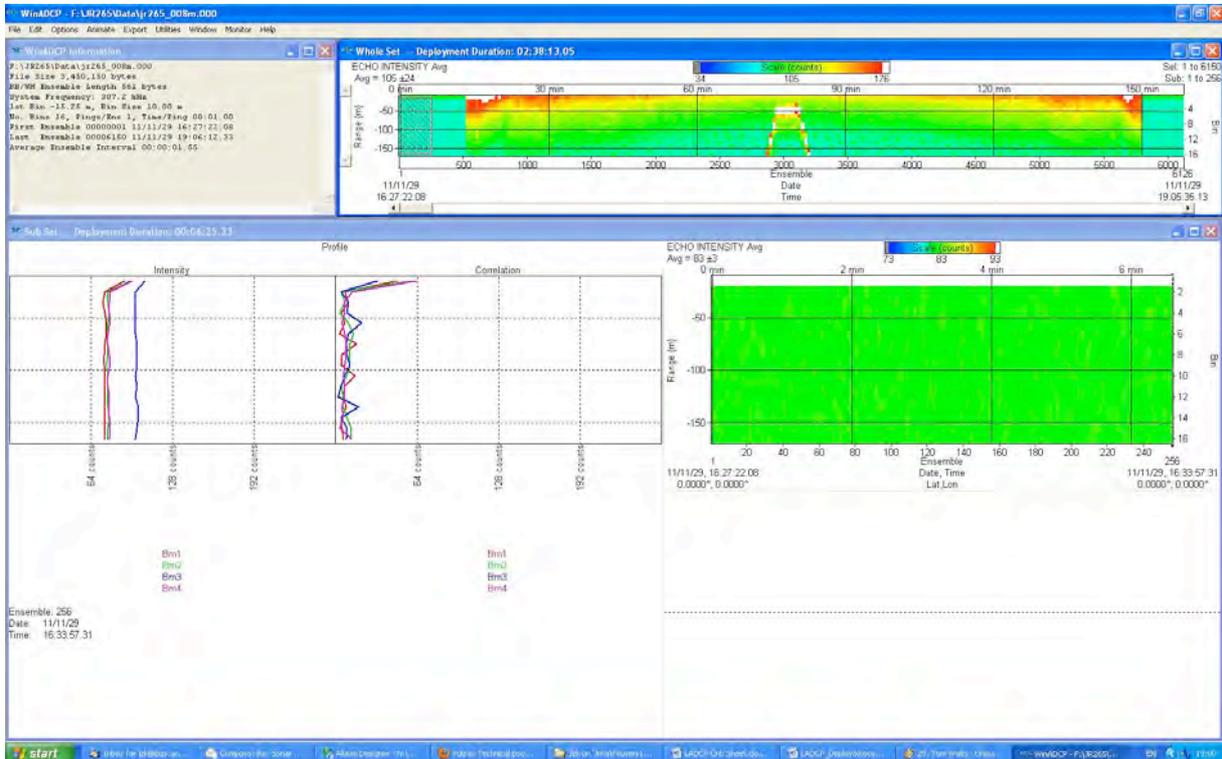
Figure 3.3. Deck-Test with weak Beam 3; Intensity offset with high counts.
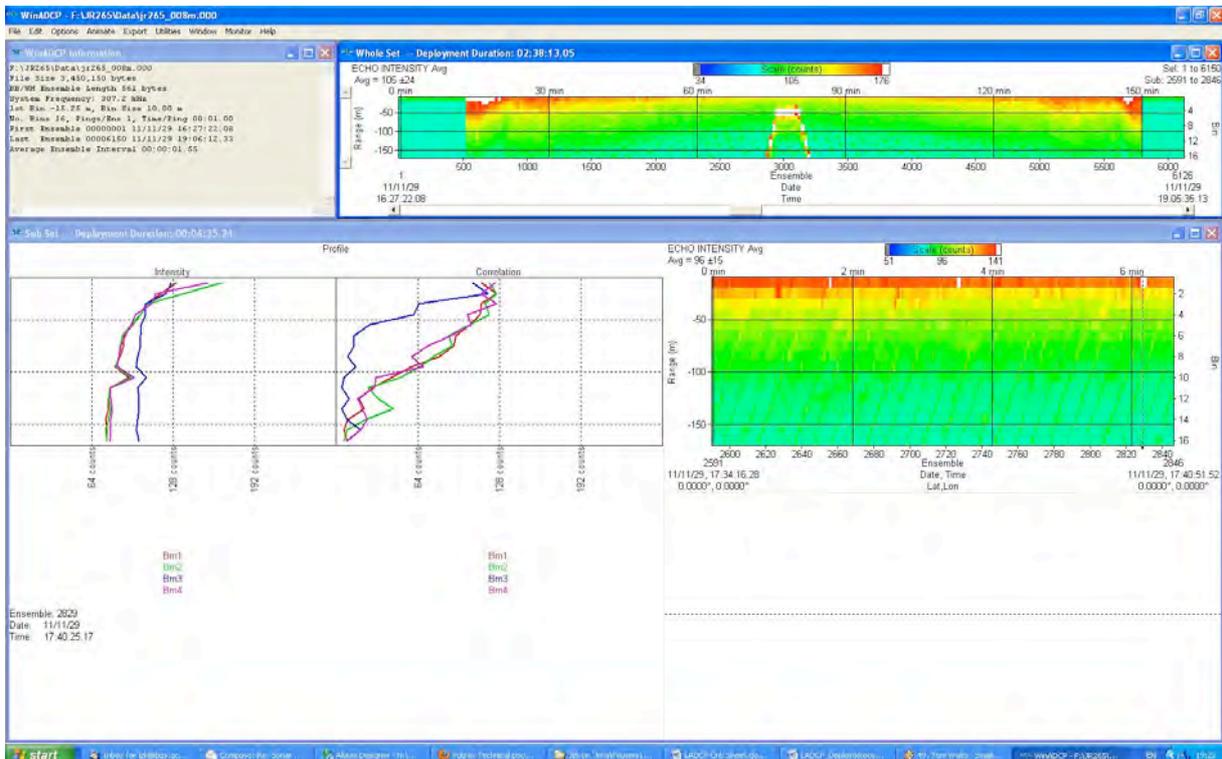
Figure 3.4. Data close to bottom showing Intensity offset and poor correlation.
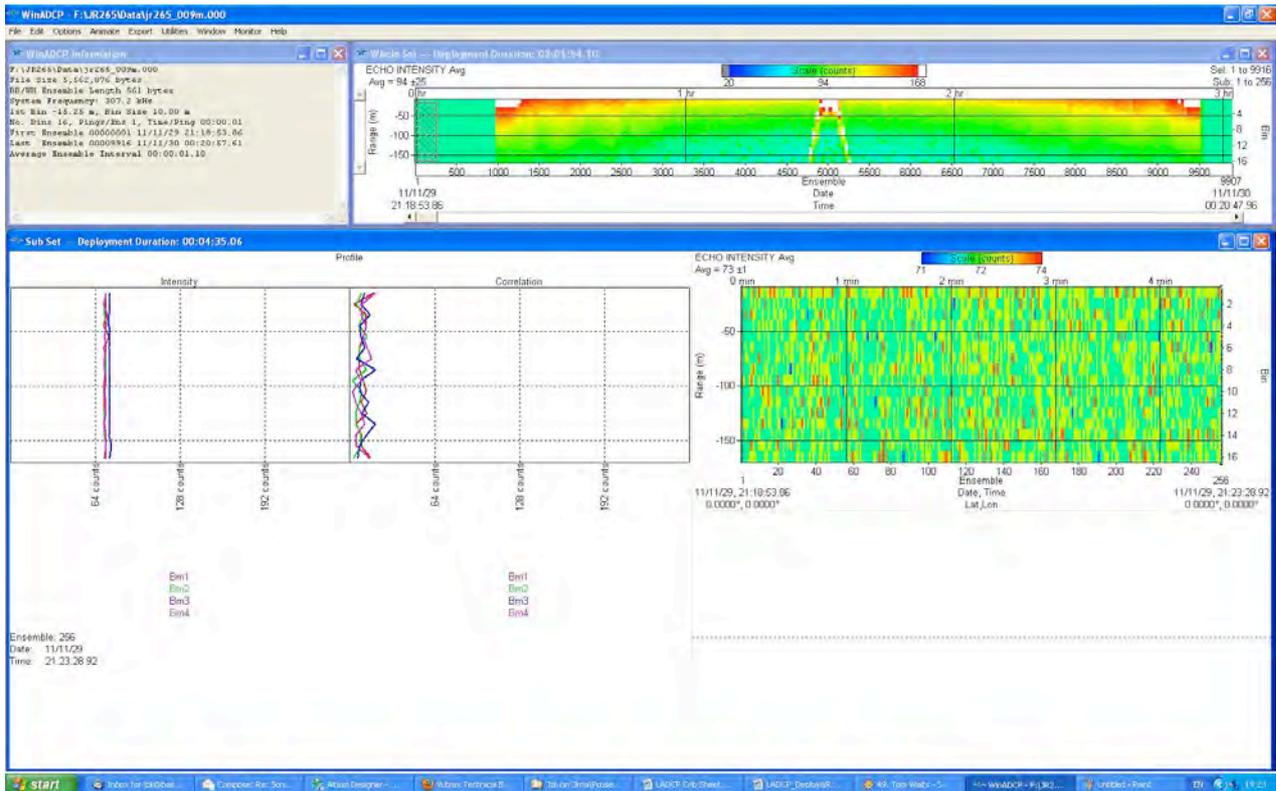
Figure 3.5. Correctly functioning unit with Profiles showing similar intensities and correlations.
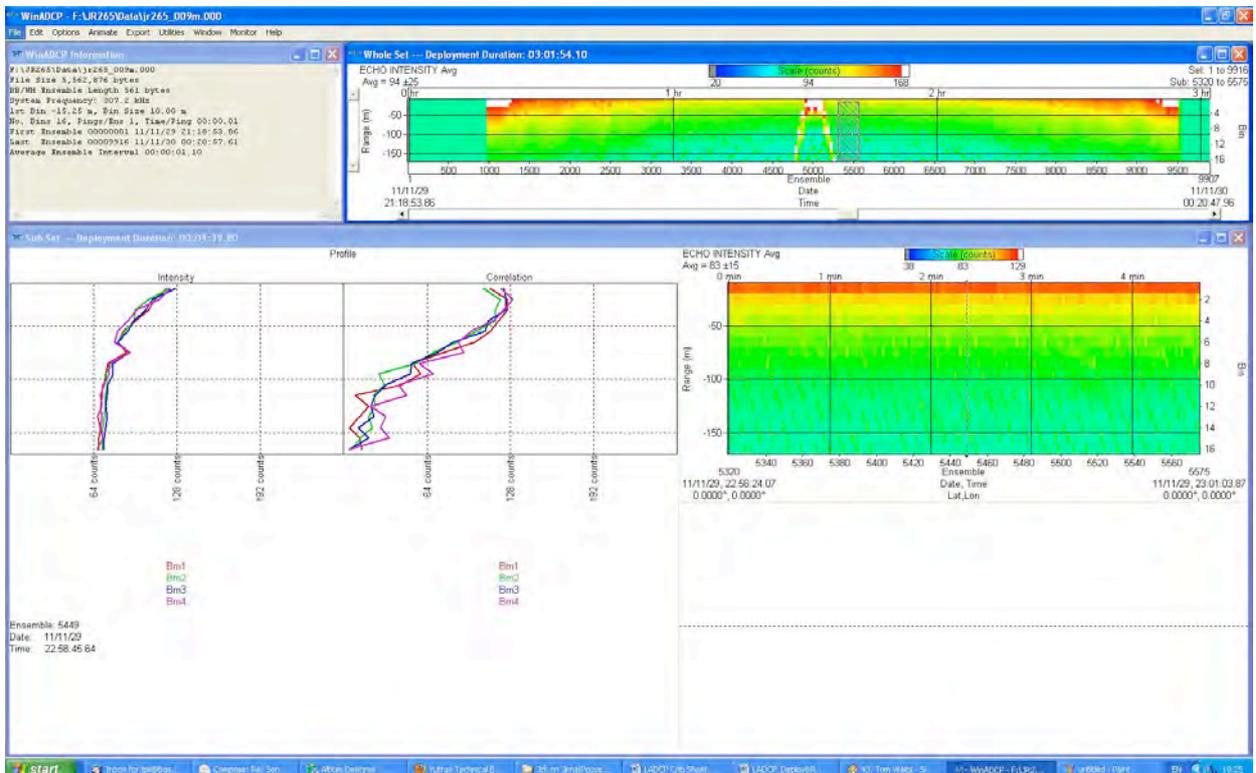
Figure 3.6. Close to bottom Profiles showing maintained close intensities and good correlations.

3.7 Data processing

Data from the LADCP instruments was processed when possible between each station to allow early detection of any problems with the ADCP workhorse. Two sets of software were

utilized: University of Hawaii (uh) and Lamont Doherty Earth Observatory at Columbia University (ldeo) programs. Both were run to allow a full picture of the LADCP performance to be obtained. Instructions are given below for initial shipboard LADCP processing during JR265.

3.7.1 UHDAS processing

Bold text denotes commands to enter at the X-window/terminal prompt. '>>' preceding bold text indicates commands to be entered in the Matlab window. Notes are in italics.

1. Log on as pstar, password pstar.
Note: You must be logged on to the jruh station to get access to the matlab licence - this should be set up when NOSEA2 is connected to the ship's network, and not required at each subsequent log in.

2. Move raw LADCP files to appropriate place on the Unix system: copy files (in j265_NNNm.000 format) from *jrlb/legwork* (mounted on nosea2 as /mnt/current/work/jr265/LADCP/) to pstar/cruise/data/ladcp/uh/raw/jr1112/ladcp

3. setup matlab paths, at the prompt enter
cd ladcp
cd uh
source LADall

4. change location to processing directory:
cd proc   *(this is not a typo - although the ladcp directory does not contain a subdirectory proc, the path to proc is set in the LADall file)*
cd Rlad
linkscript
Check the raw ladcp data; there should be a raw file called jr265_NNNm.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 down looking workhorse (WH) and 03 is an upward looking WH. Hence until the instruments are changed, use 03 in the following XXs. For JR265, there is only the downward looking WH, so NN = 02.

5. scan data file:
cd proc
perl −S scan.prl NNN_02 *This will output to screen, check that times and depth are sensible, i.e. Zmax is approximately the same as the expected depth, and Zmin and Zend should be < 50m for shallow casts, and < 200m for deep ones.*

6. Update cruise navigation files:
matlab &
>> m_setup
>> putpos(NNN,02) *check syntax*
>> magvarsm(NNN.02) *check syntax*
(ignore decimal year warning)
>> exit

7. perl −S load.prl NNN_02
loads into 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 (i.e. proc/casts/jNNN_02/scdb/.blk)*

8. perl −S domerge.prl −c0 NNN_02
merge single pings into long shear profiles

9. Grabs navigation for the LADCP profile
cd Rnav
matlab
>> m_setup
>> make_sm
>> exit
cd proc

10. first look at profile:
matlab
>> plist = NNN.02; *(this is a decimal number in matlab)*
>> do_abs
Check figure 1 for X-character in profiles indicative of ADCP failure. Check Figure 5 for good heading, i.e. CTD not rotating.
>> exit
Next print the useful figures, examine them and put into "First Look" folder.
The "lpr" command for printing did not work on JR265, so you can ftp the figures to your laptop and print from there:

Open a new Terminal window (or tab)
At the prompt type: **sftp pstar@nosea2**
pwd: **pstar**
cd /local/users/pstar/cruise/data/ladcp/uh/pro/jr1112/ladcp/proc/casts/jNNN_02/merge
mget duNNN02h.ps
File printout in the "JR265 LADCP first look" folder

Stop UH processing here if CTD has not been processed as far as 1Hz and perform the LDEO processing in Section 3.7.2

11. If/when the CTD has been processed as far as a 1hz file
cd proc
cd Rctd
matlab
>> m_setup
>> mk_ctdfile(NNN)
makes ascii version of CTD 1hz file in preparation for ladcp use
>> exit

12. **cd proc/Pctd**
matlab
>> ctd_in(NNN,02)
incorporates CTD data to LADCP profiles, using CTD to calculate exact sound speed etc.
>> exit

13. **cd proc/Fitd**
matlab
>> plist = NNN.02;
>> fd

41

check vertical velocities from ctd and adcp agree
>> exit

14.   final steps:
cd proc
perl −S add_ctd.prl NNN_02
perl −S domerge.prl −c1 NNN_02
matlab
>> plist = NNN.02;
>> do_abs
>> exit
cd casts/jNNN_02/merge
lpr -Php4550 duNNN02h.ps

   To simplify the process, a script was written on JR195 which will run through steps 3-9 in the initial UH processing (**pstar/jr265/data/ladcp/uh/script3-9**).   A further script will run through the remaining processing steps once the CTD data has been processed to the appropriate stage (**pstar/jr265/data/ladcp/uh/script-uh-withctd**).   These short-cuts were not used on JR265 because this user preferred to examine the information written to screen at every stage.
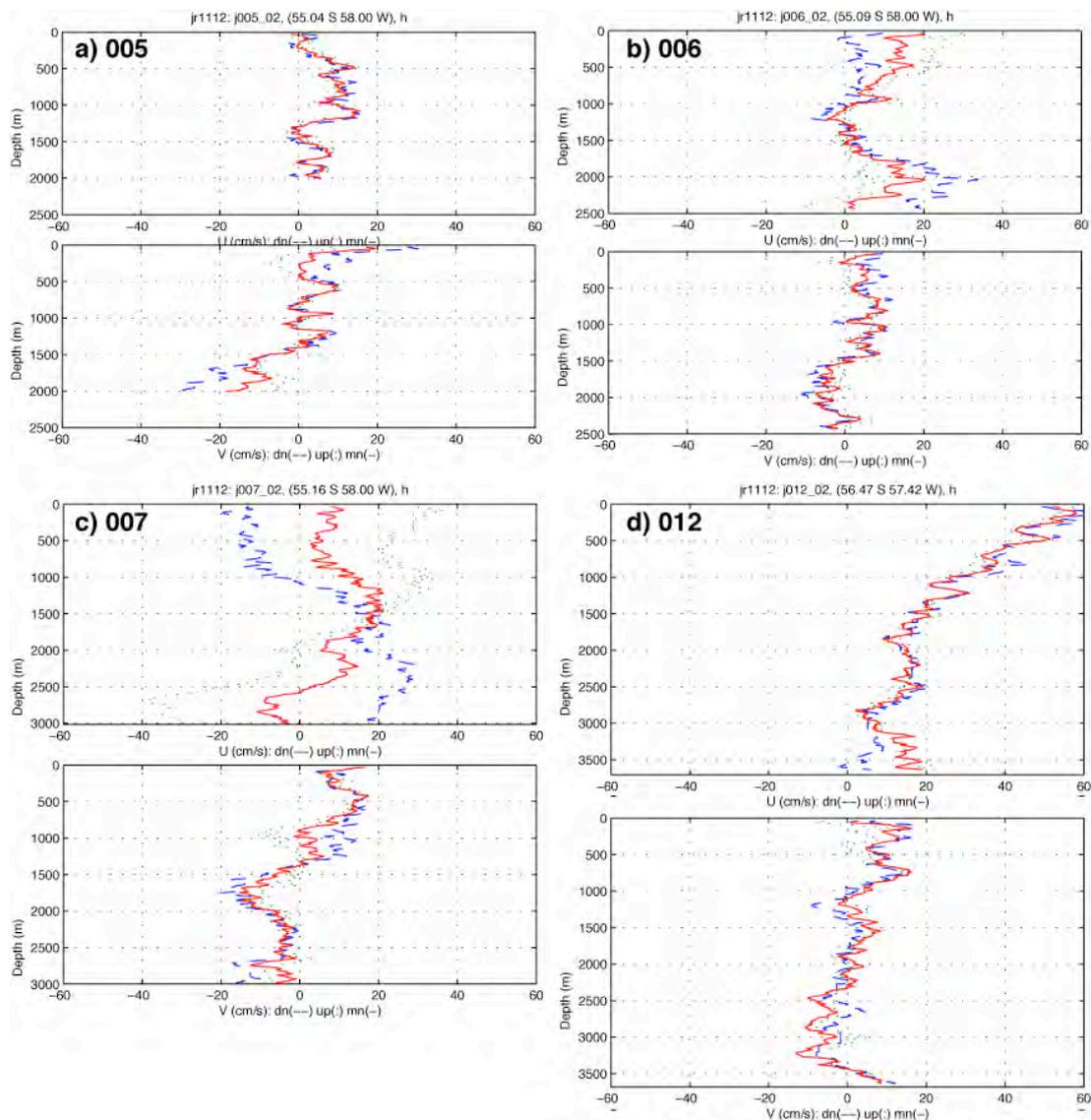
Figure 3.7. Velocity profiles generated by the UH processing: a) to c) profiles from the faulty LADCP (stations 005, 006 and 007) and d) a good profile from the second LADCP (station 012).

One check of the LADCP performance was to compare the velocity profiles from the down- and upcasts at each station. This is the duNNN02.ps figure (Figure 3.7) which is printed to go in the processing file. Preferably the up and down cast velocities do NOT form an 'X', which indicates poor quality data and a possible fault. This is a tricky diagnostic test for a non-expert however, because adjacent stations can have profiles with varying degrees of the 'X' characteristic. This is illustrated in Figure 3.7 where profiles from stations 005, 006 and 007 show X profiles that range from subtle to obvious (all from the faulty LADCP), and the profile from station 012 with the new and fully functional unit.

3.7.2 LDEO processing

This is a easy check of LADCP beam strength, but it usefulness depends on timely processing which can be hard to achieve during the early stages of the section. It was done after the first running the UH processing which generates the required navigation files, but you don't need to have done the 1Hz CTD processing first.

In a terminal window, enter:

cd pstar/data/ladcp/ldeo/jr1112
matlab
>> sp
input NNN when prompted, when asked for run letter enter 'noctd' or 'withctd' as appropriate
>> warning off
>> lp
>> print_ldeo_fig_2_13
Save useful figures not automatically saved by ldeo processing.
>> warning on
Turn warnings off because lp often calls FINITE which still works, although Mathworks has re-placed/will soon replace with ISFINITE.
Beam strength and correlation figures should show good agreement between the four (five for the Bangor unit) beams.
>> exit
If processed without CTD data, the following figures were printed for the JCR LADCP FIRST LOOK file: **jr265NNNnoctd.beam_stats.ps, jr265NNNnoctd.ps,**
jr265NNNnoctd.ensembles.ps

Open a new Terminal window (or tab)
At the prompt type: **sftp pstar@nosea2**
pwd: **pstar**
cd /local/users/pstar/jr265/data/ladcp/ldeo/jr1112/jr265NNN
mget *.ps

As with the UH processing, there are c-shell scripts developed on JR195 to run the LDEO processing all the way through the processing with CTD data. (**pstar/jr265/data/ladcp/uh/script-ldeo** and **script-ldeo-withctd**), though they were not typically used.

Examples of the useful beam stats figures are shown in Figure 3.8. The left panel shows that the LADCP had a faulty beam 3 on station 008, but the new unit used for station 009 onwards was fully functional. For station 008, the high echo amplitude and low correlation of Beam 3 matches with the information observed in the raw data in WinADCP (see section 3.6).
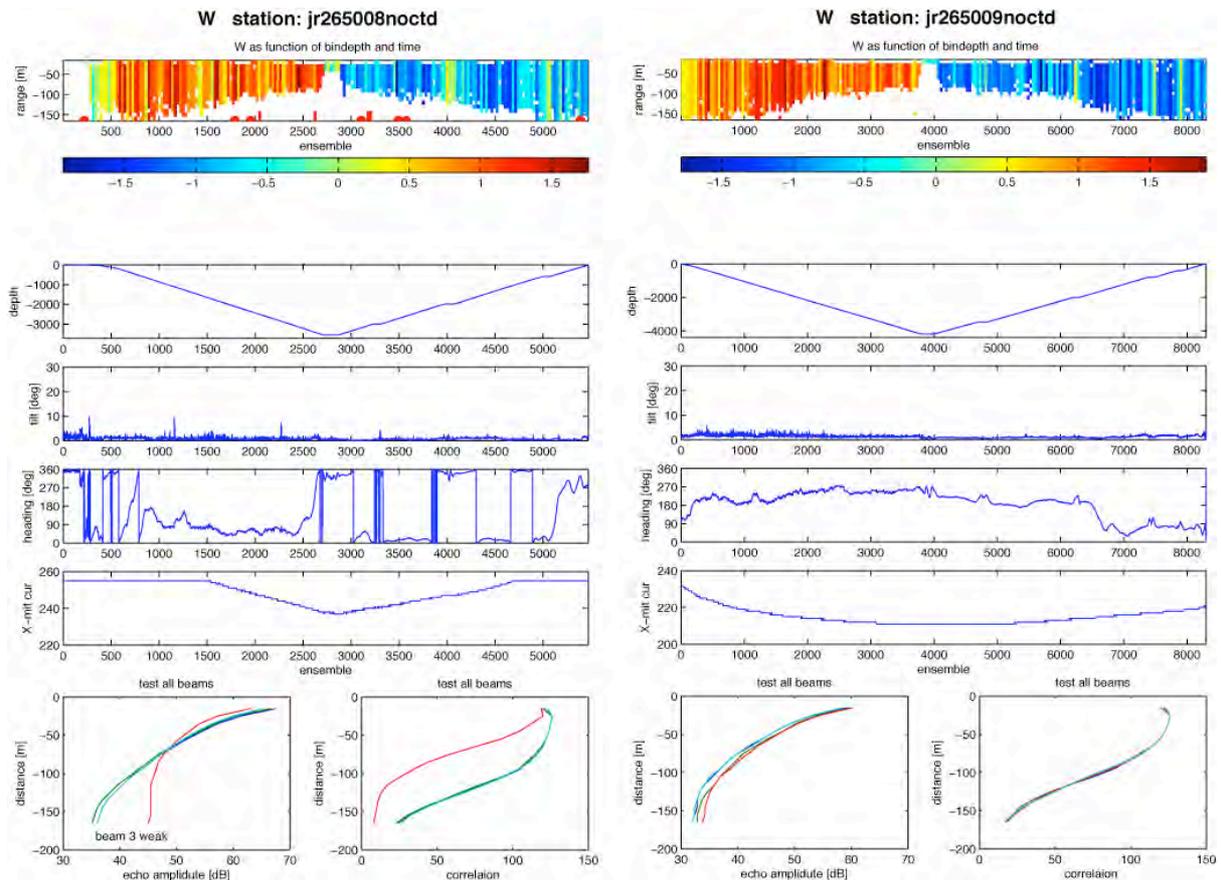
Figure 3.8. Beam Stats figures for station 008 (faulty LADCP) and station 009 (replacement unit).
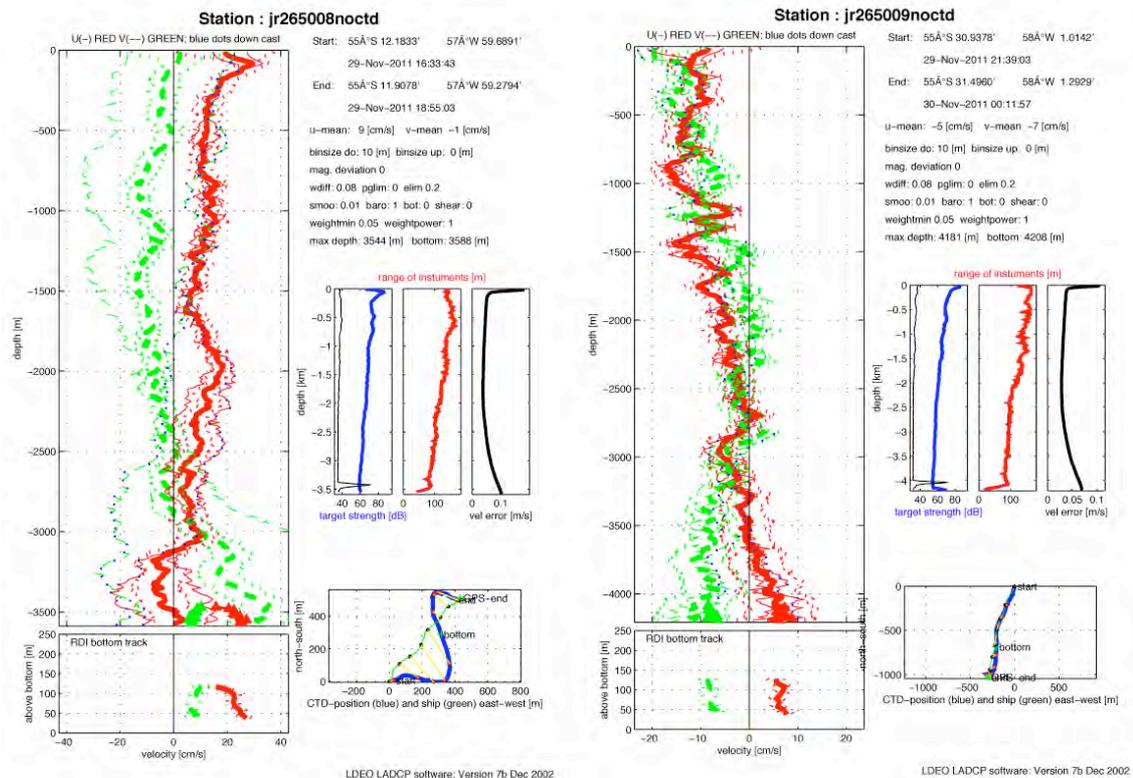
Figure 3.9. Velocity profiles for station 008 (faulty LADCP) and station 009 (replacement unit).

Examples of the velocity profiles generated are shown in Figure 3.9, also from stations 008 and 009. Note the poor quality data at station 008 (left hand panel) with large difference

between up and down cast, large difference between water track and bottom track velocities, and high velocity error.

3.8 LADCP problems on JR265

The significant problem with the LADCP on JR265 was the faulty beam 3 on the first LADCP installed. The result of the faulty beam is that casts 001 to 008 of the section have poor quality LADCP velocity data. Once the problem had been identified the LADCP was replaced and the data from the new unit was examined after each cast: it performed satisfactorily for the remainder of the cruise. The early stations with the faulty unit had a high percentage of 3-beam solutions (Table 3.1), with higher values on deeper stations. Similarly, in the pre-deployment checks the PT200 test showed beam 3 to have significantly larger values for the High Gain RSSI. Good quality VM ADCP data exists for these stations and those data should be used in preference to the LADCP data.

Cast No.	3-bm solution	High Gain RSSI value from pre-deployment PT200 test			
		beam 1	beam2	beam3	beam4
901	36%	73	76	**100**	76
001	0 %	74	77	**101**	77
002	31%	75	79	**101**	78
003	32%	75	7	**99**	78
004	32%	74	78	**101**	79
005	34%	76	77	**102**	79
006	35%	75	75	**101**	79
007	37%	76	76	**100**	78
008	40%	75	76	**99**	78
009	0% (new unit)	36	40	42	38

Table 3.1. Indication of a failing beam; percent of 3-beam solutions and High Gain RSSI values.

4. VESSEL-MOUNTED ACOUSTIC DOPPLER CURRENT PROFILER

Penny Holliday

4.1 Introduction

A 75 kHz RD Instruments Ocean Surveyor (OS75, – model 71A-1029-00, SN 2088) ADCP was used during this cruise. This has also been used on JR139 (in Dec 2005, Chief Scientist Stansfield), JR161 (Oct-Dec 2006, Shreeve), JR165 (Feb 2007, Shoosmith), JR193 (Dec 2007, Quartly), JR177 (Jan 2008, Tarling), JR218 (Oct 2008, Woodward) and JR200 (Mar 2009, Korb), JR195 (Dec 2011, Yelland). The OS75 is capable of profiling to deeper levels in the water column than the previous 150 kHz ADCP and can also be configured to run in either narrowband or broadband modes.

4.2 Instrumentation

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. 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 JR200, but note that the ship was very heavily laden during cruise JR139, and for other cruises it may be shallower.

During the trials cruise (JR139), 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 can be synchronised with the other acoustic instruments using the SSU. This issue was investigated in detail on JR218. On JR265 there was a newly fitted EM122 swath, but this was not used during the CTD transect except when it was turned on to do a brief survey for the deployment of the northernmost NOC-L BPR. In shallow water the ADCP was set in bottom track mode with varying depths (and therefore ping rates).

The heading feed to the OS75 is the heading from the Seapath GPS unit.

4.3 Configuration

The OS75 was controlled using Version 1.42 of the RDI VmDas software. The OS75 ran in various modes during JR265: narrowband with bottom-tracking on and narrowband with bottom-tracking off, with different maximum depths (Table 4.1). While bottom tracking the maximum water depth was set to 800m (50 bins, each 16 metres). SSU was not used. Narrowband profiling was enabled with an 8 metre blanking distance. The 'set modes' configuration files, as described in JR195 report, were used during the cruise (see Appendix E for cue-cards).

File	Start GMT	End GMT	Feature	Command file
002	331 13:14	332 05:54	Short Fetch Study	250m BT 8m bins NotSSU
008	332 06:05	332 18:17	Deep water, test station	800m WT 16m bins NotSSU
009	332 18:17	332 22:59	Burdwood Bank	500m BT 16m bins NotSSU
010-016	332 22:59	339 16:21	SR1b deep water	800m WT 16m bins NotSSU
019	339 16:25	339 20:42	Shallow water Elephant Island	800m BT 16m bins NotSSU
020	348 01:08	348 20:38	Shallow water Livingston Island	500m BT 16m bins NotSSU
021	351 13:31	352 11:14	Shallow water Signy	500m BT 16m bins NotSSU

Table 4.1. ADCP set up modes during JR265

Reducing the maximum water depth to less than twice the actual water depth (as measured by the EA600) has two significant advantages (see JR218 report for full details). Firstly it speeds up the ping rate as the instrument spends less time waiting for echoes. The second advantage is that the instrument stops listening before it can hear double-bottom echoes (sounds that goes transducer-bottom-surface-bottom-transducer). This leads to cleaner plots of the water column velocities. Note however that if you choose a variety of maximum water depths, the files produced by the CODAS processing need a bit of tweaking before they can be appended (see step 11).

Salinity at the transducer was set to zero, and Beam 3 misalignment was set to 60.08 degrees. Data logging was stopped and restarted once a day to keep files to a manageable size for processing.

4.4 Outputs

The ADCP writes files to a network drive that is samba-mounted from the Unix system. The raw data (.ENR and .N1R) are also written to the local PC hard drive. For use in the matlab scripts the raw data saved to the PC would have to be run through the VMDas software again to create the .ENX files. 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 JRNNN_XXX_YYYYYY.ZZZ, where XXX increments each time the logging is stopped and restarted, and YYYYYY increments each time the present filesize exceeds 10 Mb. ZZZ are the filename extensions, and are of the form:-

.N1R (NMEA telegram + ADCP timestamp; ASCII)
.ENR (Beam co-ordinate single-ping data; binary). These two are the raw data, saved to both disks
.VMO (VmDas configuration; ASCII)
.NMS (Navigation and attitude; binary)
.ENS (Beam co-ordinate single-ping data + NMEA data; binary)
.LOG (Log of ADCP communication and VmDas error; ASCII)
.ENX (Earth co-ordinate single-ping data; binary). This is read by matlab processing
.STA (Earth co-ordinate short-term averaged data; binary)
.LTA (Earth co-ordinate long-term averaged data; binary).
.N1R and .ENR files are saved to the secondary file path and can be reprocessed by the software to create the above files.

4.5 CODAS/Hawaii processing.

The data were processed using the CODAS software. The processing route can be summarised as copying the raw files, converting them into a working format, merging navigation data, deriving velocities, quality control, and conversion of data to matlab and netcdf files. Calibration information can be obtained after several water and bottom-track data files have been processed; calibration can be performed at any time during the cruise or left until the end.

While the ship is steaming, the main signal that the ADCP instrument records is the ship speed. 12 knots (6 m/s) is 1-2 orders of magnitude greater than the water velocity. This velocity is removed using GPS derived ship velocities but there is clearly the potential for a significant error associated with this process as the output data is the small difference between two large numbers. To address this, the velocity of the bottom can be measured and compared directly to the GPS velocity of the ship. This should give the amplitude error for the ADCP and the misalignment with the ship heading. This only works in water where the bottom track ping can reach the sea bed – 800m or shallower. In deeper water the processing uses changes in the ship velocity to assess what proportion of the ship velocity is contaminating the calculated water velocity. This calculation necessarily invokes assumptions that the true water velocity is relatively constant in space (if slowing down) or time (if turning round) and is therefore considered less precise than bottom tracking. Similarly to JR177 and JR200 a large number of water track data were collected during JR265, from slowing down and speeding up from stations.

Table 4.2 lists the calibrations obtained from bottom-tracking or water-tracking. They are similar to calibrations found during previous cruises (Table 4.3). Each daily file was approximately 24 hours long (note that ensemble count in *out cal files does not make sense, neither does the jday range, so the time and "ncols" information in the *.nc files is recorded below). The weighted-average of the median value of the bottom track calibrations was considered most useful and was close to the weighted mean of the water track calibrations. Calibrated surface currents during the cruise are shown in Figs 4.1 and 4.2.

Water track mode average: amplitude = 1.0163   phase = -0.1674
Bottom track mode: amplitude = 1.0100   phase = -0.0218

File NNN	BT/WT	Amplitude			Phase			ncols	Start Date	End Date
		Median	Mean	s.d.	Median	Mean	s.d			
002	**BT**	**1.0079**	**1.0079**	**0.0012**	**-0.0317**	**-0.0438**	**0.0012**	**199**	**331 13:14**	**332 05:54**
002	WT	1.0080	1.0080	0.0000	-0.2930	-0.2930	0.0000	199	331 13:14	332 05:54
008	WT	1.0035	1.0035	0.0092	0.5995	0.5595	0.9694	146	332 06:05	332 18:17
009	WT	1.0115	1.0115	0.0049	-1.0435	-1.0435	0.4971	56	332 18:17	332 22:59
009	**BT**	**1.0106**	**1.0114**	**0.0025**	**0.0047**	**0.0159**	**0.0925**	**56**	**332 18:17**	**332 22:59**
010	WT	1.0060	1.0070	0.0105	-0.0740	-0.1570	0.2635	169	332 22:59	333 13:06
011	WT	1.0160	1.0163	0.0006	-0.1920	-0.1247	0.4003	347	333 13:06	334 18:04
013	WT	1.0200	1.0218	00068	-0.3150	-0.1633	0.4262	605	335 11:29	336 13:54
014	WT	1.0225	1.0210	0.009	-0.5505	-0.3187	0.6132	270	336 13:54	338 12:28
015	WT	1.0205	1.0205	0.0177	0.2355	0.2355	0.6088	282	338 12:28	339 11:59
016	WT	1.0255	1.0255	0.0007	0.4875	0.4875	1.8010	52	339 11:59	339 16:21
019	**BT**	**1.0174**	**1.0173**	**0.0013**	**-0.0124**	**-0.0272**	**0.0765**	**51**	**339 16:25**	**339 20:42**

*Table 4.2. Calibrations derived from the CODAS processing. **BT indicates bottom tracking mode**, and WT indicates water tracking.*

cruise	date	bottom/water	mean amplitude	mean angle	notes
JR276	April 2011	water	1.0179	-1.1023	CODAS processing
JR276	**April 2011**	**bottom**	**1.0116**	**-1.0564**	**CODAS processing**
JR195	Nov 2009	water	1.0155	-0.2060	CODAS processing
JR195	**Nov 2009**	**bottom**	**1.0381**	**+0.6080**	**CODAS processing**
JR200	Mar-Apr 2009	water	1.0150	-0.0876	
JR177	Jan 2008	water	1.0124	-0.0559	
JR165	Mar-Apr 2007		1.0127	-0.0078	
JR158	Feb 2007	water	1.0161	+0.1245	
JR161	**Oct-Dec 2006**	**bottom**	**1.0127**	**-0.0481**	

Table 4.3 Mean calibration results for previous cruises.

Note that this software sometimes outputs a decimal day, calculated from time in seconds since the start of the year. Decimal day is 0.5 for noon on the 1st January: this contrasts with a jday of 1.5 for noon on the 1st January.

Below is a summary of the processing steps. [UH HTML documentation in /local/users/pstar/cruise/sw/uh_adcp/programs/adcp_doc/index.html].

1) Created once at start of cruise

~/data/vmadcp/jr265_os75

~/data/vmadcp/jr265_os75/rawdata

2) For dataset NNN (eg NNN = 002),

copy raw data files (ENX, N1R, etc) from /mnt/data/cruise/jcr/current/adcp into

/local/users/pstar/jr265/data/vmadcp/jrCCC_os75/rawdata

file names like OS75_JR265NNN_000000.ENX

NNN increments each time the ADCP logging is re-started. **Data logging was stopped and started once every day.** The 000000 increments each time a new file is started, when the previous one reaches 10 Mb. All raw files are automatically transferred to /mnt/data/cruise/jcr/current/adcp (i.e. on jrlb)

3) **cd ~pstar/jr265/data/vmadcp/jr265_os75**

cshell script in /local/users/pstar/cruise/data/exec

vmadcp_movescript

redistributes raw data from rawdata to rawdataNNN; rawdataNNN is created if necessary (may need to edit movescript so that it parses the file names correctly).

4) **adcptree.py jrCCCNNNnbenx --datatype enx**

Note "nb" for narrowband ping, and that the -- datatype has two dash characters

5) **cd jrCCCNNNnbenx**

copy in a **q_py.cnt** file. Generally, you only need to edit the dbname and datadir for each **NNN**. An example q_py.cnt file is

```
# q_py.cnt is
## comments follow hash marks; this is a comment line
--yearbase 2011
--dbname jr265001nnx
--datadir /local/users/pstar/cruise/data/vmadcp/jr265_os75/rawdata001
#--datafile_glob "*.LTA"
--datafile_glob *.ENX
--instname os75
--instclass os
--datatype enx
--auto
--rotate_angle 0.0
--pingtype nb
--ducer_depth 5
#--verbose
# end of q_py.cnt
# end of q_py.cnt
```

At the start of the cruise check **yearbase**, **dbname, os75** or **os150** and datatype **enx (glob ENX)**. Dbname should be of form jrCCCNNNPTT where P is n for narrowband, b for broadband. The instrument should be operated in narrow unless there is a good reason to choose broad. TT is "nx" for ENX; "ns" for ENS; "nr" for ENR; "lt" for LTA; "st" for STA. Standard processing is to process ENX. As far as I can tell, dbname must not exceed 11 chars. So if we use 9 for jr195NNNn, there are only two left to identify ENX, ENS, LTA, STA

6) still in directory ~data/vmadcp/jr265_os75/jr265001nbenx

quick_adcp.py --cntfile q_py.cnt

("killed matlab engine" is the normal message received)**.** This takes a minute or two per 24 hours of ENX data. Note –cntfile has two dash characters

7) To see the BT (bottom track) or WT (water track) calibration, look at the ascii output of jr265001nbenx/cal/*/*out (note that a calibration is not always achieved, for example if the ship has made no manoeuvres while the ADCP is in water tracking mode, so there may be no *out file). Note also that additional calibration information maybe saved after flags applied after gautoedit process.

8) To access data in Matlab

matlab &

>> m_setup

>> codaspaths

9) Can manually clean up data by applying flags to suspected bad data cycles (this can be done post-cruise, ie omitted, go straight to step 10). This step can also be a useful first look at the data. Note that the uncalibrated files may show a slight bias in u and/or v which will appear as stripes that coincide with periods of on-station and steaming. This effect will disappear when you correct for the amplitude and phase error (step 12).

>> cd data/vmadcp/jr265_os75/jr265001nbenx/edit

>> gautoedit

Clean up data. Select day and step (typically 0.1 or 0.2 days) to view, then "show now". "show now" may have to be done twice to get the surface velocity plot. "show next" to step through the file. "Del bad times" sets "bad" flags for a section of time, or for a whole profile. "rzap" allows single bins to be flagged. Note that "list to disk" must be clicked each time for the flags to be saved.

Applying edits identified in gautoedit, The gautoedit process in Matlab sets flags, but doesn't change the data. To apply the flags and recalculate a calibration,

quick_adcp.py –-cntfile q_pyedit.cnt (note two dashes before cntfile)

where q_pyedit.cnt contains

q_pyedit.cnt is

comments follow hash marks; this is a comment line

--yearbase 2009

--steps2rerun apply_edit:navsteps:calib:matfiles

--instname os75

--auto

end of q_pyrot.cnt

10) To get data into MSTAR:

>> cd /local/users/pstar/cruise/data/vmadcp/jr265_os75/jr265NNNnbenx

>> mcod_01

produces output file

os75_jr265NNNnnx.nc

which has a collection of vars of dimensions Nx1 1xM NxM

>> mcod_02

will calculate water speed and ship speed and get all the vars onto an NxM grid. This step makes data available for comparison with LADCP data.

11) Append individual 48-hour files using

>>mcod_mapend

This script will append individual files to create a single cruise file. It does seem to depend on the files having the same bin number and bin depths which was not the case on JR265.

12) **cd /local/users/pstar/cruise/data/vmadcp/jr265_os75/jr265NNNnbenx**

In directory apply the final cal **ONLY ONCE** (adjustments are cumulative, so if this step is done twice, the cal is applied twice) when you have done the edits and applied the time-varying heading adjustment. After inspecting the cal out files, and deciding what the amplitude and phase of the calibration should be:

quick_adcp.py –-cntfile q_pyrot.cnt (note two dashes before cntfile), where q_pyrot.cnt contains:

q_pyrot.cnt is

comments follow hash marks; this is a comment line

--yearbase 2011

--rotate_angle -1.0564

--rotate_amp 1.0116

--steps2rerun rotate:navsteps:calib

--auto

end of q_pyrot.cnt

Final calibration values used were those given by the JR265 Bottom Track data.

13) In each directory re-create Matlab files:

>>cd /local/users/pstar/cruise/data/vmadcp/jr265_os75/jr265NNNnbenx

>>mcod_01

>>mcod_02

Then remove and recreate the appended matlab file:

>>cd /local/users/pstar/cruise/data/vmadcp/jr265_os75

>>!/bin/rm os75_jr265nnx_01.nc

>>mcod_mapend
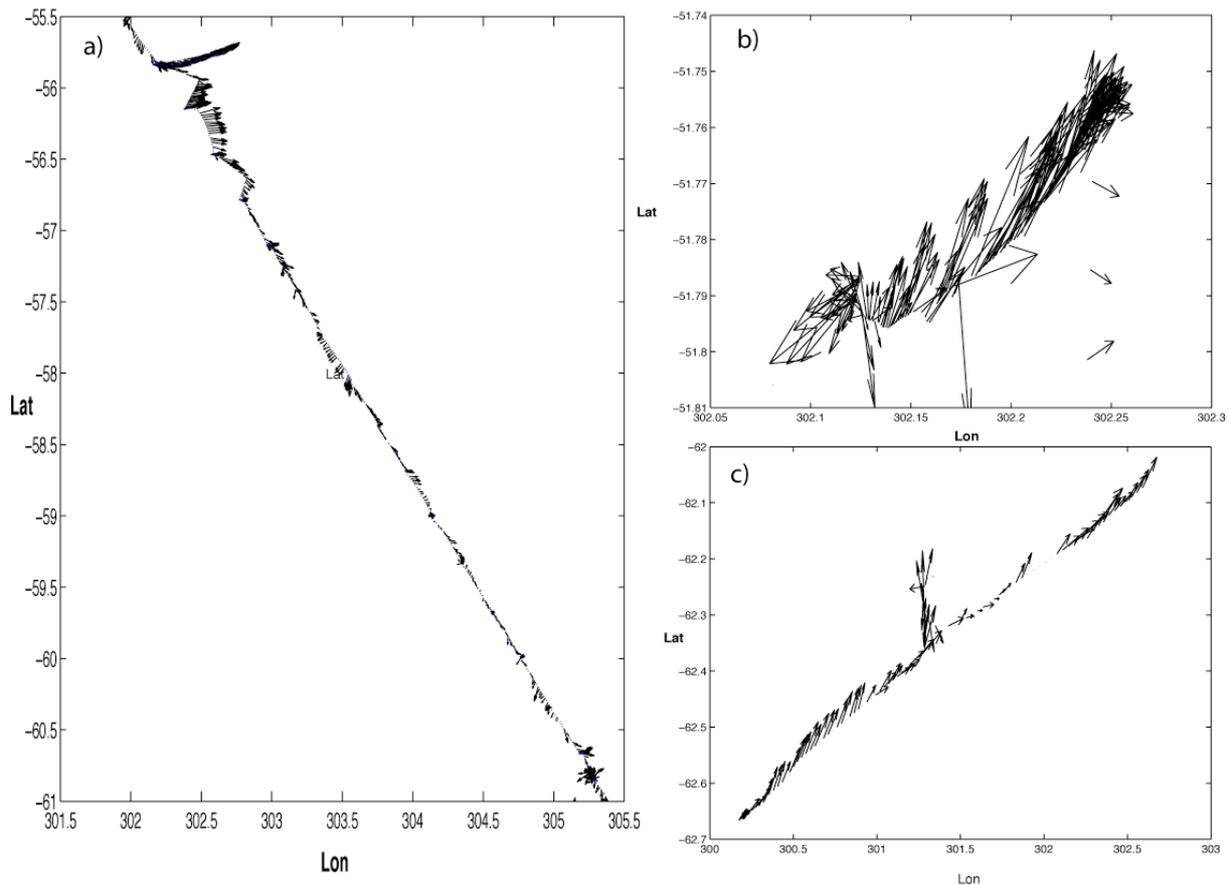
Figure 4.1. Calibrated surface currents from a) Drake Passage section, b) short fetch study (Falklands Is.) and c) Livingston Is. Note that the length of the sticks is not consistent from one plot to another.

5. SCS UNDERWAY DATA AQUISITION

Helen Snaith

5.1 Underway data acquisition using the SCS system

The underway data are logged in ascii SCS files located under:

> jr1b.jcr.nerc-bas.ac.uk:/san/datavol/data/cruise/jcr/current/scs/Compress/

which is a mounted on NOSEA2 (as /mnt/ 20111123), and linked as:

> /local/users/pstar/jr265/data/scs_raw/

The original SCS files in data/scs_raw have file extension ACO, and these files are not easily parsed as they are mixed characters with comma separation. The SCS files are cleaned up using sed scripts that run on nosea2. At the beginning of the cruise or if the sed scripts hang, type:

> unix> sedexec_stopall

> unix> sedexec_startall

This will restart all the sed scripts and create the data/scs_sed/*.ACO files from scratch from the beginning of the cruise. It will take a while to 'catch up' if parsing a whole cruise of data, but sed is very quick.

The files in data/scs_sed are versions of the ACO files with commas, colons, characters, etc removed, so they are plain numerical files that can be loaded into Matlab. To check that sed is running use:

unix> top

and watch for sed entries appearing every 10 seconds or so. If no sed is present then stop and restart the sed scripts using the commands above. Occasionally, the sed scripts will not completely clean the data, and leave behind odd characters. The data/scs_sed and data/scs_raw .ACO files cannot be edited manually without stopping and restarting the SCS logging as they are open for writing. If there are errors in the data/scs_raw files not corrected by the sed scripts, SCS logging has to be stopped, the file edited to remove offending lines, and the logging restarted.

In order to make loading subsets of files acceptably fast in Matlab, the scs_sed/*ACO files are converted to Matlab. The results are located in:

/local/users/pstar/jr265/data/scs_mat/*.mat

These files can be updated at any time in Matlab. Ensure *m_setup* has been run, then run:

matlab>>update_allmat

which will update all the mat files. It is not necessary to run this script before doing daily processing, as the scripts that access SCS files automatically run the Matlab update first.

The Underway processing covered 4 main areas:

1) Navigation (see Section 6), held in
/local/users/pstar/jr265/data/nav/seapos (data/nav/seapos)

/local/users/pstar/jr265/data/nav/gyros (data/nav/gyros)

/local/users/pstar/jr265/data/nav/ash (data/nav/ash)

/local/users/pstar/jr265/data/nav/bestnav (data/nav/bestnav)

/local/users/pstar/jr265/data/nav/tss (data/nav/tss)

2) Bathymetry (see Section 7)
/local/users/pstar/jr265/data/sim/ (data/sim)

3) Underway Meteorological Sampling (see Section 8)
local/users/pstar/jr265/data/met/surfmet/ (data/met/surfnmet)

4) Underway Temperature, Salinity, transmittance and Fluorensence (see Section 9)
/local/users/pstar/jr265/data/ocl/ (data/ocl)

The processing strategy was the same for all the underway data streams:

1) Convert SCS (.ACO) data stream to daily mstar format files [using *mday_00('instr',jday)*]
2) Perform basic cleaning of the raw daily files, removing duplicate or backward timesteps, and data outside acceptable ranges [using *m*_01(jday)* scripts]. At the end of this step, optional manual data file editing could be carried out using *mplxyed* to remove further spikes (see Appendix C.2 for more details).
3) Merge (edited) daily files with other data streams, as necessary (eg merging navigation streams or adding navigation, using *mmerge** scripts)
4) Appending merged daily files to generate single 'best' file for the entire cruise [using *mday_02('dir','instr',jday)*]
5) Carrying out final processing of cruise files

This scheme meant that the different streams could be easily scripted, either to run processing daily, or to re-run an entire stream.

Eg, *mday_00_get_all(jday)* will run *mday_00* for all instruments active on the ship and generate the daily raw files for day 'jday'.

Appendix C.1 details the daily processing schedule.

6. NAVIGATION

Helen Snaith

6.1 Instrumentation

6.1.1 Seapath system

The primary, accurate navigation system onboard the *JCR* is the Seapath 200, logged via the 'seatex' SCS data streams at 1Hz. In addition to position (seatex-gll.ACO files) the Seapath system outputs heading, in the seatex-htg file, and heave and roll via the seatex-psxn.ACO files. Unfortunately, there is no indication of which channels are which in the psxn files. Instead, the main system for measuring pitch and roll is the tsshrp system (see Section 6.1.3). The data from the Seapath system are contained in directory data/nav/seapos. Separate feeds from the Seapath system are used for the LADCP and VMADCP processing chains.

6.1.2 Ship's Gyro

The ships gyro on the bridge was logged via the SCS data stream as gyro.ACO at 1Hz. The gyro data were used to remove any large outliers in the Seapath system. The data from this system are contained in data/nav/gyros.

6.1.3 TSS Roll and Pitch

The ship has a TSS pitch and roll sensor located in the grav room, together with the Seapath pitch and roll sensors. The data from this system are contained in data/nav/tss. Early in the cruise, it was found that the copy of the tsshrp.ACO file in the data/scs_sed directory had approximately 30 corrupted lines at the top of the file. These lines prevented the file being converted to matlab format successfully. It was decided that these data were not essential during the cruise, and that the disturbance to the other underway data outweighed the benefits of stopping the logging, editing the data/scs_raw/tsshrp.ACO file and restarting the logging and sed script.

6.1.4 Ashtech

The Ashtech used to be the primary system for obtaining the most accurate measurement of the ship's heading and has been replaced by the Seapath and tsshrp systems. Data from the Ashtech were collected for completeness. The Ashtech was very unreliable on this cruise, and the heading information was regularly missing, or very inconsistent compared with the ship gyro data and so no further processing was carried out. The data from this system are held in data/nav/ash.

6.1.5 Additional Data

For completeness, the emlog data were converted to matlab, but no further processing was carried out.

6.2. Routine processing

6.2.1 SEAPATH

Data were transferred daily from the SCS system using *mday_00_get_all(JJJ)* which includes calls to:

> >> mday_00('pos',JJJ)

> >> mday_00('poshdg',JJJ)

where JJJ is the three figure jday. This generated 2 files: pos_jr265_dJJJ_raw.nc and poshdg_jr265_dJJJ_raw.nc containing the data for the jday specified in data/nav/seapos.

NB the mday_00_get_all script(JJJ) transfers the wind speed data, ocean logger, and bathymetry data as well as the navigation data streams. All these data streams are processed in a similar manner. A table showing the daily processing sequence is in Appendix C.1.

The raw pos_ daily file contain time (seconds), lat (degrees), long(degrees), inst_time (HHMM.SS), status(Blank). The raw poshdg_ daily files contain time (seconds), heading (degrees).

The data are then cleaned using the script *mday_00_clean_all(JJJ)* which calls:

> \>> mpos_01(JJJ)

> \>> mhdg_01(JJJ)

The scripts remove duplicate or backward time-steps (using *mcalc* to generate a monotonic flag, and *mdatpik* to remove data where flag <0.5 or >1.5), and only retain data within valid ranges: -90°<=lat<=90°, -180°<=long<=180° or 0°<= heading<=360° (setting data out of range to default values with *medita*). The Seapath heading variable in the _raw file is renamed head_pos.

Files called pos_jr265_dJJJ.nc and poshdg_jr265_dJJJ.nc are created, holding the cleaned data. These files are copied to versions with the suffix '_edit', which can be used by *mplxyed* to manually remove any remaining spikes or dubious data, after inspection (see Appendix C.2). This was not deemed necessary for any of the jr265 files. If changed during editing, the pos_jr265_dJJJ_edit.nc and poshdg_jr265_d265_edit.nc files must be copied to pos_jr265_dJJJ.nc and pos_jr265_dJJJ.nc. e.g.

> \>>copyfile('pos_jr265_d334_edit.nc','pos_jr265_d334.nc','f')

The _edit files can be retained as backups to resume later processing from.

6.2.2 GYRO

Data are imported from the SCS using *mday_00('gyr',JJJ)* (called from within *mday_00_get_all(JJJ)*), to produce files called gyr_jr265_dJJJ_raw.nc in data/nav/gyros.

These data are then cleaned using an identical process to that used for the Seapath heading data, using *mgyr_01(JJJ)* (called by *mday_00_clean_all(JJJ)*) with the gyro heading variable renamed head_gyr.

As for the Seapath data, an _edit version of the files is saved, for manual editing using *mplxyed* if necessary, to be copied to gyr_jr265_dJJJ.nc once editing is complete.

6.2.3 SEAPATH and GYRO

The cleaned Seapath heading and gyro data are merged onto the Seapath position data and then the pos-gyro heading difference is constructed to allow further data cleaning using:

> \>> mmerge_pos_gyr

In this script, *medita* is used to set head_pos to a default value where the Seapath and gyro headings differed by more than 5°. Only a very small number of points were removed in this process. To reduce noise, the data are averaged to 30 s prior to generating the pos-gyro difference.

The merged data are generated in file pos_jr265_dJJJ.nc (overwriting previous file) and a copy held in pos_jr265_dJJJ_mrg.nc as a backup.

Once converted to mstar format ash_jr265_dJJJ_raw.nc files using *mday_00('ash',JJJ)*, called from *mday_00_get_all(JJJ)*, the 1 Hz data were cleaned using *mash_01(JJJ)*, called from *mday_00_clean_all(JJJ)*, to give ash_jr265_dJJJ.nc files, copied to ash_jr265_dJJJ_edit.nc for manual cleaning with *mplxyed*. Within the script, the heading variable in the raw file was renamed as head_ash, backward and duplicate times were removed using *mcalc* and *mdatpik*, and the following ranges were used to set out of range values to default values (*medita*):

Ash	0<heading<360
Pitch	-5<pitch<5
Roll	-7<roll<7
Measurement RMS error:	$10^{-4} < mrms < 0.01,$
Baseline RMS error	$10^{-4} < brms < 0.1$

Consistent with the Seapath processing, the Ashtech data were merged with the cleaned daily ship's gyro data, using *mmerge_ash_gyr(JJJ)*. Within this script, all data were set to default if the absolute calculated difference between the Ashtech and Gyro headings was more than 5˚. As the cruise progressed, this accounted for large portions of the data, and processing was not taken any further.

6.3 Generating BestNav file

Having generated a series of 1Hz daily cleaned and merged position files, a single 'cruise long' 1 Hz file was generated by appending all the daily pos_jr265_dJJJ.nc files using:

>>mday_02('M_POS','pos',JJJ)

creating or updating file pos_jr265_01.nc.

Using the scripts *mbest_01*, *mbest_02*, *mbest_03* and *mbest_04* (which can be run together using *mbest_all*) this file is processed to generate file bst_jr265_01.nc in directory nav/bestnav.

>>mbest_01 – extracts the 30 second average positions from pos_jr265_01 -> pos_jr265_ave.nc

>>mbest_02 – calculates the speed, course and distance run from the 30 s average positions -> pos_jr265_spd.nc

>>mbest_03 – generates a 30 s heading file from the 1Hz gyro headings -> gyr_jr265_ave.nc

>>mbest_04 – merges the averages headings onto the speed, course an distance run to generate the bestnav file -> bst_jr065_01.nc

6.4 Summary

No problems were encountered with the Seapath or gyro Navigation systems during the cruise. The Ashtech data proved very unreliable, particularly in terms of heading, and were not processed beyond simple generation of raw and cleaned daily files.

7. ECHO SOUNDER BATHYMETRY

Helen Snaith

Bathymetry data are measured every 2 seconds by a Kongsberg EA600 single beam echo sounder and are processed daily using the basic procedure outline in Section 5.1.

Specifically, the data are transferred from the SCS system to MSTAR format using the MSTAR routine:

>>mday_00('sim',JJJ)

run as part of the from *mday_00_get_all(JJJ)*, where JJJ is the three figure jday, as part of the daily processing (see Appendix C.1). A file sim_jr265_dJJJ_raw.nc containing the data for the jday specified was created in sim.

The raw daily file contains; time (seconds), depth (feet), depth (m) and depth (fathoms). These raw files are cleaned using:

>>msim_01(JJJ)

called from *mday_clean_all(JJJ)*, which performs basic cleaning of the data. The script removes any data with duplicate times or backward timesteps (using *mcalc* to generate a monotonic flag and *datpik* to select valid flagged data). The script then sets depths outside the range of 5m to 100km to absent data using *medita*. A version of the de-spiked 2s values was saved as sim_jr265_dJJJ_despike.nc. As the data were often very noisy, the cleaning script then reduced the data to 30 s median values, and output file sim_jr265_dJJJ was copied to sim_jr265_dJJJ_smooth.nc for possible further editing using

>>mplxyed

Using mplxyed, the daily _smooth data file was plotted and any outliers were interactively selected and set to absent data values. This is described in detail in Appendix C.2. NOTE: only the depth in meters has been edited.

During periods when the NOC-L team were deploying and recovering Bottom Pressure Recorders (BPR) the EA600 was put in passive mode. This is to prevent the EA600 interfering with the release signal set to the BPR. In passive mode the data logged by the SCS system uses the signal from the EM122 swath bathymetry, when it is active, and is obviously noisy and should be removed using mplxyed. After plotting/cleaning the sim_jr265_dJJJ_smooth.nc files must be copied to sim_jr265_dJJJ.nc. e.g.

>>copyfile('sim_jr265_d334_smooth.nc','sims_jr265_d334.nc','f')

The daily position data from the Seapath system were merged on the bathymetry data and the corrected depths calculated from the carter tables using *mmerge_sim_nav*. This step must be done after the Seapath file has been cleaned. Refer to the daily processing table (Appendix C.1).

>> mmerge_sim_nav

The daily merged files are then appended using *mday_02('M_SIM','sim',JJJ)*, run as part of *mday_02_run_all(JJJ)*.

To reset all the files at a particular level, to rerun processing from a specific point, e.g. to use a new navigation file in *mmerge_sim_nav*, from the unix command type:

unix>> foreach file (sim_jr265_d???.nc)

> cp ${file:r}_smooth.nc $file

>end

similarly for resetting to the raw values, use cp ${file:r}_raw.nc $file.

The depth vs latitude, with station locations, is shown in Figure 7.1.

The EA600 was very noisy, and did not provide accurate depth readings for much of the cruise. The data were particularly noisy when underway, presumably as detection of the single beam is sensitive to ship movement. For much of the cruise, the EA600 was over-reading by up to 50 m, when compared to the altimeter readings during CTD cast, especially during the deeper casts.

However, on at least one occasion (station 027) the EA600 was under-reading by more than 100m.
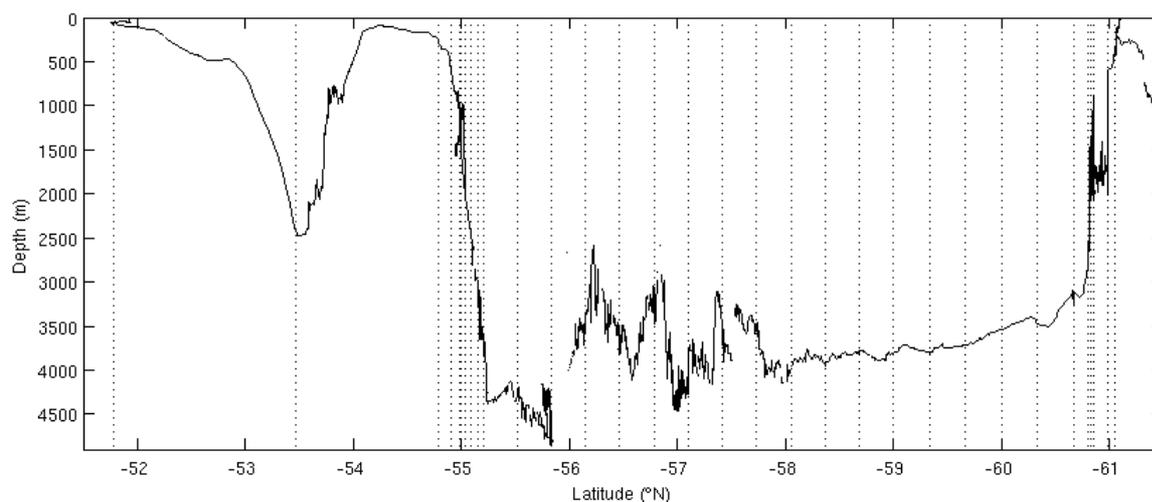
Figure 7.1 Depth profile vs latitude. Actual CTD station locations are marked.

8. SURFACE METEOROLOGICAL SAMPLING SYSTEM

Helen Snaith

8.1 Introduction

The surface meteorological conditions were measured throughout the cruise. A brief discussion of the performance of the meteorological sensors is given in this section. All times refer to GMT.

8.2 Instrumentation

The RRS *James Clark Ross* was instrumented with a variety of meteorological sensors to measure; air temperature and humidity, atmospheric pressure, short wave radiation (TIR), photosyntheticly active radiation (PAR) and wind speed and direction. These are logged as part the 'oceanlogger' at 5 second intervals, and 'met' systems at 2 second intervals. The oceanlogger also recorded the underway salinity and sea surface temperature. These data will be discussed separately in Section 9.

The meteorological instruments were mounted on the ship's foremast (Figure 8.1) in order to obtain the best exposure. The estimated heights of the instruments above the foremast platform were: Sonic anemometer, 0.65 m; air temperature and humidity 0.25 m and the irradiance sensors 0.2 m. The barometers were located in the ocean logger display cabinet in the UIC.
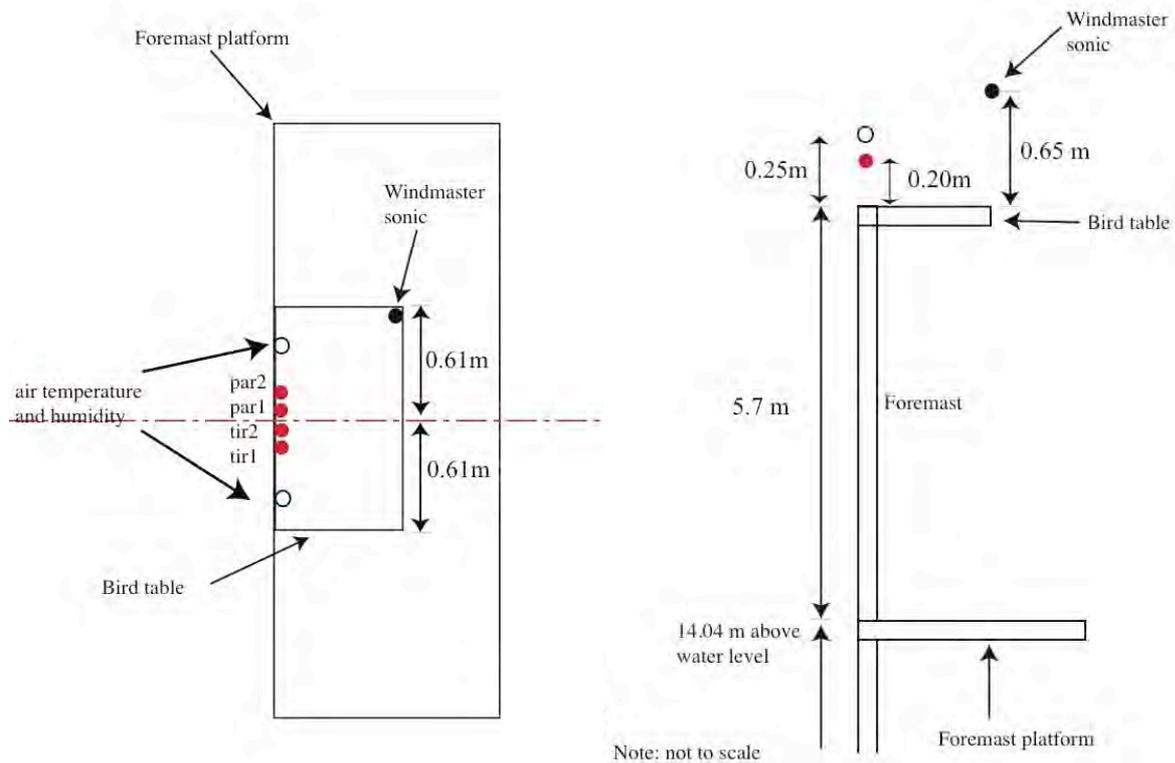
Figure 8.1 Schematic of the sensor positions on the foremast: left - plan view; right - side view.

Instrument	Serial number on cal sheet	Sensor position	Parameter	specified accuracy	Last calibration
Rotronic HC2-S3	0060599556	foremast	Airtemp1	±0.3°C	16/3/2011
			Humidity1	±1.0%	16/3/2011
Rotronic HC2-S3	0060599558	foremast	Airtemp2	±0.3°C	16/3/2011
			Humidity2	±1.0%	16/3/2011
Kipp and Zonen SP PAR Lite (400 – 700nm)	110126	foremast port side	Par1	±2%	5/1/2011
Kipp and Zonen SP PAR Lite (400 – 700nm)	110127	foremast port side	Par2	±2%	5/1/2011
Kipp and Zonen SP Lite2 (335 to 2200nm)	004742 112992	foremast starboard side	Tir1	±0.14μV/W/m^2	26/1/2011
Kipp and Zonen SP Lite (335 to 2200nm)	004742 112993	foremast starboard side	Tir2	±0.14μV/W/m^2	26/1/2011
Vaisala PTB210	V145002	UIC In ocean logger cabinet	baro1	±0.01 Hpa	10/4/2000
Vaisala PTB210	V145003	UIC In ocean logger cabinet	baro2	±0.01 Hpa	10/4/2000
Windmaste sonic anemometer	No information	Foremast	Wind speed	1.5%	N/A
			Direction	2 to 4°	N/A

Table 8.1 Meteorological instrument properties.

8.3 Routine processing

The data were routinely processed according to the underway method outlined in Section 5 - please refer to Appendix C.1 for the daily processing guide.

The data were transferred from SCS to mstar files using

> matlab>>mday_00('met',JJJ)

called by *mday_00_get_all*(*JJJ*).

The raw calibrated wind speed data files were located on NOSEA2 under:

> surfmet/met_jr265_dJJJ_raw.nc

where JJJ represents the day number.

The raw data were cleaned to remove backward and repeated timesteps (*mcalc* and *mdatpik*), using *mmet_01(JJJ)*, called from *mday_clean_all.* The script also set all data outside the following ranges to absent (using *medita*):

> Air temperature: -50 to 50 ˚C
>
> Humidity: 0.1 to 110 %
>
> TIR: -50 to 1500
>
> PAR: 0.0001 to 50

These values are set in the mmet_01.m script, found in /local/users/pstar/cruise/data/mexec_processing_scripts, which can be edited using

> matlab>>edit mmet_01.m

The daily data files (met_jr265_dJJJ.nc) were also copied to met_jr265_dJJJ_edit.nc. The _edit files were interactively edited using *mplxyed* (see Appendix C.2) to remove outliers. The clean _edit files were then copied to use for further processing using.

> matlab>>copyfile('met_jc031_dJJJ_edit.nc','met_jc031_dJJJ.nc',f)

These files were then appended together using *mday_02('M_MET','met',JJJ)*, called from *mday_02_run_all(JJJ),* to generate a single cruise met file called met_jr265_01.nc

NB Before further data processing, the daily navigation file pos_jr265_01.nc must exist and be up to date and the bestnav navigation file must be up to date and include all navigation data covering the time period of the met data (see Section 6). See Appendix C.1 for the daily processing schedule.

Once the basic processing has been carried out, running:

> matlab>>mtruew_01

calculates the true wind speed and direction for 2 minutes averages over the cruise duration. The wind direction is defined as the direction the wind is going to, rather the meteorological convention of direction coming from.

Figure 8.2 gives the time series of the 2 minute average meteorological data. Only the basic quality control criteria described above have been applied to these data. Each page contains five plots showing different variables over a four or five day period.
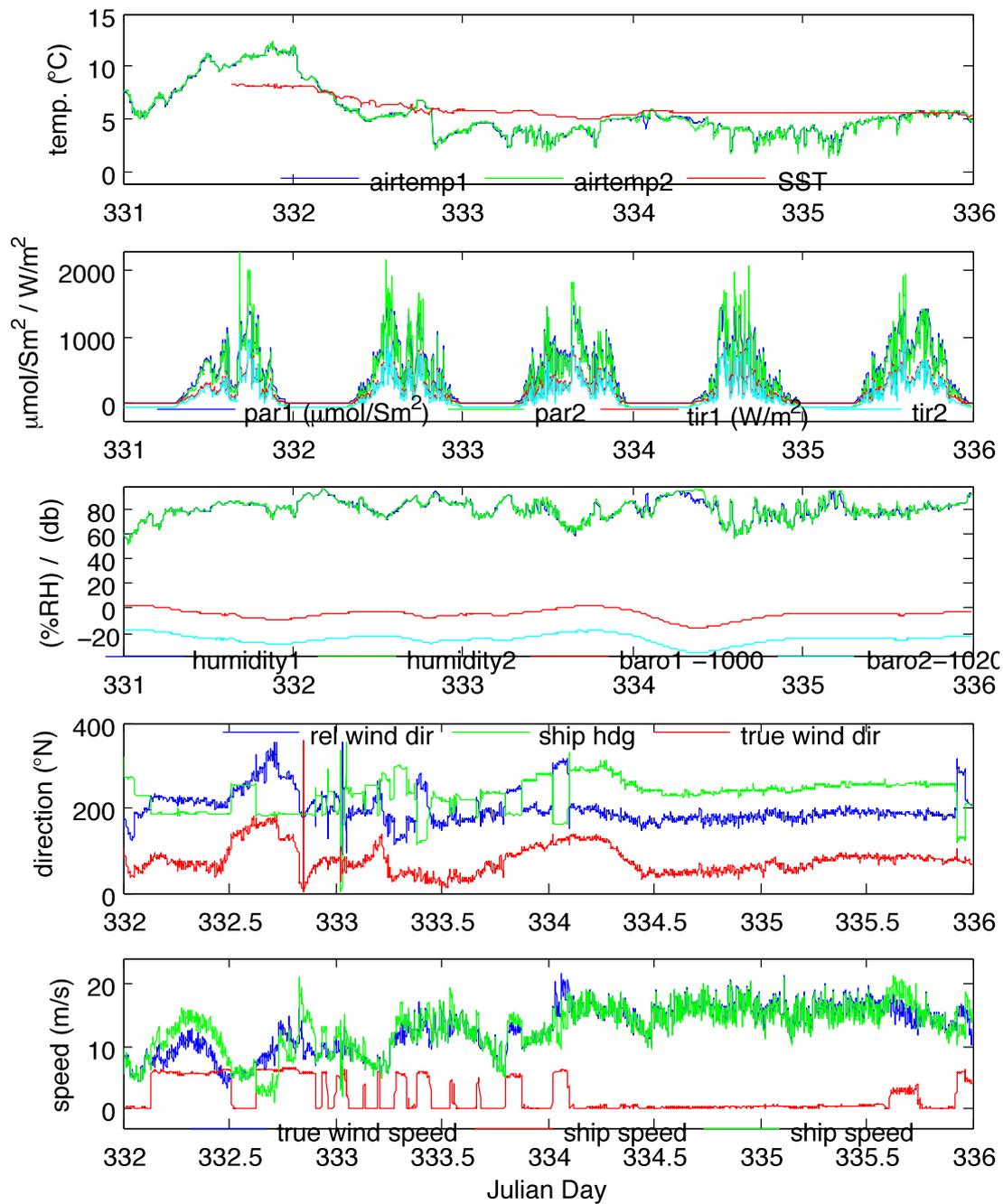
Figure 8.2.a Meteorological data for days 331 to 336. Top panel - air temperatures and sea surface temperature. Upper middle panel - downwelling radiation from the two shortwave TIR and PAR sensors. Central middle panel – Atmospheric humidity and atmospheric pressure (pressure offset). Lower middle panel – relative wind direction (reldd = 180 degrees for a wind onto the bow) and true wind direction. Note: the wind direction is degrees to, not the usual convention of degrees from. The ship' s heading is also shown. Bottom panel – relative and true wind speeds in m/s from the anemometer. The ship's speed over the ground is also shown in m/s.
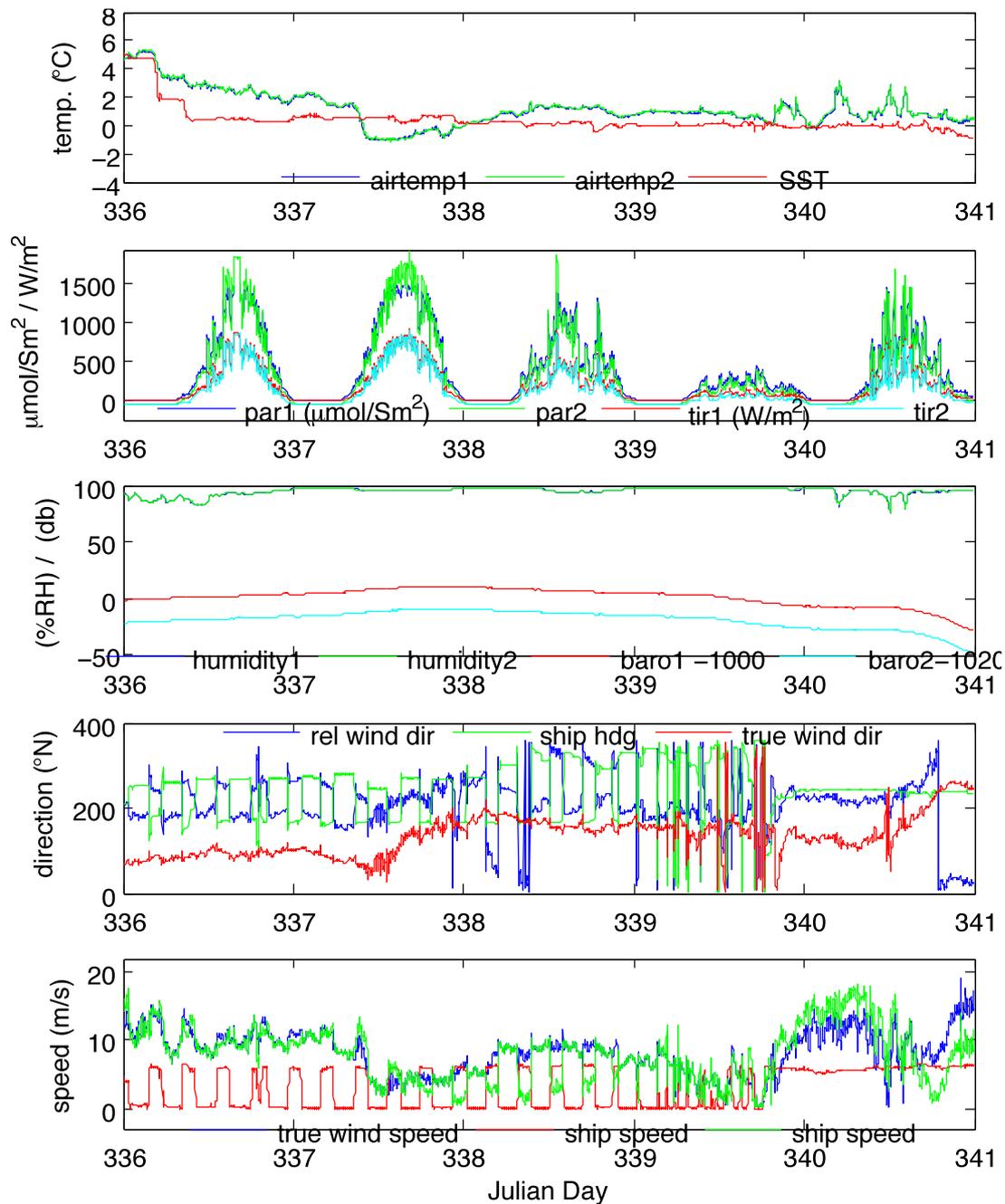
Figure 8.2.b Same plots as in figure 8.2.a, for days 336-340.

8.4 Sensor performance

Air temperature and humidity: Two air temperature and humidity sensors were located on the bird table at the top of the foremast platform.

    matlab>>ocl_jr265_diff

will produce the differences between pairs of instruments. The script produces ocl_jr265_01_diff.nc and only selects night-time air temperatures in ocl_jr265_01_air_night.nc. Night time air temperatures are used to remove any heating effects of the ship from the comparison. Night time is defined as a TIR value <0 W/m^2.

Figure 8.3 shows that the difference between humidity sensors. The mean offset for humidity <70% is -0.15%, with a st. dev. of 0.34% (range -3.3 to 2.0%). For higher humidities the

difference between the two sensors becomes much more variable, with a total range of -11 to +15%, but the mean offset is still only -0.2%, with a st. dev. of 1.14%
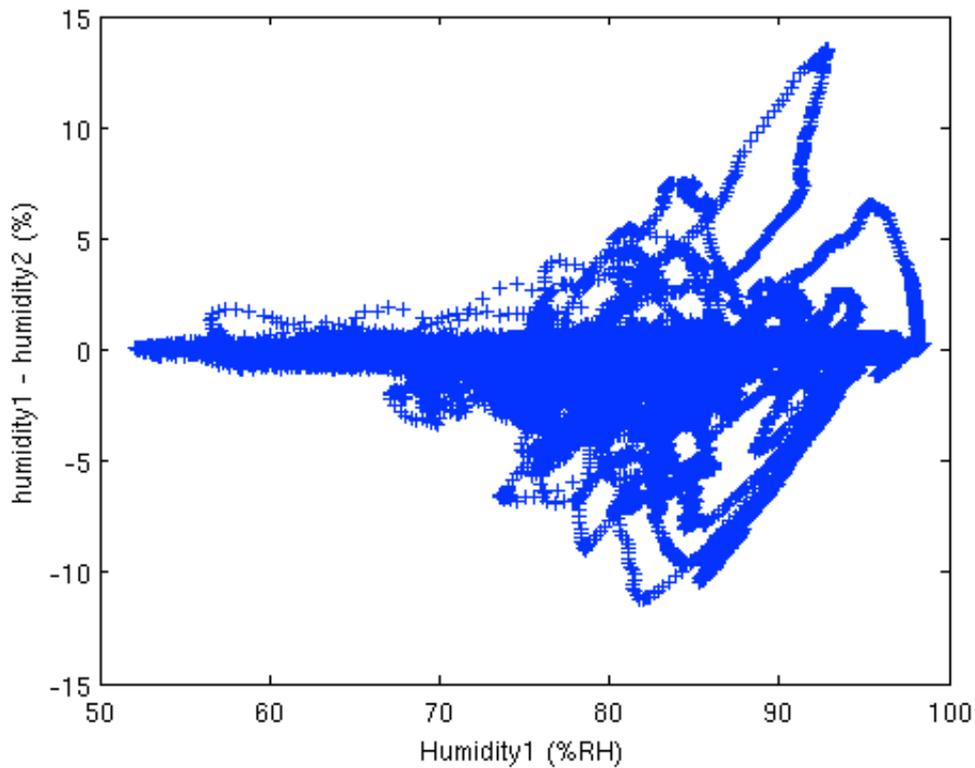
Figure 8.3 The difference between the humidity sensors
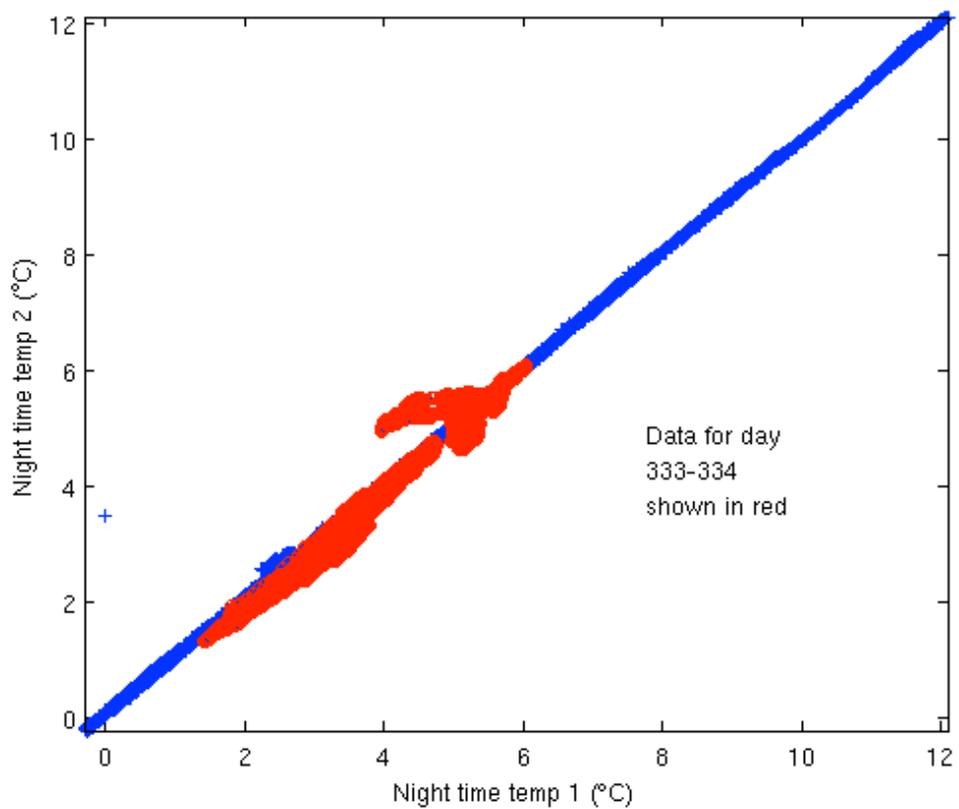
Figure 8.4 Airtemp2 vs Airtemp1 (night-time temperatures only). Data for days 333 & 334, with slightly higher difference, are highlighted in red.
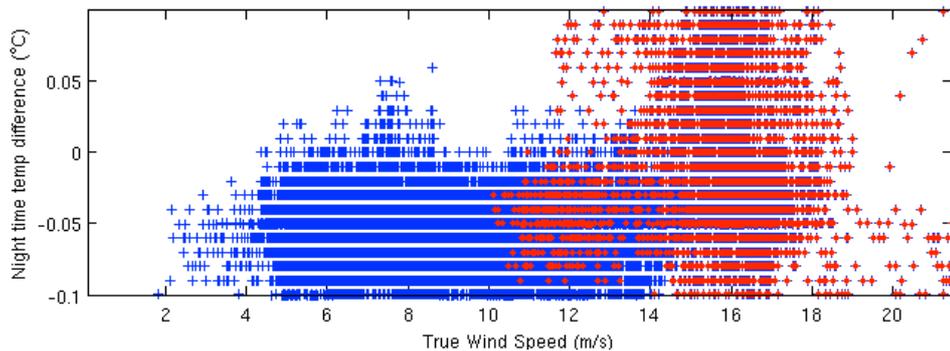
Figure 8.5 difference in night-time air temperatures against true wind speed. Data for days 333 & 334, with slightly higher difference, are highlighted in red.

Throughout the cruise, airtemp2 measured consistently higher than airtemp1, with the mean night-time temp difference being -0.05˚C (airtemp1-airtemp2), and a st. dev. of 0.03˚C. During jday 333 and 334, the offset decreased to -0.008˚C, with an increase in the st. dev. to 0.05˚C. Figure 8.4 shows the relationship of night-time temperature from sensor 1 and sensor 2, with the jday 333/334 data highlighted in red. These data were collected during a period of higher wind speeds, as shown in Figure 8.5.

Wind speed and direction: The windmaster sonic anemometer was located on the bird table. Only data from one anemometer was logged by the ship system so no comparisons with other anemometers were made. There were no obvious instrument problems during the cruise. A comparison with the AutoFlux anemometer mounted on the foremast platform will be made in the WAGES JR254D cruise report (Yelland, 2012a)

TIR and PAR sensors: The ship carried two total irradiance sensors TIR1 and TIR2 on the bird table. These measure downwelling radiation in the wavelength ranges given in Table 8.1. The mean difference between the two sensors was 6.5 W/m^2 (TIR2 higher than TIR1) with a st. dev. of almost 10 W/m^2. During darkness, both the TIR sensors had a very small -0.5 W/m^2 offset. In addition to the TIR sensors the ship carried two PAR sensors, which measured downwelling radiation. The mean difference between the two PAR sensors was 2.5 W/m^2 (PAR1 higher than PAR2), std.dev.=7.5.

9. UNDERWAY TEMPERATURE AND SALINITY

Helen Snaith

9.1 Introduction

Near surface oceanographic parameters were measured by sensors located on the non-toxic supply. These included a Fluorometer which measures fluorescence and a SBE45 thermosalinograph (TSG) measuring conductivity and water temperature at the point it reaches the instrument. The TSG (S/N 0016) was replaced before the beginning of the cruise and the new unit (S/N 0130) had a replacement conductivity cell at its last calibration (23 July 2010). The salinity was calculated in real time using the SBE45 housing temperature and conductivity measurements. The sea surface temperature (SST) was measured by a PRT100 temperature sensor located close to the non-toxic supply intake on the hull at a depth of 6 m. See Table 9.1 for serial numbers etc. The SST and salinity are recorded in the oceanlogger file, see Appendix C.1 for routine processing. This section describes the calibration of the underway temperature

(Section 9.3) and salinity (Section 9.4) measurements using underway bottle measurements of salinity, and SST and salinity measurements from the near-surface CTD data (Section 9.2).

Instrument	Serial number	Last Calibration	Sensor position	Parameter
Remote temperature SST	PRT100 RS 455-4056	Pre-2008	Near intake	Sea surface temperature
10-AU Fluorometer	No serial number visible	pre-2000	prep lab	Fluorescence
SBE45 Micro TSG	4538936-0130	23 July 2010	prep lab	conductivity temperature
Wet Labs C-Star Transmissometer	088249	27/08/2009	prep lab	transmissivity
Flow Meter O5SPFA4O	05/81r9	13/6/2011	prep lab	flow rate

Table 9.1: Underway SST, salinity and other flow instrument details.

9.2 Selecting surface CTD data

SST and salinity measurements were selected at 5 and 7 dbar from each of the 2db average CTD file. NB: for some stations carried out during heavy seas (10, 11 and 12), the CTD started down from 10 or 12m and there are no surface data. The surface data were accessed using the script:

matlab>>mctd_05

Which generates files called ctd_jr265_NNN_surf.nc in directory data/ocl/ (where NNN is the station number).
NB if you have a data from number of stations to read in, ctd_05 can be run in a loop e.g.

matlab>>for stn=1:30, ctd_05; end

Now we need to create one file of data so we append them together using:

matlab>> ('ctd_jr265_surf_01', 'ctd_jr265_surf', 'f', 'ctd_surf_files', '/', '/')

The output file is called ctd_jr265_surf_01, and a list of input files (in time order) was generated using:

ls -1 ctd_jr265_9*_surf.nc > ctd_surf_files

ls -1 ctd_jr265_0*_surf.nc >> ctd_surf_files

Next we create a 2minute average file of the underway data using.

>>mavrge('ocl_jr265_01','ocl_jr265_01_2minav','/','time','28512001 29375998 120','/')

Where the start and end times are taken from the times in the ocl_jr265_01 file.
Then merge the 2 minute averages onto the ctd_jr265_surf_01 file using

>>mmerge('ocl_jr265_001_merge', 'ctd_jr265_surf_01','time press temp temp2 psal psal2','time', 'ocl_jr265_01_2minav','time','sstemp tstemp conductivity salinity','k');

This gives file ocl_jr265_001_merge.nc, containing all the coincident surface temperature, conductivity and salinity data from the CTD and the TSG.

9.3 Calibration of underway sea surface temperature

The SST measurements were compared to the surface temperature measurements from the primary (temp) and secondary (temp1) sensors on the CTD frame. Figure 9.1 shows that the remote TSG temperature underestimates the CTD measurements by around 0.15 ˚C. The offset was represented by the following linear regression:

offset = 0.144 - 3.455e-08 x time

The calibration has not been applied to the data.
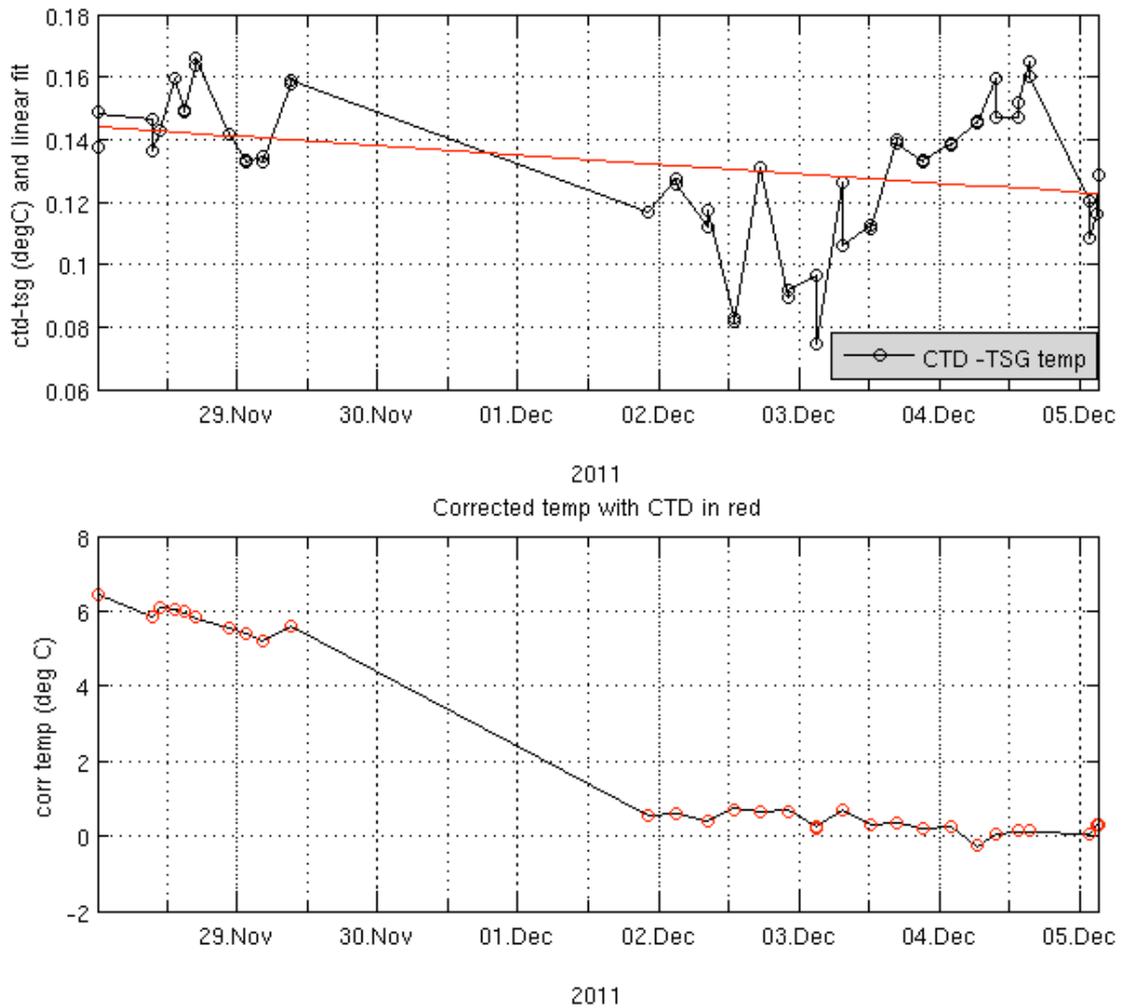
Figure 9.1 TSG remote temperature vs CTD surface temperature measurements

9.4 Calibration of underway salinity data

9.4.1 Introduction

There are two sources of independent salinity data to calibrate the underway salinity data measured by the SBE45; 1) salinity samples collected from the non-toxic water supply outflow, and 2) the surface salinities measured from near surface CTD. We have used salinity samples to provide the primary calibration method for the TSG salinity, and the CTD comparison has been used to check the resultant corrected salinity values.

Water samples were collected approximately every 4 hours during the section. Water was taken from the clear white non-toxic supply pipe that feeds the underway sensors in the prep lab. The sample bottles were filled to half-way up the shoulder and the necks were wiped dry to prevent salt crystallisation at the bottle opening. The bottles were closed using airtight single-use plastic inserts and secured with the original bottle caps, just as done for CTD salinity samples. The samples were stored in open crates and left beside the salinometer in the bio lab for a minimum of 24 hours before analysis. This allowed their temperature to adjust to the ambient temperature of the laboratory. A total of 38 TSG samples were taken over the duration of the cruise.

Using the surface salinity values from the near surface CTD casts (see Section 9.2), we were able to carry out a secondary check on the TSG salinity values. In total 29 out of the 32 stations were used in the analysis. The uncorrected surface salinities from the CTD were used in this analysis. This is believed to be acceptable as the usual correction to be applied to the measured surface

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CTD salinities will be of the order 0.01, whereas the correction for the SBE45 will be of the order 0.1.

The merged underway salinity and the CTD values are contained in the file created in Section 9.2 (ocl_jr265_001_merge.nc). Prior to calibration with the sample data, the TSG salinity already has a small difference with the uncalibrated CTD salinity. For the two CTD conductivity cells, the regressions give:

$$Sal_{TSG} = Sal_{CTD1} - 0.005153 + 7.557e\text{-}09 \text{ x time}$$

$$Sal_{TSG} = Sal_{CTD2} + 0.001938 + 1.097e\text{-}08 \text{ x time}$$

And the standard deviation of the residuals to the Primary CTD salinity is only 0.0021.

9.4.2 Calculating sample salinity

The conductivity ratio of each sample was measured by the Autosal salinometer (Section 11). The conductivity ratios were recorded and salinity was calculated using a Microsoft Excel 95 spreadsheet, along with the date and time of collection. The measured salinities of the samples were transferred to text files using matlab script

    convert_tsg_ascii2

NB this script will not work with excel 98 format files, and looks for file names including 'TSG'. The script expects the excel file to have 9 'header' lines (for SSW measurements and offsets etc) followed by up to 24 rows corresponding to bottles, with salinity in column 4, the first column being a non-numeric bottle number (eg1-1, B1) and the jday in column 9 – see table 9.1 for an example file. If the 'sample no' column is entered as numeric values (eg 1, 2, 3) the script will need to be edited. Any unused bottles should have a blank value entered for Salinity.

K15 label	0.99997	<Label Std			0.0005	-0.0056	-0.0066	-0.0375	0.0636	-0.0144
K15 * 2	1.99994	<Label * 2			0.0162					
SSW meas	1.99994	<Measured Std								
Scorr	0.00000	<Correction		stndby start	6091	stndby end	6090	Rs =	5.7	
				zero start	-0.0001	zero end	-0.00015			
				lab tmp start	23	lab temp end	22			
Sample Data:	Crate 1									
Samp No	Bath Temp	G Ratio	Salinity	Rt	Sal 1	Sal 2	CTD stn	jday		
4-1	24	1.93486	33.7218	0.967430	33.7281	-0.0063	TSG	336.5576389		
4-2	24	1.93585	33.7412	0.967925	33.7474	-0.0062	TSG	336.76875		

Table 9.1: example TSG salinity calculation excel file

The output .csv file was then converted to MSTAR format, and the dates and times were converted into seconds since midnight on 1st January 2011, using

    >>mtsg_01_jr265

To give files called botsal_tsg_jr265_cNN.nc, where NN is a sequential file number.

These files are the appended, using *mapend* to give a single botsal_tsg_jr265_01.nc file containing all the TSG sample values.

9.4.3 Calibration of Underway salinity with bottle samples

The calibration of the TSG salinity is carried out via the conductivity. The difference between the underway bottles and the TSG values are calculated using:

>>mtsg_02_jr265

which merges the 2min average files calculated in Section 9.2 (ocl_jr265_01_2minav.nc) with the botsal_tsg_jr265_01.nc file. The scripts then calculates the bottle conductivity at the temperature of the TSG sample, and calculates the difference between the TSG and bottle conductivities, only retaining values where the conductivity difference is less than .02 S/m. NB, only one point was rejected by this test, from the region of the strongest salinity gradient.

matlab>> mtsg_03_jr265

can then be used to calculate the calibration required for the TSG conductivity. This was determined as:

$$Cond_{TSG} = Cond_{bottle} + 0.008189 -2.896e-10 \text{ x time}$$

The conductivity calibration was then applied to the cruise TSG data (file ocl_jr265_01.nc) using:

matlab>> mtsg_04

To give final, calibrated values in ocl_jr265_01_cal.nc, and 10 minute averaged values in ocl_jr265_01_cal_av.nc.

9.5 Residuals

The initial bottle – TSG conductivity residuals had a std dev of 0.00018 S/m, reducing to 0.00017 after calibration. Figure 9.2 shows that the SBE45 conductivity and sample bottle conductivity, and conductivity residuals before and after calibration.
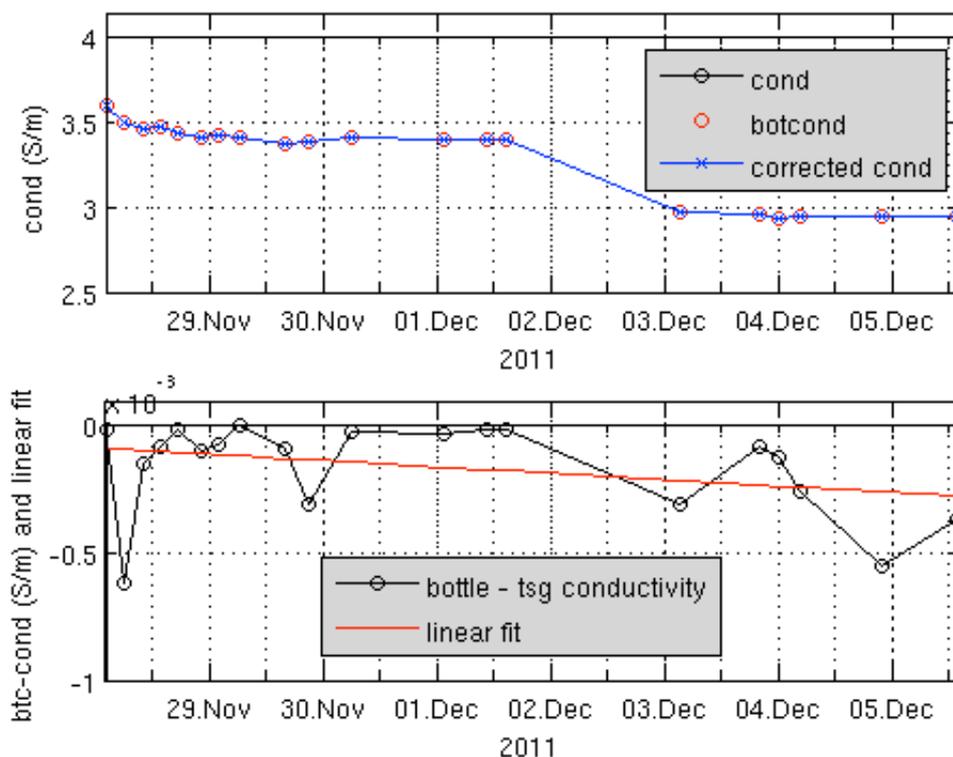
Figure 9.2 Bottle and TSG Conductivity, with conductivity differences. Note y-axis on lower plot is 10^{-3}.

In terms of salinity, the initial difference between the bottle and TSG salinity had a regression of:

$$Sal_{TSG} = Sal_{bottle} + 0.1211 - 4.266e\text{-}09 \text{ x time}$$

with an rms difference of 0.0022. After calibration of the conductivity, and recalculation of the salinity, the rms dropped marginally to 0.0019, but the regression of TSG salinity against bottle data is improved significantly to give:

$$Sal_{TSG} = Sal_{bottle} + 0.\ 005197 - 1.817e\text{-}10 \text{ x time}$$

Figure 9.3 shows the effect of the conductivity calibration on the salinity differences when compared to bottle salinity values.
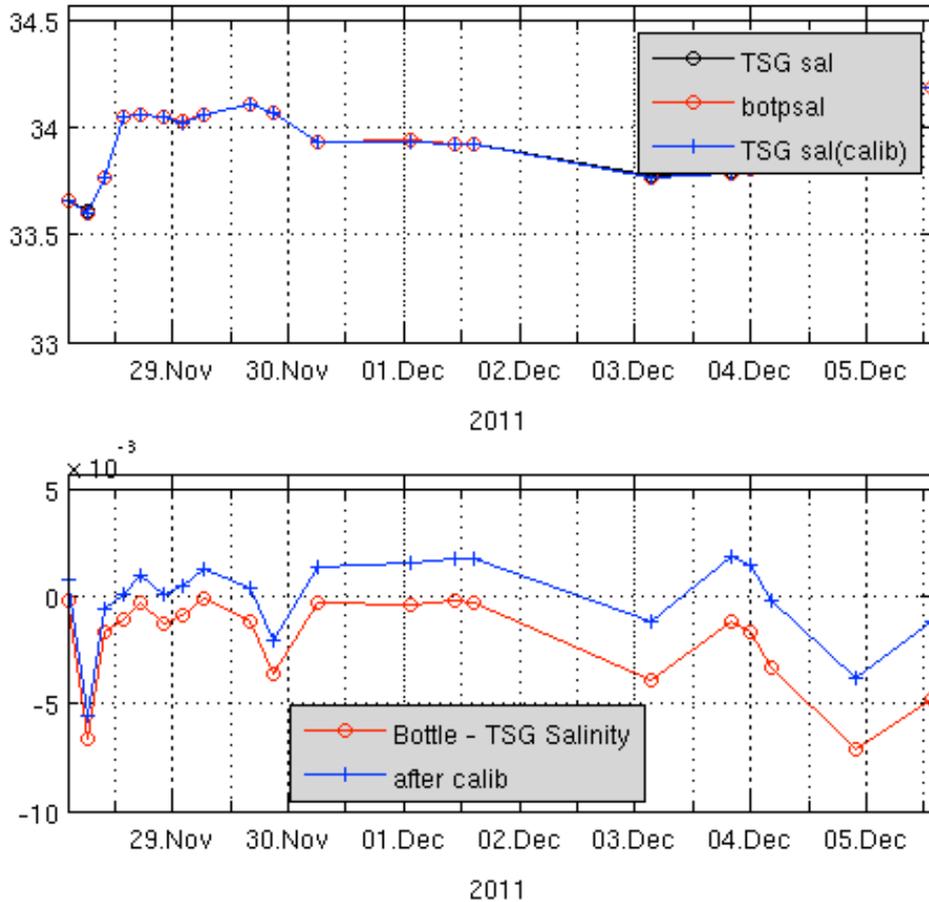
Figure 9.3 Bottle and TSG Salinity (before and after conductivity calibration), with salinity differences. Note y-axis on lower plot is 10^{-3}.

As an independent check on the calibration, the TSG salinities were also compared to the surface CTD salinities, as generated in Section 9.2 above. After the TSG salinity data were re-calculated from the calibrated conductivity values, they were merged onto the surface CTD data and onto the sample bottle data, and the residuals calculated. The results are shown in Figure 9.4. The difference between the uncalibrated salinity values for the two sensors on the CTD is seen to be greater than the difference between the surface CTD values and the TSG values. The rms of the residuals are: 0.004 ($Sal_{CTD1} - Sal_{TSG}$), 0007 ($Sal_{CTD2} - Sal_{TSG}$) and 0.006 ($Sal_{BOTTLE} - Sal_{TSG}$)
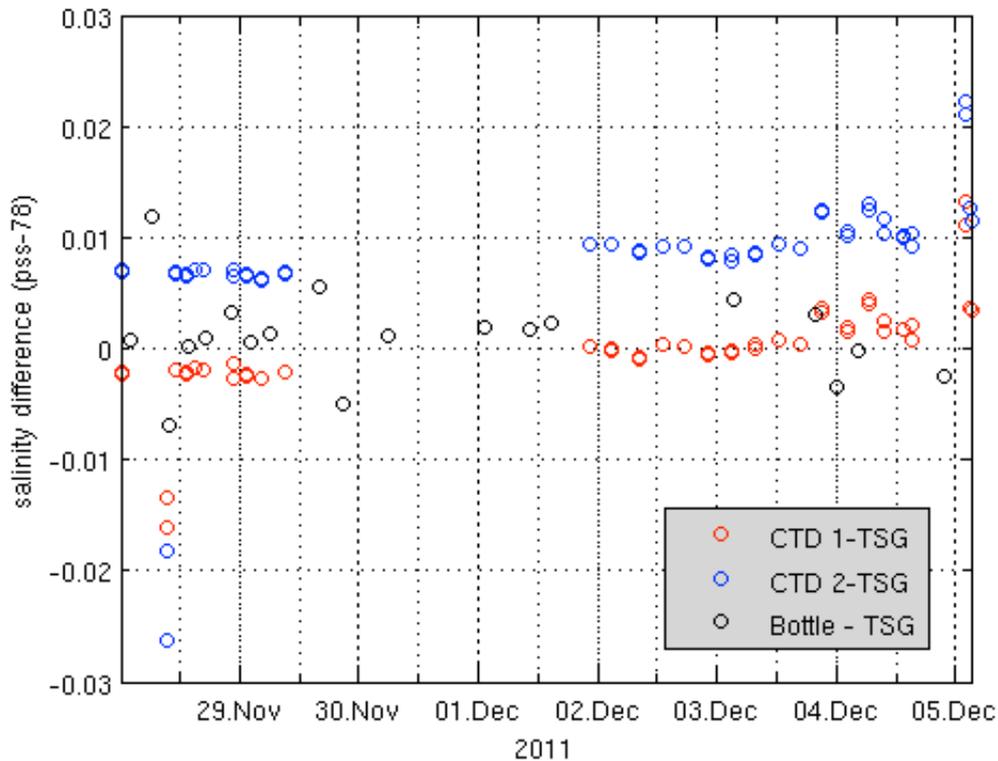
Figure 9.4 The SBE45 salinity residuals after correcting the salinity data.

10. ARGO FLOAT DEPLOYMENT

Helen Snaith and Penny Holliday

10.1 Introduction

Six U.K. Met Office floats were deployed during JR265 (Table 10.1). The floats were pre-programmed and simply needed to be activated before deployment. Full instructions, a magnet and transmission detector were supplied in one crate. All 6 floats were deployed successfully and their deployment reported to Brian King (NOC) and Jon Turton (Met Office).

Argo Number	Float Serial Number	Date	Jday	Time Activated (GMT)	Time deployed (GMT)	CTD Station Number	Lat ° S	Lon ° W
ARG01	4900	29/11/11	333	14:20	15:54	CTD 007	55° 09.45'	058° 00.00'
ARG02	4901	02/12/11	336	02:33	03:35	CTD 011	56° 08.40'	057° 34.25'
ARG03	4902	02/12/11	336	16:26	17:56	CTD 014	57° 05.93'	057° 00.43'
ARG04	4903	03/12/11	337	07:13	08:35	CTD 017	58° 03.10'	056° 26.80'
ARG05	4999	03/12/11	337	21:09	22:24	CTD 020	59° 00.00'	055° 51.80'
ARG06	4998	04/12/11	338	10:51	11:55	CTD 023	59° 59.96'	055° 14.33'

Table 10.1. JR265 ARGO Float Deployment details

10.2 Deployment procedure

A. Prepare Float:

- Get float crate on deck and opened a few hours before deployment
- Leave float in crate until deployed, if possible

- Remove the plastic bag over the sensor and the 3 labeled plugs: Keep grease / oil away from the sensors

B. Activate Float

- Record the float serial number on the checklist

- Place transmission detector between sensor and aerial (you can hang it over the aerial)

- Hold the supplied magnet against the "RESET" location on the case for approx. 5s

- After approx 10s you should hear 6 beeps, each of 3s, 8s apart

- If you don't hear the beeps – try the magnet again for a bit longer. Sometimes a stronger magnet is required (e.g. Bilge magnet supplied by Simon Wright).

- Listen for hum, and feel for vibration as the air bladder inflates (can take up to 10 mins). If in doubt, you can take out the bung in the bottom of the float and feel the bladder inflating, but make sure you put the bung back (easier before fully inflated). Alternatively, the bottom of the float will bulge slightly when bladder is fully inflated.

- Once bladder is inflated, float sends messages every 90 seconds, and transmission detector will pick them up as beeps. If you don't hear the 90s beeps – DO NOT DEPLOY THE FLOAT.

- Once 90s beeps are heard, place float in the sea within 1 hour (see step D)

- **IF IN DOUBT AS TO ACTIVATION – DO NOT DEPLOY**

C. Deploy Float

- Do not drop – place in the water

- Make sure no plastic bags, ropes etc are still attached before releasing

- Record time, lat & long of deployment in comments section of checklist and make other obs for checklist

If not deployed within 2 hours of activation put the float back in its crate until ready to deploy and start again from step B: hold the magnet against the "RESET" location for at least 10 minutes.

11. SALINOMETER

Margaret Yelland

11.1 Introduction.

An Autosal salinometer (S/N 68533, last serviced and aligned in February 2011) was set up in the Bio Lab by Julian and Seth (AME) during the pre-cruise mobilisation. During mobilisation, the salinometer was set up by adjusting the RS trim knob until the reading agreed with $2 * K_{15}$ value of the SSW. The Bio Lab is not a constant temperature lab, but is surrounded by other labs and is as far from external doors as possible. The salinometer bath temperature was set to 24 degrees and the lab temperature was kept at about 22 degrees. Unlike previous cruises, no problems were encountered in keeping the lab at roughly the correct temperature (but see Yelland (2009a) for problems on JR195 and their solutions). Standard seawater (SSW) batch P151 was used throughout the cruise: P151 has a K_{15} of 0.99997, i.e. $2*K_{15} = 1.99994$. Table 11.1 contains the SSW readings obtained at the start and end of each crate of samples, plus the standby and zero values at the start and end. These latter values are an indication of electronic drift. The salinometer was very stable apart from a small shift that occurred in the measurements of the SSW and in the standby and zero values that occurred between the analysis run

before/after day 338/339 (shown in bold in the Table). The reason for this small shift is not known.

The following sections describe: how to set up the salinometer at the start of a cruise (and how to re-standardise if the bath temperature is changed); the procedure for obtaining bottle samples and how they should be stored; obtaining a stable lab temperature; routine operation of the salinometer once it is set up; and potential problems which can be encountered during routine operation.

jday	crate	end - start	SSW start	SSW end	stndby start	stndby end	zero start	zero end
334	standardisation		1.99995	n/a	6094	n/a	-0.0001	n/a
334	WAGES-TSG-orange12	0.00003	1.99995	1.99998	6094	6094	-0.0001	0.0001
334	orange23-1	-0.00001	1.99998	1.99997	6094	6094	0.0001	0.0001
334	orange38	0.00001	1.99997	1.99998	6094	6094	0.0001	0.0001
337	bluegreen10	0.00000	1.99997	1.99997	6093	6093	0	0
337	BEEyellowblack-TSG	0.00000	1.99997	1.99997	6093	6093	0	0
337	**orange30**	**0.00001**	**1.99997**	**1.99998**	**6093**	**6094**	**0**	**0**
340	**orange26**	**0.00001**	**1.99992**	**1.99993**	**6090**	**6091**	**-0.0002**	**-0.0001**
340	redyellowA	0.00000	1.99993	1.99993	6091	6091	-0.0001	-0.0001
341	orange23-2	0.00001	1.99993	1.99994	6090	6091	-0.0001	-0.0001
341	blackyellowB	0.00000	1.99994	1.99994	6091	6091	-0.0001	-0.0001
341	green4-TSG	0.00000	1.99994	1.99994	6091	6090	-0.0001	-0.0001

Table 11.1. Standardisation history of the salinometer used on JR265. Note that the $2*K_{15}$ value of P151 was 1.99994. Throughout the analysis SSW batch P151 was used. RS trim was 5.7 and bath temperature was 24° throughout. Bold indicates a small shift in standardisation values which was accompanied by a small shift in standby and zero values.

11.2 Running the Salinometer (Autosal)

11.2.1 Initial setup of the Salinometer.

The salinometer should be set up on the bench in the "bio lab" at least 24 hours before use to allow time for the water bath to equilibrate to room temperature and to perform checks.

Connect the deionised water supply (Millipore) to the tank fill/drain nozzle and run a tube from the tank overflow to the drain/sink - all pipes are push fit. Make sure the tank fill/drain valve is open and fill the chamber until water runs out of the overflow - tank is about 18 litres. Turn the cell drain knob on bottom left.

Turn off the water supply. Close the tank drain/fill knob and remove the tubing from the nozzle. Making sure the standby/read/zero switch is set to standby, turn on the unit at the mains.

Set the bath temperature to 2-3°C **above** the lab temperature (bath was set to 24°C in the bio lab on JR265). Both heating lamps in the water bath should come on until the water has come to the right temperature. Once up to temperature, one lamp stays on and the other flashes intermittently to maintain the bath temperature a few degrees above ambient.

The check "check heater" lamp also flashes intermittently, but if it is ALWAYS on then there is a lamp problem.

A short length of tubing should be connected to the cell drain valve. Ideally this should drain into an isolated bucket that it does not touch. The cell drain must not provide an electrical path to ground, nor must it be long enough to cause a siphoning effect out of the conductivity cell (meaning the cell does not fill fully after flushing).

When not in use, the conductivity cell should be filled with deionised water. Flush the cell by placing a finger over the flush hole, until completely drained and no significant flow is coming out of the cell drain tube. Refill. Repeat at least twice.

When filled with deionised water, switch the function knob to read, and turn the suppression knob fully anticlockwise. The readout should be no higher than 0.0±0050. When finished with the reading, switch back to standby. Then switch off the pumps, leaving the chamber full.

Note that the **function knob should never be switched to read unless the cell is full.** Doing otherwise can damage the cell, and lead to unstable readings.

11.2.2 Initial standardisation

Use RS trim knob to set salinometer so that it reads the same as a standard sea water (with 2 or 3 places in the last digit). Suppression knob will need turning clockwise a long way until the display stops flashing and shows a **positive** reading. This should only be done once at the start of the cruise unless serious problems are encountered. Note that if the display on the salinometer is in ratio, this is twice the value of the standard seawater (marked "k" on the standards). Note SSW should be stored on bench near salinometer so the sample is at lab temp.

11.2.3 Taking bottle samples

Procedure for sampling Niskin Bottles. - old sample bottles are upside down in the crate, newly filled ones right way up. Protect from contamination by rain/salt (e.g. only put a few stoppers out ready for use each time - use a new small plastic bag each time to prevent the stoppers becoming salty through exposure). Rinse bottles 3 times. Fill to just below neck of bottle - need room to mix the water but want to minimise evaporation into air space.

Once a crate is full, move it in to the Bio Lab (where the salinometer lives). Put the log sheet (Appendix D) in with the crate and **note on it the date and time** it was put in the lab. Samples need to be in the lab at least 24 hrs before analysis so they come to lab temp.

Getting the **lab temp stable** is a balance between the thermostat inside the lab, and an external thermostat in the bottle annex/CTD hanger. The external thermostat regulates temps in the chem lab, but the hot air duct runs through the bio lab and can cause the temp to rise in there uncontrollably. If turning the external thermostat down does not work, ask the engineers to adjust the A/C in that part of the accommodation. A fan in the Bio Lab would help mix the air since large temperature gradients seem to exist. Putting one of the three PRT temperature probes in or near the crates to be sampled will give a better indication of when they are up to temperature.

11.3 Analysing a crate of samples once the salinometer is set up.

A standard seawater (SSW) sample is run at the start and end of each crate.

If possible run 2 crates back-to-back, using a total of 3 SSW.

NOTE that a new SSW bottle should be used each time. We are aiming for 0.001 PSU accuracy, i.e. conductivity display good to 5 in the last digit. Experience of an open SSW bottles showed that after being open for just 1 hour the salinity had increased by 0.01 PSU, i.e. an order of magnitude greater than the accuracy we need.

Make sure that the second digit is noted properly - there were at least two occasions when this digit was wrong and the salinity value was way out.

1) Note bottle details, time/date and lab temperature. Get zero and standby value. Work out twice the conductivity "k" ratio shown on the SSW vial label and note on the log sheet (Appendix D).

2) **Gently agitate the bottle** to mix out any salinity gradients which can develop in the standards and samples. Don't shake it - this introduces small bubbles.

3) Check function knob is on **STANDBY** whenever flushing/filling. If cell is empty at any time when knob is on READ, turn to STANDBY, fill and leave for 1 hr to recover.

4) Turn the flow rate on the salinometer to full and leave it there. Switch on the external pump to its first setting and leave it there.*

5) Open the SSW vial and insert the sample intake tube **using a tissue to hold the tube. The tube should be wiped before and after each sample.**

6) Fill and flush the cell 3 times.

7) Allow the chamber to refill, make sure there are **no bubbles in the cell**, and switch the function knob to READ.

8) If the display is flashing adjust the suppression knob until it stops flashing and shows a **positive** reading (usually a suppression of 1.9 for seawater).

9) Wait for the reading to stabilise, and note the entire display.

10) Switch to '**STANDBY**' and flush and fill the chamber once before the next reading.

11) Repeat until 3 consecutive (near) identical readings are obtained. (± 2 or 3 in last digit)

12) **Run a crate of samples.** Make sure to prevent contamination by wiping the sample tube and try not to touch it with bare fingers. Turn external pump off when swapping samples.

13) Again agitate (turn over) the samples and follow steps 6 to 11 in the procedure above**.**

14) **Note any and all problems. For example:**

> **stopper may be missing**
>
> **neck of bottle crusty with salt**
>
> **fluff/shrimps floating in the sample - do not use!**
>
> **anything else…**

15) After analysing a sample, put bottle upside down in the crate.

16) Once the crate is done, run **another SSW** vial to standardise again,.

17) Fill and flush chamber 3 times with **MilliQ de-ionised water**.

18) Allow chamber to refill with MilliQ and switch **pumps off**.

19) Note zero and standby again (this is a sign of electrical drift, and should not change by more than ±5 in the last digit between standardisations). Note lab temp.

* The advice re pump flow rates varies a great deal (see notes below). However, having the internal pump on full and the external pump on low has always worked reliably and simplifies the procedure. If very pushed for time the external pump rate can be increased to speed up fill/flush but the advantage is very marginal.

11.4 Potential problems:

   If difficulty is encountered obtaining a stable reading, the external pump can be turned off to prevent the sample running out.

When running the SSW, the salinometer display should be within ±20 in the last digits compared to $2*K_{15}$. If it is more than this the salinometer may need the RS trim knob adjusting but this should be avoided if at all possible - it is best to keep the same RS trim value throughout a cruise.

If large offsets (0.1 PSU or more) are seen in the salinometer/CTD comparison this may be due to the second decimal place in the salinometer readout not being noted correctly. The 1st decimal is usually constant but the second sometimes changes un-noticed by the operator.

Air in cell: The Autosal can be used without an external pump but in this case the internal pumps require an airtight seal to be made around the neck of the sample bottle at the sample intake tube. The external pump removes this requirement, and also allows quicker filling of the conductivity cell. However, a potential drawback is that the external pump requires a longer sample intake tube, and this can harbour bubbles which may significantly affect the conductivity reading. In the absence of an external pump, air can be prevented from entering the cell uptake tube by turning the internal pump to low when the tube was not submerged. The pump was turned to low rather than off completely to prevent water running back down the tube and contaminating the new sample. During JR265 the external pump was left at the low setting at all times. Occasionally small bubbles could be seen entering the cell from the left and entering the first of the 4 arms of the cell. In this case the cell was flushed and re-filled before a reading was taken. Even if bubbles are not noticed, an indication of their presence can be seen in an unusually low and/or wandering reading.

11.5 Calculation of salinity in EXCEL spreadsheets.

NOTE that the results for each crate need to be entered into an excel spreadsheet that calculates the salinities from the conductivities and bath temperature. For the MSTAR scripts to work the spreadsheet must a) be in excel 1995 version, c) have a file name that includes the word "crate" or "TSG" as appropriate, c) the bottle number column must be text format for the TSG file and number format for the CTD bottle files. Note that the MSTAR scripts "convert_sal_ascii" (for the CTD files) and "convert_tsg_ascii" (for the TSG) that convert the spreadsheet to an ascii file can change in their demands from one version to another. If the format etc is not correct then the resulting ascii files cause problems with the subsequent calibration processing.

12. DATA ARCHIVE OF NOSEA2 AND LABDATA

At the start of the cruise, a tar file of the initial sate of nosea2 was made on an external usb disk.

To maintain an offline archive of the jr265 data on nosea2, and also the data held on the jr265 areas of jr1b.jcr.nerc-bas.ac.uk, a copy was taken daily, using rsync, onto an external usb disk mounted on one of the Apple macs. After each rsync, the usb disk contained complete copies of:

nosea2:/users/pstar/jr265

nosea2:/mnt/20111123

NB: 20111123 was the mount point for jr265, but will change depending on the start date of the cruise. Within the pstar home directory, all links (current, scs_rawship, scs_raw) point to the /mnt/current directory, which will change to point to the actual mount point on a cruise by cruise basis. List the mnt directory (using ls –l) to see what the "current" link points at.

After the rsync was complete, a tar file of each of the rsynced directories was generated, to give a complete tar file at each backup time, whilst only needing to transfer changed or new files to the usb disk.

The transfer was simplified by a script, held on the external usb drive, called backup_nosea, and also linked as backup_lbdata in the same directory. When called using backup_nosea, the files in nosea2:/users/pstar/jr265 are backed up and a dated tar file generated. When invoked using backup_lbdata the nosea2:/mnt/20111123 data are backup up and tarred. The script file reads:

```tcsh
#!/bin/tcsh
set vol = jr265_2 #name of external usb disk on mac
set cruise = jr265 #name of cruise directory on nesea2 and external disk
set lbdata = 20111123 # name of legdata directory under /mnt on nosea2
set where=`pwd` #find current directory
set d=`date +%y%m%d_%H%M` # used to set tar and log file names


if (${0:t} == 'backup_nosea') then
echo "Backing up nosea2 $cruise directory"
rsync -aSv -e ssh --delete pstar@nosea2:$cruise /Volumes/$vol/$cruise/nosea2_$cruise >
    /Volumes/$vol/$cruise/nosea2_rsync.$d
cd /Volumes/$vol/$cruise/nosea2_$cruise
tar cf /Volumes/$vol/$cruise/nosea2_$d.tar $cruise
cd $where


else if (${0:t}  == 'backup_lb') then
  echo "Backing up lbdata folder for $cruise from nosea2 /mnt/$lbdata"
  rsync -aSv -e ssh --delete pstar@nosea2:/mnt/$lbdata
      /Volumes/$vol/$cruise/lbdata_$cruise > /Volumes/$vol/$cruise/lbdata_rsync.$d
cd /Volumes/$vol/$cruise/lbdata_$cruise
tar cf /Volumes/$vol/$cruise/lbdata_$d.tar $lbdata
cd $where


endif
```

13. ICT CRUISE REPORT

Johnnie Edmonston

13.1 Netware system

No problems were encountered with the netware systems.

13.2 Unix Systems

All unix systems on board presented no problems during the cruise. Nosea2, on board for the purpose of the cruise, and administered by Brian King, had the cruise data area mounted for MSTAR processing.

13.3 Linux Systems

Linux Systems, including AMS3, jrla, jrlb presented no problems during the cruise. AMS was syncing on schedule but from time to time individual users would wait several hours at a time as the system presumably struggled with large quantities of mail, and/or large attachments.

13.4 SCS

On jday 327 2153 GMT continuous acquisition was started. Acquisition still running at the time of writing this report. Anticipate closing this leg down and starting a new leg on the 24th at the latest. All back end processes, scs to levc, raw2compress, and web displays presented no problems. Nav streams were provided to POL for their above deck equipment.

13.5 Em122 SWATH system.

Kongsberg EM122 (installed July 2011 using the original transducer array installed 2007) running from Elephant Island North. No problems with it. SVP currently running at approx 1449 m/s.

13.6 Vsat

On 16th Dec 0300 GMT it was reported that vsat was still out despite heading being ok. As the ship was doing a figure of eight for POL myrtle recovery I noticed that satellite tracking would attempt to track for a few seconds before reporting syncro gyro failure and return to its home position. Woke the RO, who found the problem in a blown fuse in the syncro gyro repeater box. Once the fuse was replaced the vsat gear returned to normal function.

14. SUMMARY AND RECOMMENDATIONS:

The JR265 and JR254D cruises both went very well. Combining the hydrographic work with the WAGES air-sea interaction study worked to the benefit of all. For example, when conditions were too rough to deploy the CTD the time was used to deploy the WAGES wavebreaking buoy instead. This meant that a) the WAGES study obtained the high wind data required and b) there was no down-time when the ship was unable to do science. In addition, it was possible to deploy the WAGES buoy (and sometimes the balloon too) during the longer CTD stations, thus maximising the amount of data obtained for the WAGES study at no extra cost in terms of ship time. The success of both cruises was due to the very helpful and professional approach of the staff of the *JCR*.

Many of the recommendations from the previous Drake Passage hydrographic cruise (JR195, Yelland 2009a) have already been addressed thanks to Julian Klepacki and his colleagues at BAS AME (e.g. replacement of the ship's meteorological sensors, upgrading the Seasave and SBE data processing software and the addition of air pressure to the Oceanlogger display).

Minor recommendations from this cruise;

- A fan in the Bio Lab would prevent large gradients in air temperature and would make monitoring and regulation of the lab temp easier when using the AutoSal salinometer.

- A winch repeater in the CTD hanger / bottle annex would be useful to people working on that deck.

15. REFERENCES

Bacon, S. and Cunningham, S.A. (eds.) (2005): Drake Passage summary report: Cruises on RRS "James Clark Ross", 1993-2000. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b - Elephant Island to Burdwood Bank. Southampton, UK, Southampton Oceanography Centre, 151pp. (Southampton Oceanography Centre Cruise Report, 44)

Bacon, S. and et al, . (2002): RRS James Clark Ross Cruise 67, 19 Nov-17 Dec 2001. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b – Burdwood Bank to Elephant Island. Southampton, UK, Southampton Oceanography Centre, 118pp. (Southampton Oceanography Centre Cruise Report, 38)

Bacon, S and et al, . (2003): RRS James Clark Ross Cruise 81, 18 Dec 2002-02 Jan 2003. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b – Elephant Island to Burdwood Bank. Southampton, UK, Southampton Oceanography Centre, 86pp. (Southampton Oceanography Centre Cruise Report, 43)

Cunningham, S. A., (2001): RRS *James Clark Ross* Cruise JR55, 21 Nov – 14 Dec 2000. Drake Passage Repeat Hydrography: WOCE Southern Repeat Section 1b – Burdwood Bank to Elephant Island. Southampton Oceanography Centre Cruise Report, No. 35, 75 pp.

Gersonde, R., (1993): The Expedition Antarktis X/5 of RV *Polarstern* in 1992. Berichte zur Polarforschung, 131, 167 pp.

Hamersley, D. R. C. and G. D. Quartly (eds) (2010a): RRS James Clark Ross Cruise 193, 29 Nov - 8 Dec 2007. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b – Elephant Island to Burdwood Bank. Southampton, UK, National Oceanography Centre, 75 pp. (National Oceanography Centre Cruise Report, 26)

Hamersley, D. R. C. and G. D. Quartly (eds) (2010b): RRS James Clark Ross Cruise 194, 12 - 23 Dec 2008. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b – Elephant Island to Burdwood Bank. Southampton, UK, National Oceanography Centre, 46 pp. (National Oceanography Centre Cruise Report, 54)

Hargreaves, G. W., M.A.M. Maqueda and S. Mack, (2010): RRS James Clark Ross, Leg 1, October 27, 2009 – November 12, 2009, Leg 2, Cruise JR198, November 17, 2009 – November 28, 2009, Sea Level Measurements in the Drake Passage and Southern Ocean. Proudman Oceanographic Laboratory, Cruise Report, No xx, 15 pp

Hawker, E.J., King, B.A., Sparrow, M. and et al, . (2005): RRS James Clark Ross Cruise 94, 01 Dec-15 Dec 2003. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b - Burdwood Bank to Elephant Island. Southampton, UK, Southampton Oceanography Centre, 56pp. (Southampton Oceanography Centre Cruise Report, 55)

Maksysm, E.: JR240 cruise report. *In prep.*

McDonagh, E.L. and et al, .Hamersley, D.R.C. and McDonagh, E.L. (eds.) (2009): RRS James Cook Cruise JC031, 03 Feb-03 Mar 2009. Hydrographic sections of Drake Passage. Southampton, UK, National Oceanography Centre Southampton, 170pp. (National Oceanography Centre Southampton Cruise Report, 39) (In Press)

Morales Maqueda, M. A.: JR264 cruise report. *In prep*.

Pascal R. W., M. J. Yelland, M. A. Srokosz, B. I. Moat, E. Waugh, D. Comben, A. Cansdale, M. Hartman, D. Coles, P. C. Huseh and T. G. Leighton (2011): A spar buoy for high frequency wave measurements and detection of wave breaking in the open ocean. *Journal of Atmospheric and Ocean Technology. 28, 590-605* doi: 10.1175/2010JTECHO764.1

Read, J. F., J. T. Allen, P. Machin, G. W. J. Miller, A. I. Morrison, R. T. Pollard and P. G. Taylor, (1993): SeaSoar data collected on RRS *Discovery* Cruise 198 (Sterna) across Drake Passage and in the Bellingshausen Sea. Institute of Oceanographic Sciences Deacon Laboratory, Internal Document, No. 320, 59 pp.

Roether, W., R. Schlitzer, A. Putzka, P. Beining, K. Bulsiewicz, G. Rohardt and F. A. Delahoyde,(1993): Chlorofluoromethane and hydrographic section across Drake Passage - deep-waterventilation and meridional property transport. *J. Geophys. Res*. 98 (C8): 14423-14435.

Sparrow, M., Hawker, E.J. and et al, . (2005): RRS James Clark Ross Cruise 115, 01 Dec-19 Dec 2004. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b - Burdwood Bank to Elephant Island. Southampton, UK, Southampton Oceanography Centre, 80pp. (Southampton Oceanography Centre Cruise Report, 56)

Stansfield, K., Meredith, M. and et al, . (2008): RRS James Clark Ross Cruise 139, 05 Dec-12 Dec 2005. Drake Passage Repeat Hydrography: WOCE Southern Repeat Section 1b – Burdwood Bank to Elephant Island. Southampton, UK, National Oceanography Centre Southampton, 72pp. (National Oceanography Centre Southampton Cruise Report, 24)

Turner, D. R., (1993): BOFS 'Sterna 92' Cruise Report, Discovery 198 11/11/92 – 17/12/92. Plymouth Marine Laboratory, Plymouth, UK, 85 pp.

Watson, A.: JR276 cruise report. *In prep*.

Williams, A., Hadfield, R.E. and Quartly G.D., (2008): RRS James Clark Ross Cruise 163, 07 Dec-15 Dec 2006. Drake Passage repeat hydrography: WOCE Southern Repeat Section 1b - Burdwood Bank to Elephant Island. Southampton, UK, Southampton Oceanography Centre, 80pp. (National Oceanography Centre Cruise Report, 25)

Yelland, M. J., (2009a): RRS James Clark Ross Cruise 195, 18 Nov – 29 Nov 2009. Drake Passage repeat hydrography of WOCE section SR1b: a beginner's guide. Southampton, UK, National Oceanography Centre, 123 pp. (National Oceanography Centre Cruise Report, 45)

Yelland, M. J., R. W. Pascal, P. K. Taylor, and B. I. Moat, B. I. (2009b): AutoFlux: an autonomous system for the direct measurement of the air-sea fluxes of CO2, heat and momentum. *Journal of Operational Oceanography, 2, (1),* 15-23

Yelland, M. J. (2012a): JR254D cruise report. *In prep.*

Yelland, M. J. (2012b): WAGES 2010/11 season on JCR and JR254A, B, C cruise report. *In prep*.

APPENDIX A. BRIDGE LOGS

A.1 Bridge log of scientific operations.

GMT	Event	Lat	Lon	Comment
27/11/2011 15:06	Shallow Test (Wave Buoy 1)	-51.78724	-57.87571	Commence deploying W.Buoy
27/11/2011 15:10	Shallow Test (Wave Buoy 1)	-51.78711	-57.87575	Tethered buoy in the water.
27/11/2011 15:14	Shallow Test (Wave Buoy 1)	-51.78653	-57.87579	Tethered buoy fully deployed. Approx 200m of line. Vessel HDG 355deg. DP current 048deg X 0.5kts
27/11/2011 15:21	Shallow Test CTD	-51.78655	-57.8758	Commence deployment CTD
27/11/2011 15:29	Shallow Test CTD	-51.78656	-57.87579	CTD in the water and soaking. EA 600 depth 54m.
27/11/2011 15:31	Shallow Test CTD	-51.78666	-57.87581	CTD veering
27/11/2011 15:35	Shallow Test CTD	-51.78678	-57.87585	All stopped wire out 45m
27/11/2011 15:37	Shallow Test CTD	-51.78763	-57.8763	CTD at surface.
27/11/2011 15:47	Shallow Test CTD	-51.78773	-57.87636	CTD commence hauling.
27/11/2011 15:49	Shallow Test CTD	-51.78783	-57.87644	CTD recovered on deck
27/11/2011 15:51	Shallow Test CTD	-51.78827	-57.87671	Gantry block and CTD secure
27/11/2011 15:59	Shallow Test (Wave Buoy 1)	-51.79412	-57.87169	Wind 345Deg 27Kts. DP Current 211Deg 0.8Kts V/L HDG 355Deg
27/11/2011 18:00	Shallow Test (Wave Buoy 1)	-51.79309	-57.85044	Commence altering heading to 180 degrees. Since deployment. vessel moved 291 degrees x 1.03nm
27/11/2011	Shallow Test (Wave	-51.79477	-	Altered heading to 260 degrees. now altering back to 000 degrees

19:54	Buoy 1)		57.84116	
27/11/2011 20:23	Shallow Test (Wave Buoy 1)	-51.79015	- 57.83607	Heading stead on 325 degrees
27/11/2011 20:49	Shallow Test (Balloon 1)	-51.79004	- 57.83605	Commence balloon deployment
27/11/2011 20:50	Shallow Test (Balloon 1)	-51.78958	- 57.83483	Balloon deployed
27/11/2011 20:57	Shallow Test (Balloon 1)	-51.78943	- 57.83293	Commence recovery of balloon
27/11/2011 21:03	Shallow Test (Balloon 1)	-51.78852	- 57.82975	Balloon recovered to deck.
27/11/2011 21:13	Shallow Test (Wave Buoy 1)	-51.78667	- 57.82185	Teather transfered to starboard side
27/11/2011 21:37	Shallow Test (Wave Buoy 1)	-51.76862	- 57.77539	Change heading to 270 degrees
28/11/2011 00:00	Shallow Test (Wave Buoy 1)	-51.76139	- 57.76414	Change heading to 230 degrees. V/L has moved 044 degrees x 0.6 NM since 0000 UTC
28/11/2011 01:15	Shallow Test (Wave Buoy 1)	-51.75732	- 57.75761	Commence recovery of buoy
28/11/2011 02:35	Shallow Test (Wave Buoy 1)	-51.75707	-57.7573	Buoy recovered to deck. V/L moved 044 degrees x 0.4 NM since 0115 UTC
28/11/2011 03:06	Deep Test	-53.46154	- 57.94652	V/L stopped on station on DP for CTD
28/11/2011 12:23	Deep Test CTD	-53.46157	- 57.94652	CTD deployed
28/11/2011 12:28	Deep Test CTD	-53.46157	- 57.94651	CTD soaked. veering to 2350 m
28/11/2011 12:34	Deep Test CTD	-53.4616	- 57.94652	CTD stopped @ 2350m
28/11/2011 13:13	Deep Test CTD	-53.46155	- 57.94654	CTD recovered to deck
28/11/2011 14:59	1 (CTD 1)	-54.78941	- 57.99588	Vessel on DP for CTD deployment. water depth 265m
28/11/2011 21:48	1 (CTD 1)	-54.7894	- 57.99588	CTD deployed

28/11/2011 21:52	1 (CTD 1)	-54.78942	-57.99578	CTD at 250m
28/11/2011 22:01	1 (CTD 1)	-54.7897	-57.99417	CTD secure on deck
28/11/2011 22:22	2 (CTD 2)	-54.90944	-57.99372	V/L stopped on station for CTD 2
28/11/2011 23:13	2 (CTD 2)	-54.90944	-57.9937	CTD deployed for soak
28/11/2011 23:16	2 (CTD 2)	-54.90943	-57.99372	CTD veering to 600m
28/11/2011 23:21	2 (CTD 2)	-54.90944	-57.99373	CTD stopped @ 608m
28/11/2011 23:32	2 (CTD 2)	-54.90939	-57.99371	CTD recovered to deck
28/11/2011 23:49	2 (CTD 2)	-54.90939	-57.99367	V/L off DP proceeding to CTD 3
28/11/2011 23:55		-54.97387	-57.99483	Commence swath survey
29/11/2011 00:23		-55.00285	-57.94578	Complete swath survey
29/11/2011 01:07	3 (CTD 3)	-54.97974	-57.97507	V/L on station for CTD 3
29/11/2011 01:29	3 (CTD 3)	-54.97991	-57.97525	CTD deployed for soak
29/11/2011 01:35	3 (CTD 3)	-54.97989	-57.97526	CTD veering to 1100m
29/11/2011 01:40	3 (CTD 3)	-54.98007	-57.97509	CTD stopped @ 1075m
29/11/2011 01:59	3 (CTD 3)	-54.98003	-57.97511	CTD recovered to deck
29/11/2011 02:27	4 (BPR 1)	-54.98003	-57.9751	BPR released
29/11/2011 02:41	4 (BPR 1)	-54.98015	-57.97513	BPR on the seabed. Vessel off D.P
29/11/2011	5 (CTD 4)	-54.99908	-	Vessel all stoped on D.P.

			57.99723	
03:05				
29/11/2011 03:24	5 (CTD 4)	-54.99908	- 57.99721	Commence deploying CTD
29/11/2011 03:25	5 (CTD 4)	-54.99908	- 57.99721	CTD in the water and soaking
29/11/2011 03:29	5 (CTD 4)	-54.99908	- 57.99721	Veering CTD to near bottom. EA 600 depth 1517m
29/11/2011 03:34	5 (CTD 4)	-54.99909	- 57.99723	Wire out 1490m. commence hauling
29/11/2011 04:00	5 (CTD 4)	-54.99909	- 57.99723	CTD at surface.
29/11/2011 04:33	5 (CTD 4)	-54.9991	- 57.99723	CTD recovered to deck
29/11/2011 05:00	6 (CTD 5)	-55.03924	- 57.99832	Commence deployment CTD
29/11/2011 05:05	6 (CTD 5)	-55.03922	- 57.99833	CTD in the water and soaking
29/11/2011 05:07	6 (CTD 5)	-55.03924	- 57.99834	CTD Veering. EA600 depth 2051m
29/11/2011 05:11	6 (CTD 5)	-55.03923	- 57.99837	Wire out 2025m. Commence hauling
29/11/2011 05:47	6 (CTD 5)	-55.03928	- 57.99831	CTD at surface.
29/11/2011 06:31	6 (CTD 5)	-55.03929	- 57.99832	CTD on deck
29/11/2011 06:41	7 (BPR recovery)	-54.94314	-58.3397	V/L on DP 1000m due east of BPR for recovery
29/11/2011 08:02	7 (BPR recovery)	-54.94315	- 58.33959	Move to 500m due east
29/11/2011 08:10	7 (BPR recovery)	-54.94266	- 58.34903	All stopped 460m due east. sending release signal
29/11/2011 08:18	7 (BPR recovery)	-54.94274	- 58.34962	Release signal sent
29/11/2011 08:26	7 (BPR recovery)	-54.94271	- 58.34954	Buoy released

29/11/2011 08:31	7 (BPR recovery)	-54.94263	-58.34749	Buoy on surface
29/11/2011 08:48	7 (BPR recovery)	-54.9412	-58.34807	Buoy grapnelled
29/11/2011 08:59	7 (BPR recovery)	-54.94064	-58.34781	Buoy recovered to deck
29/11/2011 10:47		-55.0946	-57.9992	Vessel stopped ready for CTD deployment
29/11/2011 10:57	8 (CTD 6)	-55.09457	-57.99917	CTD deployed. veering to 2450m depth
29/11/2011 11:05	8 (CTD 6)	-55.09459	-57.99921	CTD stopped @ 2450m
29/11/2011 11:46	8 (CTD 6)	-55.0946	-57.99915	CTD recovered to deck
29/11/2011 12:51		-55.15751	-58.0009	V/L on station for CTD 7
29/11/2011 13:36	9 (CTD 7)	-55.15748	-58.00092	CTD deployed for soak
29/11/2011 13:45	9 (CTD 7)	-55.15754	-58.00097	CTD veering to 3000m
29/11/2011 13:50	9 (CTD 7)	-55.15749	-58.00093	CTD stopped @ 3000m
29/11/2011 14:41	9 (CTD 7)	-55.15752	-58.0009	CTD at surface.
29/11/2011 15:44	9 (CTD 7)	-55.15753	-58.00093	CTD on deck
29/11/2011 15:51	10 (Apex 1)	-55.15757	-58.00099	Commence deployment Apex Buoy
29/11/2011 15:56	11 (Wave Buoy 2)	-55.20233	-57.99407	V/L on D.P
29/11/2011 16:21	11 (Wave Buoy 2)	-55.20292	-57.99464	Commence deployment of Wave Buoy
29/11/2011 16:24	11 (Wave Buoy 2)	-55.20218	-57.99385	Buoy released. Paying out line.
29/11/2011	11 (Wave Buoy 2)	-55.20305	-	Wave Buoy fully deployed. tethered line approx 200m

16:26			57.99483	
29/11/2011 16:31	12 (CTD 8)	-55.20295	- 57.99468	Commence CTD deployment
29/11/2011 16:38	12 (CTD 8)	-55.20277	- 57.99454	CTD in the water and soaking
29/11/2011 16:41	12 (CTD 8)	-55.20268	-57.9944	CTD Veering. EA600 depth 3623m
29/11/2011 16:43	11 (Wave Buoy 2)	-55.20217	- 57.99412	Tether switched to STBD side. D.P current 221deg x 1.8Kts. Wind 230deg x 19Kts. Ships HDG 235deg
29/11/2011 16:53	12 (CTD 8)	-55.19975	- 57.99031	CTD all stopped. wire out 3550m
29/11/2011 17:44	12 (CTD 8)	-55.19963	- 57.99001	Commence hauling CTD
29/11/2011 17:47	11 (Wave Bouy 2)	-55.19873	- 57.98874	Sleet. Wind 239deg x 15Kts. D.P current 223deg x 1.8Kts
29/11/2011 18:17	11 (Wave Buoy 2)	-55.19876	- 57.98856	Sleet passed now dry
29/11/2011 18:20	11 (Wave Buoy 2)	-55.1985	- 57.98803	Commence W.Buoy recovery
29/11/2011 18:26	11 (Wave Buoy 2)	-55.19845	- 57.98798	Wave buoy fully recovered. Vessel moved 040(T) x 0.37nm whilst wave buoy deployed
29/11/2011 18:31	12 (CTD 8)	-55.19845	- 57.98791	CTD at surface.
29/11/2011 18:58	12 (CTD 8)	-55.19848	- 57.98794	CTD on deck
29/11/2011 19:08	13 (Wave buoy 3)	-55.51486	- 58.01071	Commence deployment of Wave Buoy
29/11/2011 21:09		-55.51529	- 58.01651	Vessel on DP
29/11/2011 21:18	13 (Wave buoy 3)	-55.5151	- 58.01403	Wave buoy deployed. leading off starboard quarter
29/11/2011 21:19	13 (Wave buoy 3)	-55.51519	- 58.01569	Transfered wave buoy to port quarter
29/11/2011 21:22	13 (CTD 9)	-55.51527	- 58.01652	Commence deployment of CTD

29/11/2011 21:30	13 (CTD 9)	-55.51537	-58.01671	CTD deployed
29/11/2011 21:36		-55.52183	-58.02038	Alter vessels heading from 265 degrees to 280 degrees
29/11/2011 22:43	13 (CTD 9)	-55.52219	-58.02053	CTD stopped at depth 4200m
29/11/2011 22:49	13 (Wave buoy 3)	-55.52497	-58.02151	Commence wave buoy recovery
29/11/2011 23:43	13 (Wave buoy 3)	-55.52494	-58.02154	Wave Buoy recovered to deck.
29/11/2011 23:53	13 (CTD 9)	-55.52495	-58.02157	CTD recovered to deck
30/11/2011 00:29		-55.8322	-57.81839	V/L on station on DP
30/11/2011 02:28	14 (CTD 10)	-55.83283	-57.81905	CTD deployed. Wire jumped off sheave.
30/11/2011 02:47	14 (CTD 10)	-55.83383	-57.81359	CTD recovered to deck. Wire checked no damage.
30/11/2011 02:57	14 (CTD 10)	-55.83384	-57.81359	Gantry and CTD secure. Vessel W.O.W
30/11/2011 03:09		-55.83389	-57.81331	Vessel off D.P. W.O.W.
30/11/2011 04:30		-55.83009	-57.82339	Vessel on D.P assesing conditions
30/11/2011 06:35		-55.83002	-57.8209	Decision made that conditions are not workable. vessel off DP heave too
30/11/2011 08:13		-55.83797	-57.82574	V/L on DP in preparation for wavex deployment
30/11/2011 10:40	15 (Wave buoy 4)	-55.83803	-57.8254	Wave buoy deployed. leading off port quarter
30/11/2011 11:22	15 (Wave buoy 4)	-55.83868	-57.82134	V/L has moved 094 degrees x 0.19 NM since deployment. Weather - occassional light drizzle
30/11/2011 12:00	15 (Wave buoy 4)	-55.83816	-57.81355	Alter vessels heading from 240 degrees to 230 degrees
30/11/2011	15 (Wave buoy 4)	-55.83827	-	V/L has moved 085 degrees x 0.33 NM since 1200 UTC. Weather - occassional light drizzle/ very

12:49			57.81178	slight snow flurries
30/11/2011 13:00	15 (Wave buoy 4)	-55.83948	-57.79893	V/L has moved 100 degrees x 0.46 NM since 1300 UTC. Weather - squally passing showers
30/11/2011 14:00	15 (Wave buoy 4)	-55.84071	-57.78472	V/L has moved 099 degrees x 0.48 NM since 1400 UTC. Weather - squally passing showers
30/11/2011 15:00	15 (Wave buoy 4)	-55.84074	-57.77898	Heading Changed 240Deg
30/11/2011 15:23	15 (Wave buoy 4)	-55.84034	-57.77277	Heading changed to 230Deg
30/11/2011 15:48	15 (Wave buoy 4)	-55.84035	-57.76925	V/L has moved 088 degrees x 0.51 NM since 1500 UTC.
30/11/2011 16:00	15 (Wave buoy 4)	-55.8405	-57.75679	Hdg 230 C.O.G 091Deg x 0.43nm. light snow showers. Squally
30/11/2011 17:00	15 (Wave buoy 4)	-55.84046	-57.75288	Heading changed 240Deg
30/11/2011 17:16	15 (Wave buoy 4)	-55.84045	-57.74603	Changed Heading 235Deg
30/11/2011 17:45	15 (Wave buoy 4)	-55.84039	-57.74322	Vessel has moved 090Deg x 0.46nm since 1600UTC V/L Hdg 235Deg
30/11/2011 18:00	15 (Wave buoy 4)	-55.83975	-57.72761	Vessel has moved 086Deg x 0.53nm since 1700UTC V/L Hdg 235Deg
30/11/2011 19:00	15 (Wave buoy 4)	-55.83963	-57.7179	Change heading to 245 degrees
30/11/2011 19:32	15 (Wave buoy 4)	-55.83922	-57.71562	Change heading to 240 degrees
30/11/2011 19:39	15 (Wave buoy 4)	-55.83904	-57.70975	Vessel moved 086 degrees x 0.63nm in last hour
30/11/2011 20:00	15 (Wave buoy 4)	-55.83774	-57.68916	Vessel moved 085 degrees x 0.67 nm in last hour
30/11/2011 21:00	15 (Wave buoy 4)	-55.83712	-57.67924	Change heading to 230degrees
30/11/2011 21:31	15 (Wave buoy 4)	-55.83674	-57.67351	Change heading 240 degrees
30/11/2011 21:48	15 (Wave buoy 4)	-55.83648	-57.66989	Vessel moved 083 degrees x 0.67 nm in last hour

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30/11/2011 22:00	15 (Wave buoy 4)	-55.83514	57.65213	Vessel moved 083 degrees x 0.60 nm in last hour
30/11/2011 23:00	15 (Wave buoy 4)	-55.83512	- 57.65117	Change heading 250 degrees
30/11/2011 23:03	15 (Wave buoy 4)	-55.83407	- 57.64469	Change heading 245 degrees
30/11/2011 23:15	15 (Wave buoy 4)	-55.83427	- 57.64713	Change heading 240 degrees
30/11/2011 23:18	15 (Wave buoy 4)	-55.83284	- 57.63221	V/L has moved 078 degrees x 0.66 NM since 2300 UTC. Weather - squally wintry showers
01/12/2011 00:00	15 (Wave buoy 4)	-55.83179	- 57.62645	Change heading to 230 degrees
01/12/2011 00:15	15 (Wave buoy 4)	-55.82913	- 57.61454	Change heading 240 degrees
01/12/2011 00:46	15 (Wave buoy 4)	-55.82777	- 57.60914	V/L has moved 069 degrees x 0.88 NM since 2400 UTC. Weather - squally wintry showers
01/12/2011 01:00	15 (Wave buoy 4)	-55.82574	- 57.60119	Change heading 245 degrees
01/12/2011 01:20	15 (Wave buoy 4)	-55.82403	- 57.59255	Change heading 250 degrees
01/12/2011 01:38	15 (Wave buoy 4)	-55.82338	- 57.58933	Change heading 245 degrees
01/12/2011 01:45	15 (Wave buoy 4)	-55.8225	- 57.58518	Change heading 240 degrees
01/12/2011 01:54	15 (Wave buoy 4)	-55.82195	- 57.58247	V/L has moved 069 degrees x 0.98 NM since 0100 UTC. Weather - squally wintry showers
01/12/2011 02:00	15 (Wave buoy 4)	-55.81963	- 57.57356	Change heading 245 degrees
01/12/2011 02:22	15 (Wave buoy 4)	-55.81658	- 57.56248	V/L has moved 064 degrees x 0.73 NM since 0200 UTC. Weather - squally wintry showers
01/12/2011 03:00	15 (Wave buoy 4)	-55.81414	- 57.55313	Change heading 240 degrees
01/12/2011 03:33	15 (Wave buoy 4)	-55.81318	- 57.54782	Vessel has moved 068(T) x 0.54nm since 0300UTC V/L Hdg 240Deg. Weather - squally wintry showers
01/12/2011	15 (Wave buoy 4)	-55.81062	-	Change heading 250 degrees

04:00			57.54154	
01/12/2011 04:43	15 (Wave buoy 4)	-55.81017	-57.54044	Change heading 245 degrees
01/12/2011 04:50	15 (Wave buoy 4)	-55.80923	-57.53813	Vessel has moved 054(T) x 0.40nm since 0400UTC V/L Hdg 245Deg. Weather - squally wintry showers
01/12/2011 05:00	15 (Wave buoy 4)	-55.80394	-57.52532	Vessel has moved 054(T) x 0.53nm since 0500UTC V/L Hdg 245Deg. Weather - squally wintry showers
01/12/2011 06:00	15 (Wave buoy 4)	-55.80338	-57.52224	Changed Heading 255Deg
01/12/2011 06:12	15 (Wave buoy 4)	-55.79785	-57.50518	V/L moved 062Deg x 0.77nm V/L HDG 255Deg Light rain
01/12/2011 07:00	15 (Wave buoy 4)	-55.79549	-57.49798	Change heading to 250degrees
01/12/2011 07:17	15 (Wave buoy 4)	-55.79097	-57.48082	Vessel moved 063 degrees x 0.94nm in last hour
01/12/2011 08:00	15 (Wave buoy 4)	-55.7889	-57.47153	Teather transfered to starboard quarter
01/12/2011 08:22	15 (Wave buoy 4)	-55.78588	-57.45375	Vessel moved 073 degrees x 0.97 nm in last hour
01/12/2011 09:00	15 (Wave buoy 4)	-55.78549	-57.45187	Change heading to 260degrees
01/12/2011 09:04	15 (Wave buoy 4)	-55.78236	-57.43709	Change heading to 250 degrees
01/12/2011 09:38	15 (Wave buoy 4)	-55.77974	-57.42343	Change heading 260 degrees
01/12/2011 10:11	15 (Wave buoy 4)	-55.77844	-57.41952	Change heading 255 degrees
01/12/2011 10:21	15 (Wave buoy 4)	-55.77507	-57.40342	Vessel moved 068 degrees x 0.85 nm
01/12/2011 11:00	15 (Wave buoy 4)	-55.76753	-57.37509	V/L has moved 063 degrees x 1.06 NM since 1100 UTC. Weather - showers seen not at station
01/12/2011 12:00	15 (Wave buoy 4)	-55.75748	-57.34463	V/L has moved 060 degrees x 1.17 NM since 1200 UTC. Weather - passing moderate showers
01/12/2011 13:00	15 (Wave buoy 4)	-55.7464	-57.31573	Commence recovery of wave buoy. V/L has moved 055 degrees x 1.24 NM since 1300 UTC

01/12/2011 13:58	15 (Wave buoy 4)	-55.74566	-57.31495	Wave Buoy broken in two during recovery. bottom section recovered to deck.
01/12/2011 14:15	15 (Wave buoy 4)	-55.74568	-57.31492	V/L off DP. Proceeding to CTD 10 to assess conditions
01/12/2011 14:31	16 (CTD 10)	-55.83452	-57.83101	Vessel on D.P assessing conditions
01/12/2011 18:06	16 (CTD 10)	-55.8347	-57.82929	Vessel on D.P assessing conditions
01/12/2011 18:11	16 (CTD 10)	-55.8348	-57.8296	Commence deployment of CTD
01/12/2011 18:36	16 (CTD 10)	-55.83472	-57.82911	CTD deployed and soaking
01/12/2011 18:41	16 (CTD 10)	-55.83413	-57.82494	CTD veering to 4700m EA600 depth 4739m
01/12/2011 18:44	16 (CTD 10)	-55.83206	-57.81231	CTD stopped at 4720m
01/12/2011 20:09	16 (CTD 10)	-55.82886	-57.79325	CTD recovered to deck
01/12/2011 22:02		-56.14969	-57.62291	V/L on DP
02/12/2011 00:51	17 (CTD 11)	-56.14998	-57.62388	CTD deployed
02/12/2011 01:05	17 (CTD 11)	-56.14972	-57.62241	Veering to approx. 3400m
02/12/2011 01:09	17 (CTD 11)	-56.14505	-57.59586	CTD stopped @ 3489m
02/12/2011 02:10	17 (CTD 11)	-56.13989	-57.56989	CTD at surface.
02/12/2011 03:18	17 (CTD 11)	-56.13966	-57.56874	CTD recovered to deck
02/12/2011 03:20	18 (APEX 2)	-56.13938	-57.56729	Commence deployment Apex Bouy
02/12/2011 03:27	18 (APEX 2)	-56.19564	-57.50141	Apex Buoy deployed
02/12/2011	19 (CTD 12)	-56.46745	-	Commence CTD deployment

05:40			57.43384	
02/12/2011 05:45	19 (CTD 12)	-56.46731	-57.4333	CTD Soaking
02/12/2011 05:48	19 (CTD 12)	-56.46711	-57.43189	Veering CTD to near bottom. EA 600 depth 3770m
02/12/2011 05:52	19 (CTD 12)	-56.46534	-57.41873	Wire out 3663m. Commence hauling
02/12/2011 06:54	19 (CTD 12)	-56.46362	-57.40447	CTD recovered to deck
02/12/2011 08:06	19 (CTD 12)	-56.46362	-57.40447	CTD secure on deck
02/12/2011 10:13	20 (wave buoy 5)	-56.78289	-57.2293	Commence deployment of wavex buoy from stbd quarter
02/12/2011 10:18	20 (wave buoy 5)	-56.78306	-57.2303	Wave buoy in the water. leading off starboard quarter
02/12/2011 10:22	20 (wave buoy 5)	-56.78324	-57.23188	Wave buoy fully deployed and secure
02/12/2011 10:27	20 (CTD 13)	-56.78341	-57.23025	CTD deployed
02/12/2011 10:38	20 (CTD 13)	-56.7843	-57.21849	CTD stopped @ 3267m
02/12/2011 11:44	20 (wave buoy 5)	-56.78456	-57.21185	Commence recovery of wave buoy
02/12/2011 12:25	20 (wave buoy 5)	-56.78407	-57.20858	Wave buoy recovered to deck
02/12/2011 13:01	21 (CTD 14)	-57.10119	-57.03603	V/L on D.P site 14
02/12/2011 14:57	22 (Wave Buoy 6)	-57.10168	-57.03793	Commence deployment of Wave Buoy
02/12/2011 15:01	22 (Wave Buoy 6)	-57.1017	-57.03839	Wave buoy deployed. leading off starboard quarter. Paying out line
02/12/2011 15:03	22 (Wave Buoy 6)	-57.10178	-57.03934	Wave Buoy fully deployed. tethered line approx 200m
02/12/2011 15:07	21 (CTD 14)	-57.10184	-57.03935	Commence CTD deployment

02/12/2011 15:13	21 (CTD 14)	-57.10182	-57.03885	CTD deployed and Soaking
02/12/2011 15:17	21 (CTD 14)	-57.10177	-57.03791	CTD veering to near bottom. EA 600 depth 4237m
02/12/2011 15:20	22 (Wave Buoy 6)	-57.10149	-57.03248	Teather transfered to Port quarter
02/12/2011 15:38	23 (Balloon 2)	-57.10144	-57.03106	Balloon deployed
02/12/2011 15:43	23 (Balloon 2)	-57.1014	57.03038	Camera attached
02/12/2011 15:46	23 (Balloon 2)	-57.10141	-57.03017	Balloon fully deployed. 0.31nm x 087Deg since 1500UTC
02/12/2011 15:47	22 (Wave Buoy 6)	-57.10127	-57.02757	V/L on D.P Hdg 268Deg/
02/12/2011 16:00	21 (CTD 14)	-57.10067	-57.02086	Wire out 3870m. Commence hauling. EA600 depth 3913m
02/12/2011 16:28	23 (Balloon 2)	-57.10062	-57.02039	Commence balloon recovery
02/12/2011 16:30	23 (Balloon 2)	-57.10031	57.01796	Camera detached
02/12/2011 16:40	23 (Balloon 2)	-57.10027	-57.01769	Balloon fully recovered
02/12/2011 16:41	22 (Wave Buoy 6)	-57.09964	-57.0128	Vessel moved 078(T) x 0.50nm. Hdg 268deg since 1600UTC
02/12/2011 17:00	22 (Wave Buoy 6)	-57.09946	-57.00938	Commence wave buoy recovery
02/12/2011 17:11	22 (Wave Buoy 6)	-57.0989	57.00719	Wave buoy fully recovered. V/L move 075Deg x 0.19nm since 1700UTC. D.P Hdg 268Deg
02/12/2011 17:21	21 (CTD 14)	-57.09888	-57.00722	CTD at surface.
02/12/2011 17:48	21 (CTD 14)	-57.09887	-57.00717	CTD recovered to deck
02/12/2011 17:51	24 (APEX 3)	-57.09887	57.00734	Apex Buoy deployed
02/12/2011		-57.41549	-	Vessel on DP commence deployment of wave buoy

18:00			56.83109	
02/12/2011 20:25	25 (Wave Buoy 7)	-57.41582	-56.83167	Wave buoy in the water
02/12/2011 20:29	25 (Wave Buoy 7)	-57.41591	-56.83375	Wave buoy deployed off port quarter
02/12/2011 20:35	25 (CTD 15)	-57.41595	-56.83301	CTD deployed
02/12/2011 20:43	25 (Balloon 3)	-57.41614	-56.82901	Balloon deployed
02/12/2011 21:20	25 (CTD 15)	-57.41605	-56.82626	CTD stopped at 3475m
02/12/2011 21:47	25 (Balloon 3)	-57.41604	-56.82618	Commence recovery of balloon
02/12/2011 21:48	25 (Balloon 3)	-57.41608	-56.82507	Balloon recovered to deck.
02/12/2011 21:59	25 (Wave Buoy 7)	-57.41647	-56.82241	Commence wave buoy recovery
02/12/2011 22:26	25 (Wave Buoy 7)	-57.41678	-56.82094	Wave buoy recovered to deck
02/12/2011 22:36	25 (CTD 15)	-57.41673	-56.82094	CTD recovered on deck
03/12/2011 01:07	26 (CTD 16)	-57.73303	-56.64388	CTD deployed
03/12/2011 01:15	26 (CTD 16)	-57.73305	-56.64383	Veering to approx. 3500m
03/12/2011 01:20	26 (CTD 16)	-57.73329	-56.64278	CTD stopped @ 3459m
03/12/2011 02:18	26 (CTD 16)	-57.73333	-56.64281	CTD at surface.
03/12/2011 03:36	26 (CTD 16)	-57.73332	-56.64284	CTD on deck
03/12/2011 05:44	27 (CTD 17)	-58.05115	-56.44594	Commence deployment CTD
03/12/2011 05:47	27 (CTD 17)	-58.05109	-56.44592	CTD veering to 3900m. EA 600 depth 3985m

03/12/2011 05:50	27 (CTD 17)	-58.05092	-56.44599	CTD stopped at 3933m
03/12/2011 07:01	27 (CTD 17)	-58.05094	-56.44604	CTD recovered on deck
03/12/2011 08:22	27 (Apex 4)	-58.05095	-56.44623	Apex buoy deployed
03/12/2011 10:28	28 (CTD 18)	-58.36668	-56.24868	CTD deployed
03/12/2011 10:34	28 (CTD 18)	-58.36667	-56.25026	CTD stopped @ 3876m
03/12/2011 11:45	28 (CTD 18)	-58.36665	-56.2502	CTD recovered to deck
03/12/2011 15:08	29 (CTD 19)	-58.68376	-56.05403	Commence deploying CTD
03/12/2011 15:11	29 (CTD 19)	-58.68378	-56.054	CTD deployed and soaking
03/12/2011 15:13	29 (CTD 19)	-58.68378	-56.05402	Veering CTD to near bottom. EA 600 depth 3786m
03/12/2011 15:17	29 (CTD 19)	-58.68378	-56.0541	CTD stopped at 3730m
03/12/2011 17:19	29 (CTD 19)	-58.68376	-56.05401	Commence hauling CTD
03/12/2011 17:21	29 (CTD 19)	-58.68374	-56.0541	CTD at surface.
03/12/2011 17:33	29 (CTD 19)	-58.68374	-56.0541	CTD recovered to deck
03/12/2011 19:33	30 (wave buoy 8)	-59.0004	-55.85178	Commence deployment of wavex buoy from stbd quarter
03/12/2011 19:35	30 (wave buoy 8)	-59.0005	-55.85255	Buoy in water
03/12/2011 19:38	30 (wave buoy 8)	-59.00082	-55.85488	Wave buoy fully deployed and secure
03/12/2011 19:44	30 (CTD 20)	-59.00087	55.85527	CTD deployed
03/12/2011	30 (wave buoy 8)	-59.00081	-	Ship moving 302 degrees at 0.1 knots. Ship heading 267 degrees. Buoy leading 060 degrees

19:55			55.85548	
03/12/2011 20:00	30 (wave buoy 8)	-59.00004	-55.85781	Ship stationary. Vessel heading 267 degrees. Wave buoy bearing 055 degrees
03/12/2011 21:00	30 (CTD 20)	-59.00005	-55.85779	CTD @ depth 3752m
03/12/2011 21:01	30 (wave buoy 8)	-59.00004	-55.85965	Commence recovery of wavex buoy
03/12/2011 21:47	30 (wave buoy 8)	-58.99995	-55.86049	Wavex buoy recovered to deck
03/12/2011 21:58	30 (CTD 20)	-58.99997	-55.86048	CTD`recovered to deck
03/12/2011 22:18	30 (APEX 5)	-59	-55.86207	Apex float deployed
04/12/2011 00:27	31 (CTD 21)	-59.33347	-55.65163	CTD deployed
04/12/2011 00:33	31 (CTD 21)	-59.33343	-55.65165	CTD veering to approx. 3700m
04/12/2011 00:38	31 (CTD 21)	-59.33335	-55.65112	CTD stopped @ 3736m
04/12/2011 01:41	31 (CTD 21)	-59.33332	-55.65114	CTD recovered to deck
04/12/2011 04:57	32 (CTD 22)	-59.66698	-55.44535	Commence deploying CTD
04/12/2011 05:00	32 (CTD 22)	-59.66693	-55.44517	CTD deployed and soaking
04/12/2011 05:04	32 (CTD 22)	-59.66688	-55.44502	CTD veering to near bottom. EA600 depth 3714 m
04/12/2011 05:07	32 (CTD 22)	-59.6667	-55.44438	Wire out 3654m. Commence hauling
04/12/2011 06:09	32 (CTD 22)	-59.66669	-55.44435	CTD recovered to deck
04/12/2011 07:33	33 (CTD23)	-59.99902	-55.23601	V/L on DP at site CTD 23
04/12/2011 09:27	33 (CTD23)	-59.99899	-55.23642	CTD deployed

04/12/2011 09:33	33 (CTD23)	-59.9996	-55.23833	CTD all stopped @ 3478m
04/12/2011 10:36	33 (CTD23)	-59.9996	-55.23834	CTD recovered to deck
04/12/2011 11:54	33 (APEX 6)	-59.99959	-55.23835	Float released. drifting clear. V/L remaining on station for stern tube inspection
04/12/2011 11:55	33 (APEX 6)	-59.99944	-55.23871	Float upright
04/12/2011 14:05	34 (Wave buoy 9)	-60.33505	-55.0306	Wave buoy deployed off stbd quarter. Leading 140 degrees true
04/12/2011 14:09	34 (Wave buoy 9)	-60.3334	55.03134	Buoy fully deployed. Ships heading 330 degrees.
04/12/2011 14:16	35 (CTD 24)	-60.3331	-55.03158	CTD deployed
04/12/2011 14:24	35 (CTD 24)	-60.33311	55.03158	CTD veering to approx 3440m
04/12/2011 14:27	34 (Wave buoy 9)	-60.3331	-55.03159	HDG 330(T). Weather - dry. Buoy leading 150(T)
04/12/2011 15:00	34 (Wave buoy 9)	-60.33307	-55.0316	Teather transfered to Port quarter. Change heading to 320(T)
04/12/2011 15:15	35 (CTD 24)	-60.3331	-55.03162	Wire out 3420m. Commence hauling
04/12/2011 15:24	34 (Wave buoy 9)	-60.33309	55.03159	Commence recovering wave buoy. vessel heading 320(T). buoy brg 180(T). Dry
04/12/2011 16:00	35 (CTD 24)	-60.33307	-55.0316	CTD at the surface
04/12/2011 16:32	35 (CTD 24)	-60.33307	-55.0316	CTD recovered on deck
04/12/2011 16:40		-60.66841	-54.82049	Vessel on D.P at CTD site 25
04/12/2011 18:32	36 (Wave buoy 10)	-60.66727	-54.82156	Commence deploying wave buoy on the port quarter
04/12/2011 18:34	36 (Wave buoy 10)	-60.66684	54.82095	Wave buoy deployed. leading off port quarter. paying out line
04/12/2011	36 (Wave buoy 10)	-60.66623	-	Wave buoy fully deployed

18:37			54.82133	
04/12/2011 18:42	37 (CTD 25)	-60.66624	-54.82134	Commence deploying CTD
04/12/2011 18:46	37 (CTD 25)	-60.66623	-54.82134	CTD deployed and soaking
04/12/2011 18:50	36 (Wave buoy 10)	-60.66619	-54.82071	Teather transfered to starboard quarter
04/12/2011 18:54	37 (CTD 25)	-60.6661	-54.81975	Veering CTD to near bottom. EA 600 depth 3130m
04/12/2011 18:57	36 (Wave buoy 10)	-60.66595	-54.81862	Vessel heading 280(T). Wave buoy 080(T). Dry
04/12/2011 19:00	36 (Wave buoy 10)	-60.66575	-54.81708	Alter heading to 300 degrees
04/12/2011 19:04	38 (Balloon 4)	-60.66493	-54.81363	Ballon deployed from port quarter
04/12/2011 19:19	36 (Wave buoy 10)	-60.66417	-54.81116	Alter heading to 290 degrees
04/12/2011 19:27	37 (CTD 25)	-60.66369	-54.8054	CTD @ depth 3060m
04/12/2011 19:47	36 (Wave buoy 10)	-60.66353	-54.80179	Vessel heading 290 degrees. moved in last hour 074 degrees x 0.55nm. buoy on bearing 080 degrees
04/12/2011 20:00	38 (Balloon 4)	-60.66347	-54.80122	Commence recovery of balloon
04/12/2011 20:02	38 (Balloon 4)	-60.66318	-54.79828	Balloon recovered to deck
04/12/2011 20:14	36 (Wave buoy 10)	-60.6631	-54.79761	Commence recovery of wavex buoy
04/12/2011 20:17	36 (Wave buoy 10)	-60.66309	-54.79518	Wavex buoy recovered to deck
04/12/2011 20:29	37 (CTD 25)	-60.66352	-54.79267	CTD recovered to deck
04/12/2011 20:57	39 (CTD 26)	-60.79939	-54.7445	V/L on DP for CTD 26
04/12/2011 21:50	39 (CTD 26)	-60.79946	-54.74379	CTD deployed

04/12/2011 21:59	39 (CTD 26)	-60.79947	- 54.74334	CTD @ 2530 metres
04/12/2011 22:43	39 (CTD 26)	-60.79947	- 54.74335	CTD recovered to deck
05/12/2011 00:21		-60.79947	- 54.74334	V/L off DP
05/12/2011 00:23		-60.83334	- 54.71703	V/L on DP
05/12/2011 00:49	40 (POL APEX 1)	-60.83484	- 54.72019	POL APEX deployed
05/12/2011 01:18	40 (POL APEX 1)	-60.83432	- 54.72068	Communications with buoy tested - OK
05/12/2011 01:29	40 (CTD 27)	-60.83334	- 54.72148	CTD deployed
05/12/2011 01:39	40 (CTD 27)	-60.83326	- 54.72158	CTD veering to approx. 1600m
05/12/2011 01:44	40 (CTD 27)	-60.83323	- 54.72166	CTD stopped at 1579m. Finding bottom on echosounder
05/12/2011 02:11	40 (CTD 27)	-60.83324	- 54.72166	CTD stopped @ 1729m
05/12/2011 02:33	40 (CTD 27)	-60.83324	- 54.72169	CTD at the surface
05/12/2011 03:08	40 (CTD 27)	-60.83325	-54.7217	CTD recovered to deck
05/12/2011 03:12	41 (CTD 28)	-60.85025	- 54.71174	Vessel on DP at CTD site 28
05/12/2011 03:32	41 (CTD 28)	-60.85026	- 54.71174	Commence CTD deployment
05/12/2011 03:34	41 (CTD 28)	-60.85034	- 54.71149	CTD deployed
05/12/2011 03:38	41 (CTD 28)	-60.85042	- 54.71112	CTD veering. EA600 depth 975m
05/12/2011 03:43	41 (CTD 28)	-60.85043	- 54.71111	Wire out 978m. Commence hauling
05/12/2011	41 (CTD 28)	-60.85042	-	CTD at surface

04:00			54.71112	
05/12/2011 04:24	41 (CTD 28)	-60.85042	- 54.71111	CTD on deck
05/12/2011 04:47	42 (Fetch)	-60.83318	- 54.72154	Commence Fetch deployment. EA600 depth is 1640m. vessel heading 306 degrees
05/12/2011 04:59	42 (Fetch)	-60.83315	- 54.72166	Fetch released
05/12/2011 05:01	42 (Fetch)	-60.83305	- 54.72195	Hydrophone deployed
05/12/2011 05:04	42 (Fetch)	-60.83304	- 54.72195	Fetch at a depth of 900m
05/12/2011 05:13	42 (Fetch)	-60.83306	- 54.72201	Fetch on seabed and hydrophone recovered
05/12/2011 05:29		-60.83304	- 54.72198	Vessel off DP
05/12/2011 06:04	43 (BPR 1)	-60.82514	- 54.72183	Vessel on D.P for BPR1 deployment
05/12/2011 06:20	43 (BPR 1)	-60.82493	-54.7221	Commence deploying BPR1
05/12/2011 06:32	43 (BPR 1)	-60.82493	-54.7221	BPR released. EA600 depth 920m (ish)
05/12/2011 06:34	43 (BPR 1)	-60.82491	- 54.72207	BPR at depth 520m
05/12/2011 06:44	43 (BPR 1)	-60.82492	- 54.72209	BPR on seabed
05/12/2011 07:10	43 (BPR 1)	-60.82491	- 54.72209	V/L off D.P. commencing boxing in of BPR
05/12/2011 07:14	43 (BPR 1)	-60.82333	- 54.72268	Finished boxing in of BPR
05/12/2011 07:40	43 (BPR 1)	-60.82821	- 54.72317	V/L on D.P. talking to BPR
05/12/2011 07:50	43 (BPR 1)	-60.82847	- 54.72464	BPR released
05/12/2011 08:01	43 (BPR 1)	-60.82851	- 54.72496	FETCH sighted at surface

05/12/2011 08:51	43 (BPR 1)	-60.82798	-54.72633	FETCH grapeled
05/12/2011 09:05	43 (BPR 1)	-60.82774	-54.72665	FETCH buoy on deck
05/12/2011 09:06	43 (BPR 1)	-60.82039	-54.73124	BPR sighted
05/12/2011 09:18	43 (BPR 1)	-60.81878	-54.72873	BPR grapeled
05/12/2011 09:28	43 (BPR 1)	-60.81724	-54.72817	BPR recovered to deck
05/12/2011 09:37	44 (BPR 2)	-60.85241	-54.70429	V/L stopped on D.P. at BPR 2 site
05/12/2011 10:03	44 (BPR 2)	-60.85288	-54.70502	BPR released. E.T.A. to surface 20mins
05/12/2011 10:21	44 (BPR 2)	-60.84833	-54.71593	BPR sighted at surface
05/12/2011 10:49	44 (BPR 2)	-60.84682	-54.71528	BPR recovered to deck
05/12/2011 11:00	44 (BPR 2)	-60.85239	-54.71058	Signal to BPR sent
05/12/2011 11:11	44 (BPR 2)	-60.85341	-54.7095	BPR sighted at surface
05/12/2011 11:32	44 (BPR 2)	-60.84777	-54.71171	Buoy hooked
05/12/2011 11:45	44 (BPR 2)	-60.84767	-54.71151	BPR on deck
05/12/2011 11:48	44 (BPR 3)	-60.84933	-54.7112	BPR released
05/12/2011 12:17	44 (BPR 2)	-60.84932	-54.71125	Buoy on seabed
05/12/2011 12:37	44 (BPR 3)	-60.84933	-54.71125	Vessel off DP. Boxing in on BPR.
05/12/2011 12:40	44 (BPR 3)	-60.85094	-54.71148	Buoy boxed in. proceeding to CTD site 29
05/12/2011	45 (CTD 29)	-61.05111	-	CTD deployed

			54.58701	
13:58				
05/12/2011 14:07	45 (CTD 29)	-60.98145	-54.62983	CTD veering to approx depth 560m
05/12/2011 14:11	45 (CTD 29)	-60.98118	-54.63001	CTD stopped at 520m
05/12/2011 14:21	45 (CTD 29)	-60.98113	-54.63006	CTD recovered to deck
05/12/2011 15:19	46 (CTD 30)	-61.05022	-54.58776	Vessel on D.P at CTD site 30
05/12/2011 15:23	46 (CTD 30)	-61.05011	-54.58723	Commence deploying CTD
05/12/2011 15:26	46 (CTD 30)	-61.05012	-54.58726	CTD deployed and soaking
05/12/2011 15:28	46 (CTD 30)	-61.05012	-54.58725	CTD veering to near bottom. EA600 depth 364
05/12/2011 15:35	46 (CTD 30)	-61.05012	-54.58725	Wire out 345m. Commence hauling
05/12/2011 15:45	46 (CTD 30)	-61.05012	-54.58725	CTD at the surface
05/12/2011 15:47	46 (CTD 30)	-61.05012	-54.58728	CTD recovered on deck
14/12/2011 23:59	47 (Wave buoy 11)	-62.67009	-59.8341	Stopped on station ready to deploy wave buoy
15/12/2011 00:07	47 (Wave buoy 11)	-62.67002	-59.83341	Wave buoy deployed off starboard quarter
15/12/2011 00:14	47 (Wave buoy 11)	-62.67058	-59.83441	Buoy tether fully deployed vessel stopped to drift with buoy
15/12/2011 01:00	47 (Wave buoy 11)	-62.66801	-59.82751	V/L has moved 052 degrees x 0.25 NM since 2400 UTC. Weather - dry 3/8 cloud cover
15/12/2011 01:05	47 (Wave buoy 11)	-62.66769	-59.82653	Change heading to 275 degrees
15/12/2011 02:00	47 (Wave buoy 11)	-62.66318	-59.81618	V/L has moved 048 degrees x 0.46 NM since 0100 UTC. Weather - dry 1/8 cloud cover
15/12/2011 02:14	47 (Wave buoy 11)	-62.66279	-59.81299	V/L steaming 270 degrees at 0.5 knots. towing the buoy at 1.0 knots through the water

Date/Time	Event	Latitude	Longitude	Comment
15/12/2011 02:38	47 (Wave buoy 11)	-62.66281	-59.8198	V/L stopped. Change heading to 000 degrees
15/12/2011 03:00	47 (Wave buoy 11)	-62.66199	-59.81827	V/L has moved 055 degrees x 0.19 NM since 0100 UTC. Weather - dry 1/8 cloud cover
15/12/2011 04:00	47 (Wave buoy 11)	-62.66093	-59.80348	Commence recovering wave buoy vessel heading 000(T) wave buoy leading 090(T) since 0300 GMT vessel has moved 080(T) x 0.42nm
15/12/2011 04:07	47 (Wave buoy 11)	-62.66092	-59.80085	Wave buoy clear of the water
15/12/2011 04:09	47 (Wave buoy 11)	-62.66094	-59.80081	Wave Buoy recovered on deck.
16/12/2011 03:37	48 (Myrtle recovery)	-60.61865	-53.84551	V/L stopped on D.P.
16/12/2011 03:42	48 (Myrtle recovery)	-60.61862	-53.84551	V/L off D.P. carrying out figure of eight for Myrtle location
16/12/2011 05:06	48 (Myrtle recovery)	-60.61878	-53.85119	Completed fix for Myrtle. Myrtle position 60 37.197'S 053 50.3459'W
16/12/2011 05:21	48 (Myrtle recovery)	-60.61928	-53.83866	V/L on D.P.
16/12/2011 05:27	48 (Myrtle recovery)	-60.62039	-53.83987	V/L stopped on D.P. For sending release command
16/12/2011 05:33	48 (Myrtle recovery)	-60.62037	-53.83985	Release command sent. no confirmation
16/12/2011 08:40	48 (Myrtle recovery)	-60.62035	-53.83987	Release failed. Decision taken to move off station
16/12/2011 08:46	48 (Myrtle recovery)	-60.62042	-53.83976	Vessel off DP. heading East for swath survey
16/12/2011 09:31	48 (Myrtle recovery)	-60.61818	-53.84381	End of swath survey. proceeding to recovery position for APEX whilst on passage to Signy
16/12/2011 13:58	49 (APEX Recovery)	-60.62684	-51.98521	V/L on DP
16/12/2011 13:59	49 (APEX Recovery)	-60.62636	-51.98484	PSN received by email
16/12/2011 14:03	49 (APEX Recovery)	-60.62591	-51.98377	V/L off DP. Proceeding to last received PSN
16/12/2011	49 (APEX Recovery)	-60.63678	-	V/L on DP. Searching for buoy

14:29			51.96164	
16/12/2011 14:56	49 (APEX Recovery)	-60.63322	-51.95017	Buoy sighted. 7 points off stbd bow. Approx. 80m off
16/12/2011 15:02	49 (APEX Recovery)	-60.63144	-51.94695	Buoy alongside. Commence recovery. attempting to catch with net
16/12/2011 15:40	49 (APEX Recovery)	-60.62393	-51.92452	APEX buoy hooked and recovered onboard. V/L stopped on D.P.
16/12/2011 15:54	50 (Sonar Bell)	-60.62348	-51.92344	Commence deploying Sonar Bell
16/12/2011 15:57	50 (Sonar Bell)	-60.62347	-51.92353	Sonar Bell deployed. veering to 1000m
16/12/2011 16:23	50 (Sonar Bell)	-60.62304	-51.923	All stopped at 1000m. EA600 depth 3665m
16/12/2011 16:31	50 (Sonar Bell)	-60.6228	-51.92277	Cable veering further 500m to total of 1500m
16/12/2011 16:40	50 (Sonar Bell)	-60.62254	-51.92244	stopped at 1500m
16/12/2011 16:43	50 (Sonar Bell)	-60.62251	-51.92242	commence hauling sonar bell
16/12/2011 17:01	50 (Sonar Bell)	-60.6221	-51.92184	Cable stopped at 500m
16/12/2011 17:03	50 (Sonar Bell)	-60.62206	-51.92176	Re-commence hauling to 250m
16/12/2011 17:07	50 (Sonar Bell)	-60.62198	-51.92163	Stopped hauling at 250m
16/12/2011 17:13	50 (Sonar Bell)	-60.62184	-51.92139	Re-commence hauling
16/12/2011 17:18	50 (Sonar Bell)	-60.62177	-51.9212	Sonar bell at surface
16/12/2011 17:20	50 (Sonar Bell)	-60.62172	-51.92116	Sonar bell recovered to deck
17/12/2011 13:18		-60.69543	-45.55697	V/L on DP for deploying wave buoy
17/12/2011 13:50	51 (Wave buoy 12)	-60.69535	-45.56706	Buoy deployed over STBD quarter

17/12/2011 13:58	51 (Wave buoy 12)	-60.69535	-45.56885	Tether fully deployed. Weather - dry, 7/8 cloud cover
17/12/2011 15:00	51 (Wave buoy 12)	-60.69424	-45.56282	V/L has moved 067 degrees x 0.18 NM since 1358 UTC. Weather - dry, 7/8 could cover
17/12/2011 16:00	51 (Wave buoy 12)	-60.6924	-45.55673	Vessel moved 059(T) x 0.20nm. Dry. Hdg 270(T) since 1500UTC. Buoy brg 070(T)
17/12/2011 16:23	51 (Wave buoy 12)	-60.69149	-45.55494	Changed Heading 295(T)
17/12/2011 17:00	51 (Wave buoy 12)	-60.69017	-45.5516	Vessel has moved 050 x 0.20nm since 1600UTC V/L Hdg 295(T). Dry. Buoy brg 076(T)
17/12/2011 18:00	51 (Wave buoy 12)	-60.68865	-45.54737	Vessel has moved 051 x 0.15nm since 1700UTC V/L Hdg 295(T). Dry. Buoy brg 080(T)
17/12/2011 18:17	51 (Wave buoy 12)	-60.68827	-45.54599	Change heading 285(T)
17/12/2011 19:00	51 (Wave buoy 12)	-60.68932	-45.54302	Vessel has moved 109(T)x 0.14nm since 1800UTC V/L Hdg 285(T). Dry. Buoy brg 090(T)
17/12/2011 20:00	51 (Wave buoy 12)	-60.69066	-45.53652	Vessel heading 285 degrees. V/L COG 112 degrees x 0.2nm. Buoy Brg 070 degrees
17/12/2011 20:56	51 (Wave buoy 12)	-60.69118	-45.53028	Commence recovery of wavex buoy
17/12/2011 21:10	51 (Wave buoy 12)	-60.69116	-45.52769	Wavex buoy recovered to deck

Table A.1 Scientific events obtained from the bridge log.

A.2 Bridge weather log.

date	time GMT	wind dir	force	air temp	sea temp	sea state	swell state	precip	cloud
27/11/2011	15:00	Nw	4	11.4	8.5	slight	slight		overcast
	21:00	NNW	6	11.2	8.6			dry	clouds forming
28/11/2011	00:00					slight	low	dry	clear
	03:00	SW	4	6.8	7.7			dry	
	12:00							dry	overcast cloud developing
	21:00	NW	5	7.4	6.5			showers	

29/11/2011	00:00	SW	6	3.6	6.3	mod		dry	overcast
	06:00	SSW	6	3.8	6.2	mod	slight	rain at times	
	09:00	SW	6	4.1	5.9	mod		dry	overcast
	15:00	SSW	6	4.1	5.9	mod	mod	dry	overcast
	18:00	SSW	4	3.7	5.7	mod	mod	sleet	overcast
30/11/2011	00:00	NW	6	5.3	5.9	mod	mod	dry	overcast
	03:00	NW	6	5.1	5.9	mod to high	mod to high	light rain	
	09:00	296	8 to 7	6	6.2	rough	mod	wet	overcast
	12:00	232	6	5.5	6.2	mod	high		overcast
	18:00	231	8	4.1	6.1	rough	rough		overcast
01/12/2011	00:00	SW	8	4.5	6.1	rough	high	snow	overcast
	03:00	SW	7	3.7	6	mod to high	heavy	snow showers	overcast
	06:00	250	7	4.9	6	mod to rough	mod to rough	showers	overcast
	12:00	266	7	4.3	5.9	rough	high	rain showers	overcast
	18:00	WS	7 to 8	5.7	5.9	mod	mod		overcast
	21:00	WSW	7	5.7	6	rough	rough	dry	overcast
02/12/2011	00:00	WSW	7	6.5	5.9	rough	high		overcast
	03:00	WSW	6	5.7	5.3	mod	mod	light rain	overcast
	06:00	260		3.4	2.7			dry	overcast
	12:00	W	4	3.3	1.4	slight	mod	dry	overcast
	15:00	W	4	3.2	1.3	slight	mod	dry	
	21:00	W	5	2.4	1.2	mod	mod	dry	clear
03/12/2011	00:00	W	4	2.2	1.2		mod	dry	fog
	06:00	W	5	2.3	1.4	slight	mod		fog
	09:00	250	4	2.8	1.4	slight	slight	dry	overcast
	12:00	SW	2	0	1.4	slight	low	dry	overcast
	18:00	WNW	2	-0.4	1.7	slight	mod	dry	
	21:00	WNW	2	0.6	1.3	slight	slight	dry	fog

04/12/2011	00:00	NNW	3	0.7	1.1	slight	slight	broken cloud	fog
	06:00	NNW	4	1.1	1	slight	slight		fog
	09:00	NW	4 to 5	1.1.	1.2	slight	slight	dry	fog
	12:00	NNW	5	1.6	1	slight	slight	showers	fog
	15:00	NNW	4 ot 5	1.6	1.1	slight	slight	dry	overcast
	18:00	330	5	1.4	0.7	slight	slight	rain showers	overcast
05/12/2011	00:00	NNW	4	0.9	1	slight	low		cloud with fog later
	03:00	NNW	4	1.3	1.1	slight	slight	dry	fog
	06:00	NNW	2	4.3	0.9	slight	low	dry	fog
	12:00	NW	3	1.6	1	slight	slight	light rain	fog
	15:00	NNW	3	0.7	1	slight	slight	rain	overcast
15/12/2011	00:00	W	5	2.6	1.1	slight	low	dry	sun clear
	03:00	NW	2 to 3	3.9	1	slight		dry	1 8th cloud
17/12/2011	12:00	W	8	1.2	0		mod	dry	
	18:00	WNW	8	1.5	0.3		slight		
	21:00	WNW	7 to 8	1.8	0.2	mod	slight	dry	cloud
18/12/2011	00:00	WSW	5	1.5	0.4	slight	slight	dry	overcast
	03:00	SW	5 to 6	1	0.1	slight	slight	dry	

Table A.2 Bridge weather observations for the Drake Passage section and subsequent WAGES deployments.

APPENDIX B – JR265 CTD INSTRUCTIONS

B.1 CTD deck unit setup, processing and data transfer.

Pre-sail checks

CTD unit configuration

Make a list of the sensors (with serial numbers) deployed on the CTD frame. Cross check with list provided by BAS technician. Highlight any discrepancies.

CON file checks

1- Once the configuration of the CTD package is known, the SeaBird configuration master file needs to be checked or written from new. For JR265, the CTD configuration had been used previously so the default CON file was used.

> Open SeaSave and under the Configure menu go to "New Instrument Configuration". Click <Create new> or <Modify> depending on whether or not you already have a CON file to edit.
> If creating from existing config save the new configuration under a new name using <Save as>.
> In addition to the list of sensors deployed on the frame (and their serial numbers), you will need the sensors calibration sheets and the mapping between voltage ports (V0, V1, V2, … V7) and the ancillary sensors or, for conductivity and temperature, whether the sensor is used as primary or secondary sensor. Remove any unused sensor setup and ensure that all sensors on the CTD frame are represented in the CON file.
> Enter the new serial numbers, calibration date and calibration coefficients for each sensor. Save as you go along.

2- Print the CON file report and cross-check against calibration sheets again to catch any typing mistakes.

3- Save the final CON file under the JR265 cruise directory ready for use on the first station.

SBE Data processing set-up

Data Conversion settings
· Process scans to end of file: selected
· Scans to skip over = 0;
· Output format = ASCII;
· Convert data from: Upcast and downcast;
· Create file types: both data and bottle files;
· Source of scan range data: Scans marked with bottle confirm bit;
· Scan range offset = 0;
· Scan range duration = 2;
· Merge separate header file selected;
· Selected Output Variables:
· Pressure in db;
o   Primary and secondary conductivity in mS/cm;

o   Primary and secondary temperature ITS-90 in deg C;
o   Scan count;
o   Pressure temperature in deg C;
o   Altimeter, in m;
o   Time elapsed in seconds;
o   Oxygen SBE43 in umol/kg;
o   PAR/irradiance;
o   Beam transmission and beam attenuation (note that we used a calibration
                based on % transmission relative to water);
o   Fluorescence;
o   Oxygen Voltage, SBE43
o   Voltage V4 (transmissometer voltage)

AlignCTD settings

To find the optimum setting for the oxygen measurement the deep test station 901 was used. The shallow test station 900 could not be used to determine the settings as oxygen gradients were not significant enough. Align CTD was run multiple times with the oxygen data advanced by 0, 2, 4, 6, 8 and 10 seconds. The profiles of oxygen concentration on both downcast and upcast were plotted. The downcast and upcast matched best using an advance of 8 seconds. The test was repeated using advances of 7, 7.5, 8, 8.5 and 9 seconds, again finding 8 seconds gave the best results. An advance of 8 seconds was applied to all stations.

CellTM settings

The SeaBird recommended settings of alpha = 0.03 and 1/beta = 7.0 were used on both primary and secondary conductivities.

Data path directory setup

· Check that there are at least 5 Gbytes free on hard drive;
· Create new directory for cruise data path under D:/data/ : e.g. D:/data/jr265/;
· Create sub-directory "config" under D:/data/*cruise* to store the master config file
    and SeaSave windows setup.

B.2 Bottle file formats

*BL files

This file is output by the SeaBird data acquisition software SeaSave and should be located under:

/local/users/pstar/jr195/data/ctd/BOTTLE_FILES/

file name format is : ctd_jr265_001.bl

Pylon number, firing number, date, time, firing start scan number, firing end scan number.

e.g. D:\data\jr194\data\jr194_020\jr194_020.BL
RESET Dec 16 2008 15:37:33
1, 1, Dec 16 2008 16:49:16, 103197, 103233
2, 2, Dec 16 2008 16:55:17, 111862, 111897
3, 3, Dec 16 2008 17:01:03, 120159, 120194

4, 4, Dec 16 2008 17:11:09, 134704, 134739
5, 5, Dec 16 2008 17:20:47, 148582, 148617
6, 6, Dec 16 2008 17:30:20, 162331, 162366
7, 7, Dec 16 2008 17:39:48, 175970, 176005
8, 8, Dec 16 2008 17:49:08, 189407, 189442
9, 9, Dec 16 2008 17:58:40, 203130, 203165
10, 10, Dec 16 2008 18:02:27, 208577, 208612
11, 11, Dec 16 2008 18:05:01, 212280, 212315
12, 12, Dec 16 2008 18:07:08, 215319, 215354
13, 13, Dec 16 2008 18:09:12, 218316, 218351
14, 14, Dec 16 2008 18:11:14, 221245, 221280
15, 15, Dec 16 2008 18:12:56, 223689, 223724
16, 16, Dec 16 2008 18:14:27, 225878, 225913
17, 17, Dec 16 2008 18:15:59, 228075, 228110
18, 18, Dec 16 2008 18:17:34, 230366, 230401
19, 19, Dec 16 2008 18:18:24, 231547, 231582

B.3 Instrument calibration constants

Numerical values for all of the constants can be found in Appendix B.4 which includes the configuration report for the cruise.

The final ASCII output file is of the form *???ctdnn_ctm.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*

All processed files were saved to the //jrua/pstar drive, and the *_ctm.cnv*, *.ros* and *.bl* files also copied to *~/pstar/data/ctd/ASCII_FILES/*.

The pressure sensor was calibrated following:

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

where P is the pressure, T is the pressure period in μS, U is the temperature in degrees Centigrade, D is given by $D = D_1 + D_2 U$, C is given by $C = C_1 + C_2 U + C_3 U^2$, T_0 is given by $T_0 = T_1 + T_2 U + T_3 U^2 + T_4 U^3 + T_5 U^4$.

The conductivity sensor was calibrated following:

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

where p is pressure, t is temperature, and $\delta = CTcorr$ and $\varepsilon = Cpcorr$.

The temperature sensor was calibrated following:

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

where *f* is the frequency output by the sensor.

The oxygen sensor was calibrated following:

where V is voltage output from SBE43, T temperature, S Salinity, Oxsat(T,S) is oxygen saturation and P pressure while Soc, Tcor, Pcor are the constants from calibration sheet characteristic to instrument.

PAR/Irradiance sensor was calibrated following:

where calibration constants M and B are dependent on sensor type, V is output voltage while multiplier, cal.const and offset are the constants from calibration sheet characteristic to instrument.

Fluorometer was calibrated following:

+offset

where V is output voltage measured by CTD and VB, V1, $V_{acetone}$, SF, offset are the constants from calibration sheet characteristic to instrument.

B.4 Seabird CTD configuration file as used throughout JR265.

Date: 12/15/2011
Instrument configuration file: C:\Documents and
Settings\ctd\Desktop\JR265\jr265config.xmlcon
Configuration report for SBE 911plus/917plus CTD

Frequency channels suppressed : 0
Voltage words suppressed   : 0
Computer interface   : RS-232C
Deck unit   : SBE11plus Firmware Version >= 5.0
Scans to average   : 1
NMEA position data added   : No
NMEA depth data added   : No
NMEA time added   : No
Surface PAR voltage added   : No
Scan time added   : No

1) Frequency 0, Temperature
   Serial number : 4874
   Calibrated on : 25/06/2010
   G   : 4.30432453e-003
   H   : 6.35938529e-004
   I   : 2.05234495e-005

```
J          : 1.72243973e-006
F0         : 1000.000
Slope      : 1.00000000
Offset     : 0.0000
```

2) Frequency 1, Conductivity
```
  Serial number : 3248
  Calibrated on : 25/06/2010
  G          : -1.01194759e+001
  H          : 1.52674111e+000
  I          : 4.22561427e-004
  J          : 4.58098975e-005
  CTcor      : 3.2500e-006
  CPcor      : -9.57000000e-008
  Slope      : 1.00000000
  Offset     : 0.00000
```

3) Frequency 2, Pressure, Digiquartz with TC
```
  Serial number : 0771
  Calibrated on : 25/06/2010
  C1         : -4.785925e+004
  C2         : -3.416160e-001
  C3         : 1.442400e-002
  D1         : 3.781000e-002
  D2         : 0.000000e+000
  T1         : 3.011158e+001
  T2         : -3.924450e-004
  T3         : 4.201770e-006
  T4         : 2.250320e-009
  T5         : 0.000000e+000
  Slope      : 0.99992000
  Offset     : -0.89300
  AD590M     : 1.284610e-002
  AD590B     : -8.492760e+000
```

4) Frequency 3, Temperature, 2
```
  Serial number : 2191
  Calibrated on : 23/06/2010
  G          : 4.31985118e-003
  H          : 6.39204988e-004
  I          : 2.30432597e-005
  J          : 2.23447131e-006
  F0         : 1000.000
  Slope      : 1.00000000
  Offset     : 0.0000
```

5) Frequency 4, Conductivity, 2
```
  Serial number : 1912
  Calibrated on : 25/06/2010
  G          : -4.16170047e+000
```

```
H          : 5.36176393e-001
I          : -5.83630963e-004
J          : 5.65767279e-005
CTcor      : 3.2500e-006
CPcor      : -9.57000000e-008
Slope      : 1.00000000
Offset     : 0.00000
```

6) A/D voltage 0, PAR/Irradiance, Biospherical/Licor
```
 Serial number      : 7235
 Calibrated on      : 12/07/2010
 M                  : 1.00000000
 B                  : 0.00000000
 Calibration constant : 38610038610.04000100
 Multiplier         : 1.00000000
 Offset             : -0.03666484
```

7) A/D voltage 1, Free

8) A/D voltage 2, Fluorometer, Chelsea Aqua 3
```
 Serial number : 088-249
 Calibrated on : 13/11/2007
 VB          : 0.181700
 V1          : 2.097600
 Vacetone    : 0.202800
 Scale factor : 1.000000
 Slope       : 1.000000
 Offset      : 0.000000
```

9) A/D voltage 3, Free

10) A/D voltage 4, Transmissometer, WET Labs C-Star
```
 Serial number : CST-1279DR
 Calibrated on : 26/08/2009
 M          : 22.4505
 B          : -1.4144
 Path length : 0.250
```

11) A/D voltage 5, Free

12) A/D voltage 6, Oxygen, SBE 43
```
 Serial number : 0242
 Calibrated on : 21/01/09
 Equation    : Sea-Bird
 Soc         : 4.16500e-001
 Offset      : -4.97900e-001
 A           : -9.13570e-004
 B           : 1.62030e-004
 C           : -2.34710e-006
 E           : 3.60000e-002
```

Tau20   : 1.20000e+000
D1   : 1.92634e-004
D2   : -4.64803e-002
H1   : -3.30000e-002
H2   : 5.00000e+003
H3   : 1.45000e+003

13) A/D voltage 7, Altimeter
    Serial number : 2130.27001
    Calibrated on : 10/11/2006
    Scale factor : 15.000
    Offset   : 0.000

B.5 Details of MSTAR processing

NB: The cnv file MUST contain the scan number and pressure temperature as one of the output variables

3 Feb 2009; updated 13 Oct 2009; updated for jr195 Nov 2009 (gmon+bim).   NOT updated for JR265 - see section 2.6 for implementation during the 2011 Nov/Dec cruise.

This table shows the sequence for ctd and bottle processing

start processing CTD data on nosea2:

cd jr195

cd data/ctd/

step	script	example infile(s)	example otfiles	comments	requires previous step
1	msam_01	none	sam_di344_016.nc	create empty sam file (eg list of vars is in sam_di344_varlist.csv) variable list file is kept in directory M_TEMPLATES	-
2	mctd_01	ctd_di344_016_ctm.cnv	ctd_di344_016_raw.nc	read in ctd data (may need to be edited for exact ctd file name)	-
3	mctd_02	ctd_di344_016_24hz.nc	ctd_di344_016_24hz.nc	rename SBE variable names	2
4	mctd_03	ctd_di344_016_24hz.nc	ctd_di344_016_1hz.nc ctd_di344_016_psal.nc	average to 1 hz and calculate psal, potemp	3
5	mdcs_01	none	dcs_di344_016.nc	create empty dcs file; this is used to store information about start, bottom and end of good data in ctd file	-
6	mdcs_02	dcs_di344_016.nc	dcs_di344_016.nc	populate dcs file with data to identify bottom of cast	3,5
7	mdcs_03	dcs_di344_016.nc	dcs_di344_016.nc ctd_di344_016_surf.nc	populate dcs file with data to identify start and end of cast	3,6
8	mdcs_04	dcs_di344_016.nc pos_di344_01.nc	dcs_di344_016_pos.nc	merge positions onto ctd start bottom end times (requires nav file) can be left until calibration stage	7 & nav
9	mdcs_05	dcs_di344_016_pos.nc	dcs_di344_016_pos.nc ctd_di344_016_raw,nc ctd_di344_016_24hz.nc ctd_di344_016_1hz.nc	apply positions to set of files. Any of this list have positions set if the file exists The list should be extended to include any other chemistry files, and	8

			ctd_di344_016_psal.nc ctd_di344_016_surf.nc ctd_di344_016_2db.nc fir_di344_016_bl.nc fir_di344_016_time.nc fir_di344_016_winch.nc fir_di344_016_ctd.nc sal_di344_016.nc sam_di344_016.nc sam_di344_016_resid.nc dcs_di344_016.nc	the winch file if it exists It can be used at any time, once step 8 is complete Can be left until calibration stage (see 8)	
10	mctd_04	ctd_di344_016_psal.nc	ctd_di344_016_2db.nc	extract downcast data from psal file using index information in dcs file; sort, interpolate gaps and average to 2db. Plot t,s curves using 2bd file.	4,8
11	mfir_01	ctd_di344_016.bl	fir_di344_016_bl.nc	read in .bl file and create fir file	-
12	mfir_02	fir_di344_016_bl.nc ctd_di344_016_1hz.nc	fir_di344_016_time.nc	merge time from ctd onto fir file using scan number	4,11
13	mfir_03	fir_di344_016_time.nc ctd_di344_016_psal.nc	fir_di344_016_ctd.nc	merge ctd upcast data onto fir file	4,12
14	mfir_04	fir_di344_016_ctd.nc	sam_di344_016.nc	paste ctd fir data into sam file	1,13
15a	mwin_01	techsas_files	win_di344_016.nc	times extracted from start and end of ctd 1hz file, plus 10 minutes at either end	4
15	mwin_03	fir_di344_016_time win_di344_016.nc	fir_di344_016_winch.nc	merge winch wireout onto fir file (only relevant if winch data available)	12 & 15a
16	mwin_04	fir_di344_016_winch.nc	sam_di344_016.nc	paste win fir data into sam file	1,15
17	msal_01	none	sal_di344_016.nc	read in the bottle salinities	-
18	msal_02	sal_di344_016.nc	sam_di344_016.nc	paste sal data into sam file	1,17
19	msam_02	sam_di344_016.nc	sam_di344_016_resid.nc	calculate residuals in sam file	14,18

APPENDIX C - UNDERWAY DATA PROCESSING

Helen Snaith

C.1 Daily underway data processing schedule.

**** Note that these steps need to be done in the order listed here. Run m_setup first****

script	calls	input file(s)	output file(s)	Comments
mday_00_get_all(JJJ) runs mday_00('instr',JJJ) for 'instr':	pos	scs_sed/seapos-gll.ACO	nav/seapos/pos_jr265_dJJJ_raw.nc	updates scs_mat/*.mat files for all streams, converted given streams to MSTAR format, as long as output directory exists
	poshdg	scs_sed/seapos-hdt.ACO	nav/seapos/poshdg_jr265_dJJJ_raw.nc	
	gyr	scs_sed/gyro.ACO	nav/gyros/gyr_jr265_dJJJ_raw.nc	
	ash	scs_sed/ashtech.ACO	nav/ash/ash_jr265_dJJJ_raw.nc	
	chf	scs_sed/emlog-vhw.ACO	chf/chf_jr265_dJJJ_raw.nc	
	tss	scs_sed/tsshrp.ACO	nav/tss/tss_jr265_dJJJ_raw.nc	
	sim	scs_sed/ea600.ACO	sim/sim_jr265_dJJJ_raw.nc	
	met	scs_sed/anemometer.ACO	met/surfmet/met_jr265_dJJJ_raw.nc	
	ocl	scs_sed/oceanlogger.ACO	ocl/ocl_jr265_dJJJ_raw.nc	
mday_00_clean_all(JJJ)	mpos_01(JJJ)	nav/seapos/pos_jr265_dJJJ_raw.nc	nav/seapos/pos_jr265_dJJJ.nc	This will discard data cycles with repeat or backwards time jumps, and data outside specified ranges are set default msim_01 generates 30s median average output files also copied as <file>_edit.nc ready for editing in next step
	mhdg_01(JJJ)	nav/seapos/poshdg_jr265_dJJJ_raw.nc	nav/seapos/poshdg_jr265_dJJJ.nc	
	mgyr_01(JJJ)	nav/gyros/gyr_jr265_dJJJ_raw.nc	nav/gyros/gyr_jr265_dJJJ.nc	
	mash_01(JJJ)	nav/ash/ash_jr265_dJJJ_raw.nc	nav/ash/ash_jr265_dJJJ.nc	
	mchf_01(JJJ)	chf/chf_jr265_dJJJ_raw.nc	chf/chf_jr265_dJJJ.nc	
	msim_01(JJJ)	sim/sim_jr265_dJJJ_raw.nc	sim/sim_jr265_dJJJ.nc	
	mmet_01(JJJ)	met/surfmet/met_jr265_dJJJ_raw.nc	met/surfmet/met_jr265_dJJJ.nc	
	mocl_01(JJJ)	ocl/ocl_jr265_dJJJ_raw.nc	ocl/ocl_jr265_dJJJ.nc	
mplxyed	pos	nav/seapos/pos_jr265_dJJJ_edit.nc	nav/seapos/pos_jr265_dJJJ.nc	_edit /_smooth files edited in place, then copied to replace original files. Can be used to restart processing
	gyr	nav/gyros/gyr_jr265_dJJJ_edit.nc	nav/gyros/gyr_jr265_dJJJ.nc	
	ash	nav/ash/ash_jr265_dJJJ_edit.nc	nav/ash/ash_jr265_dJJJ.nc	
	sim	sim/sim_jr265_dJJJ_smooth.nc	sim/sim_jr265_dJJJ.nc	
	met	met/surfmet/met_jr265_dJJJ_edit.nc	met/surfmet/met_jr265_dJJJ.nc	
	ocl	ocl/ocl_jr265_dJJJ_edit.nc	ocl/ocl_jr265_dJJJ.nc	
underwaycheckplots		nav/seapos/pos_jr265_dJJJ_edit.nc sim/sim_jr265_dJJJ_smooth.nc met/surfmet/met_jr265_dJJJ_edit.nc ocl/ocl_jr265_dJJJ_edit.nc		plots variety of parameters to png files

mmerge_pos_gyr(JJJ)		nav/seapos/pos_jr265_dJJJ.nc nav/seapos/poshdg_jr265_dJJJ.nc nav/gyros/gyr_jr265_dJJJ.nc	nav/seapos/pos_jr265_dJJJ.nc nav/seapos/pos_jr265_dJJJ_mgd.nc	_mgd file has gyro & poshdg merged but not vector averaged
mmerge_ash_gyr(JJJ)		nav/ash/ash_jr265_dJJJ.nc nav/gyros/gyr_jr265_dJJJ.nc	nav/ash/pos_jr265_dJJJ.nc nav/ash/pos_jr265_dJJJ_mgd.nc	_mgd file has gyro merged but not vector averaged
mmerge_sim_nav(JJJ)		sim/sim_jr265_dJJJ.nc nav/seapos/pos_jr265_dJJJ.nc	sim/sim_jr265_dJJJ.nc sim/sim_jr265_dJJJ_merged.nc [sim/sim_jr265_dJJJ_merged_cor.nc]	Carter corrected depths, merged on pos_ lat & lon. _merged_cor file is copy of sim_jr265_dJJJ.nc
mmerge_ocl_nav(JJJ)		ocl/ocl_jr265_dJJJ.nc nav/seapos/pos_jr265_dJJJ.nc	ocl/ocl_jr265_dJJJ.nc [ocl/ocl_jr265_dJJJ_merged].nc	_merged files is a copy
mday_02_run_all(JJJ) runs mday_02('dir','instr',JJJ) for 'dir','instr':	M_POS,pos	nav/seapos/pos_jr265_dJJJ.nc	nav/seapos/pos_jr265_01.nc	Just appends current day to end of cruise file. If reprocess previous files, start again (rm *_jr265_01.nc) and run: for jday=day1:last_day; mday_02_run_all(jday); end
	M_GYS,gyr	nav/gyros/gyr_jr265_dJJJ.nc	nav/gyros/gyr_jr265_01.nc	
	M_ASH,ash	nav/ash/ash_jr265_dJJJ.nc	nav/ash/ash_jr265_01.nc	
	M_SIM,sim	sim/sim_jr265_dJJJ.nc	sim/sim_jr265_01.nc	
	M_MET,met	met/surfmet/met_jr265_dJJJ.nc	met/surfmet/met_jr265_01.nc	
	M_OCL,ocl	ocl/ocl_jr265_dJJJ.nc	ocl/ocl_jr265_01.nc	
mbest_all	mbest_01	nav/seapos/pos_jr265_01.nc	nav/seapos/pos_jr265_ave.nc	30 s averaged nav
	mbest_02	nav/seapos/pos_jr265_ave.nc	nav/seapos/pos_jr265_spd.nc	calculate speed course and distance run
	mbest_03	nav/gyros/gyr_jr265_01.nc	nav/gyros/gyr_jr265_ave.nc	30s vector averaged headings
	mbest_04	nav/gyros/gyr_jr265_01.nc nav/seapos/pos_jr265_spd.nc nav/seapos/pos_jr265_01.nc	nav/bestnav/bst_jr265_01.nc	merge vector-averaged heading onto average speed, course
mtruew_01		nav/bestnav/bst_jr265_01.nc met/surfmet/met_jr265_01.nc		calculate true wind speed and direction

make_plot_jr265.jnl		ocl_jr265_01.nc met_jr265_01.nc	met_jr265_316-318.ps ferret.jnl.~*	unix>>cd /local/users/pstar /jr265/data/ocl unix>>setup v6.2 ferret unix>>ferret yes? go make_plots_jr265.jnl start stop yes?quit e.g. go make_plots_jr265.jnl 316 318 would plot data between 316 and 318
ocl_diff_jr265		ocl_jr265_01.nc	ocl_jr265_01_diff.nc ocl_jr265_01_diff_night.nc	Do not run daily. Calculates the difference between meteorological variables. Used to examine offsets between different sensors. Air temperature difference is selected for night time only.

C.2 mplxyed editing of data.

The mstar routine mplxyed is used to plot data and interactively set data cycles to absent. A description of how to use mplxyed is described here using the bathymetry data. A matlab session should be started and m_setup need to be entered at the matlab prompt.

>>pwd

ans=

/local/users/pstar/jr265/data/sim

>> mplxyed

*** mplxyed ***

Enter name of input disc file Type name of mstar file, e.g. sim_jr265_d335_smooth

```
*******************************************************************
Data Name :  sim_jr265_d316 <version> 11 <site> jr265_atsea
Platform :   ship | RRS James Clark Ross | Cruise 195
Instrument :    dpthi  -999.00  dpthw  -999.00
Position (lat lon) : -999.00000  -999.00000
Position (lat lon) : -999 00.000 -999 00.000
Data time origin : 2009-01-01 00:00:00
Fields :    5
Dimension sets:
set  nrows    ncols     norecs
1:  1       37903     37903
*******************************************************************
   *name        *units  *dims*    min  *     max   *   nabs * absval   *
*******************************************************************
* 1*time         *seconds  * 1 * 27216000.000 * 27302397.000 *      0 * -99999.000 *
* 2*depth_feet    *feet     * 1 *       0.0   *   7170.660 *     0 * -99999.000 *
* 3*depth         *m        * 1 *      2.150  *   2185.620 *  21619 * -99999.000 *
* 4*depth_fathoms *Fathoms  * 1 *        NaN  *      NaN  *  37903 * -99999.000 *
```

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* 5*deltat   *seconds * 1 *   1.000 *   796.000 *   0 * -99999.000 *
****

comment: This mstar file created from scs stream

comment: ea600

comment: at 2009-11-14 11:31:25

comment: Time converted from matlab day number to seconds after mstar time origin

File last updated : 2009-11-15 12:11:31

Type variable name or number of independent (x) variable:

1

Type variable names or numbers of dependent (y) variables:

3

Type the number of the variable you wish to edit from the list below

  1 depth

: 1

which action ?

s : select data cycles

l : list selected data

w : plot with selected data cycles removed

o : plot with original data

a : zoom but make 'auto' tick values

z : zoom to exact area chosen with cursor

f : replot with first pdf

b : go back to previous pdf

e : edit selected data to NaN

r : refresh

q : quit

A window has appeared showing the change in depth with time. Using the actions above s through to q we can clean up the data.
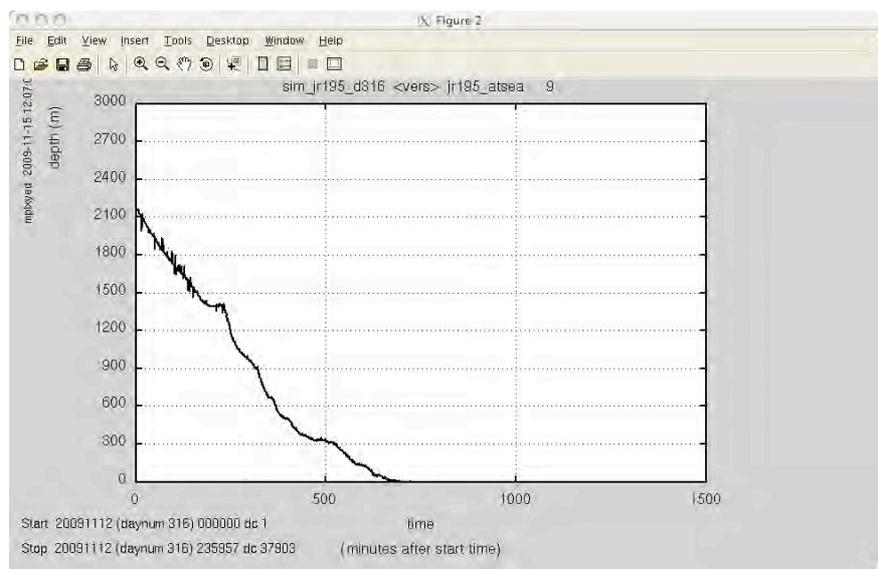
in the matlab window at the action prompt type a

You are taken to the depth vs time window. Using the cross hares click a box around the early part of the time series were the data is noisy.
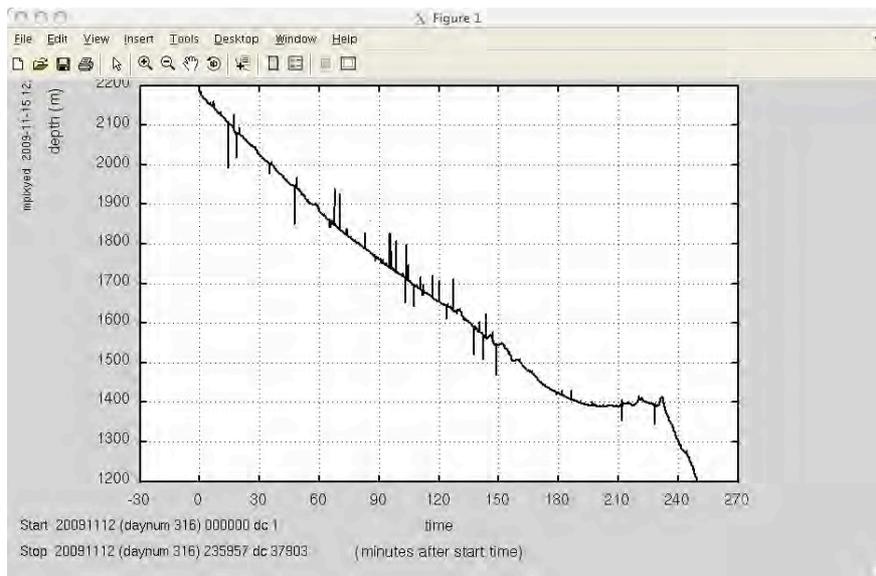
we can now select the obvious outliers as absent. At the action point in the matlab window press s. You are taken to the depth vs time window. Use the cross hares select the data you wish to set to absent (see cyan box below).
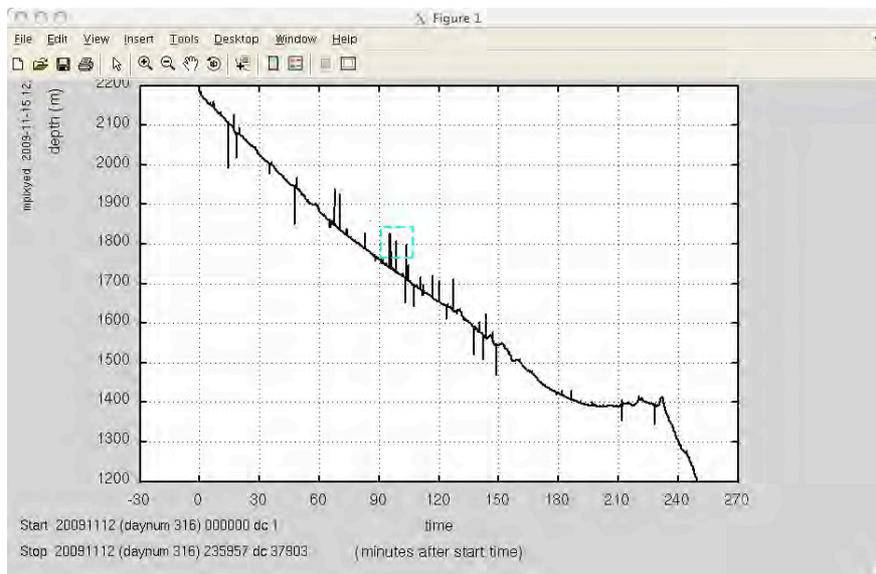
At the action point in the matlab window press w. This shows you the data without the data cycles you have select. If you are happy press e which will edit selected data to absent (NaN in matlab). After repeating this a few times the window has lots of cyan boxes around so lets refresh it using r. Repeat this process and the data will look something like:
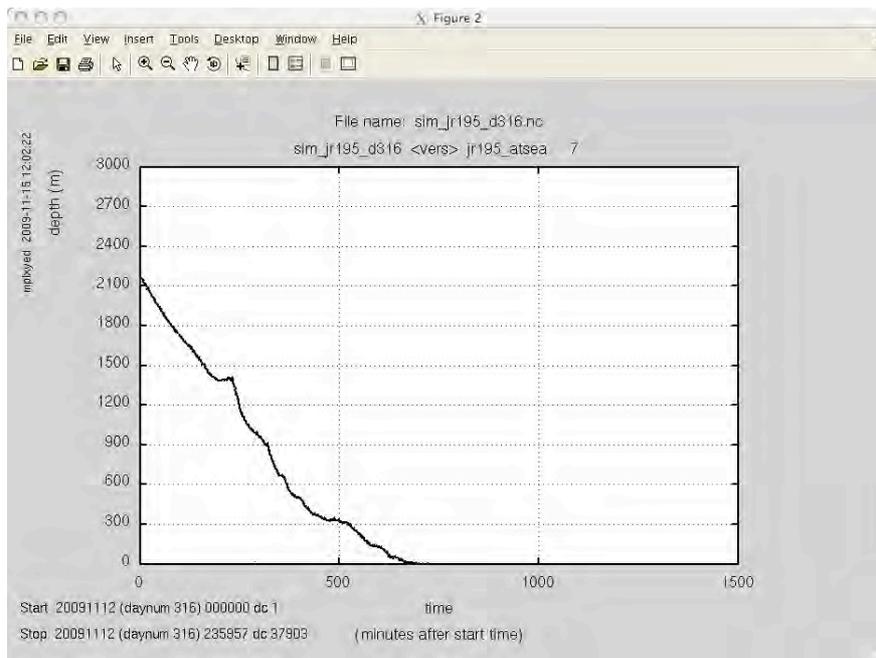
When you are happy use the action q to quit out of mplxyed.

Now the IMPORTANT bit. Copy the sim_jr265_d316_smooth.nc file sim_jr265_d316.nc. We can do this in matlab by using:

>>copyfile('sim_jr265_d316_smooth.nc', 'sim_jr265_d316.nc', 'f')

If the sim_jr265_d316.nc file is not present the sim_jr265_d316_raw.nc file will be appended instead.

Retain the _edit copy of the file, so you can use it if you need to reprocess data for this point on at a later date (eg change the nav file and want to re-merge the data)

APPENDIX D - LOG SHEETS

Margaret Yelland

The following log sheets are appended below:

- CTD deck sampling log - used by the operator of the CTD deck unit.

- CTD salt sampling log sheet - partly filled in by the operator of the CTD deck unit, then passed to the people taking the salt samples from the Niskin bottles.

- LADCP log sheet - completed by the person setting up the LADCP before and after each CTD cast.

- TSG sampling log sheet - completed by the person performing the watchkeeping check when sampling the non-toxic supply.

- Salinometer operations - completed by the person operating the Autosal salinometer.

- Underway log sheet - completed by the person performing watchkeeping checks.

CTD Sampling Deck Log for JR265 (Drake Passage 2011)

Station: _____   **Time in water:** _____

Date: _____   **Time start down:** _____

Julian Day: _____   **Time at bottom:** _____

Operator: _____   **Wire Out (m):** _____

Water depth (EA600): _____   **Pressure (db):** _____

Deck Pressure (db)   **Altimeter (m):** _____

Start: _____   **Time start up:** _____

End: _____   **Time inboard:** _____

Start Lat (ºS): _____   **End Lat (ºS):** _____

Start Lon (W): _____   **End Lon (ºW):** _____

Rosette Num.	Niskin Bottle Num.	Actual wire out (m)	Pressure (db)	Temp (ºC)	Salinity	Expected Niskin to samlpe	Actual Niskin sampled	Comments (expected wire out pre-cast)
1	1							
2	2							
3	3							
4	4							
5	5							
6	6							
7	7							
8	8							
9	9							
10	10							
11	11							
12	12							
13	13							
14	14							
15	15							
16	16							
17	17							
18	18							
19	19							
20	20							
21	21							
22	22							
23	23							
24	24							

Salts sample crate number: **colour:**

Sea Ice obs:

JR265 - NISKIN sampling log sheet

CRATE IDENTIFIER (colour code of bottles and/or number)_____

CTD operator to fill in columns 2 and 3

SAMPLER to fill in columns 1 and 4

Once crate is full, move to BIO LAB and **NOTE DATE AND TIME**.

SAMPLE NUMBER (label on bottle)	CTD STATION NUMBER	NISKIN BOTTLE NUMBER	COMMENT (e.g. leaky Niskin etc.)

LADCP Logsheet JR265

For use with BAS setup (single LADCP, PC and BBTalk scripts)

CTD Cast		Date		JDAY	
Lat		Lon		Depth	

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

Is PC clock time synchronised? (Y/N)	
LADCP woken up with Break (Time GMT)	
Run PreDeployTest.rds script (Time in GMT) Log file name	jr265_ .log
Note any failed tests here	
Internal Moisture reading	
Are pitch and roll changing (Y/N)	
Space Used / Free (Mb)	
Tests completed (time in GMT)	

2. Deployment

Send Config file (WHM265.txt) (Time GMT)	
Disconnect cable, attach blanking plug (Y/N)	
Time in Water (GMT)	

3. Recovery

Connect cables, attach blanking plug (Y/N)	
Wake up with Break (Time in GMT)	
rr: Latest Filename, date and time Space Used / Free (Mb)	
Change baud rate with cb811 (Y/N)	
Recover Recorder data: Filename Disable Window Output (y/n)	
Change baud rate with cb411 (time in GMT)	
Power down with cz (Time in GMT)	

WinADCP: Beam Intensity OK?   **Correlation OK?**

4. Data File Copying Stage (for Penny only)

Original Filename		Copied to Legwork/LADCP: .000	
Renamed filename		Copied to Legwork/LADCP: .log	

JR265 - TSG underway sampling log sheet

CRATE IDENTIFIER (colour code of bottles and/or number)_____

NOTE JDAY (or date if unsure) and time the sample was taken.

Samples to be taken at least every 4 hours.

Once crate is full, move to BIO LAB and NOTE DATE AND TIME.

SAMPLE NUMBER (label on bottle)	JDAY (or date)	TIME GMT (i.e. ship + 3 hours)	COMMENT

SALINOMETER OPERATION LOG SHEET

Ship: Cruise no.: JR265 (2011)   Day/date:
Analyst: Lab Temp Start: End: Cell temp:
SSW Batch: K15:   2*K15   Crate No, Colour:
Standby Start: Zero start: Rs set:
Stanby End: Zero End: File name:

Sample number	Guildline Ratio measured	Comments, final value

JR265. Watch keeping sheet.   (complete every 4hours)

JDAY	Time (GMT)	Ea600 Depth (m)	SCS logging	Wind spd	ADCP NAV feed	Ensemble number	Flow (l/min)	AirT (˚C)	Varying T,S, Chl	TSG Time of sample	Salinometer Lab T (˚C)

APPENDIX E. VM-ADCP SETUP.

JCR ADCP cue card

1. Turn ADCP on at the wall (switch above monitor labelled "ADCP Power" needs to be switched to "ON" and should light up red). The "on" switch on the PC is the right hand button.

2. Check there is sufficient space on the hard drive (at least 3GB)

3. Make sure the Navigation Repeater is running (find this in the Start menu); (JR165 is now the default, no need to create for each cruise)
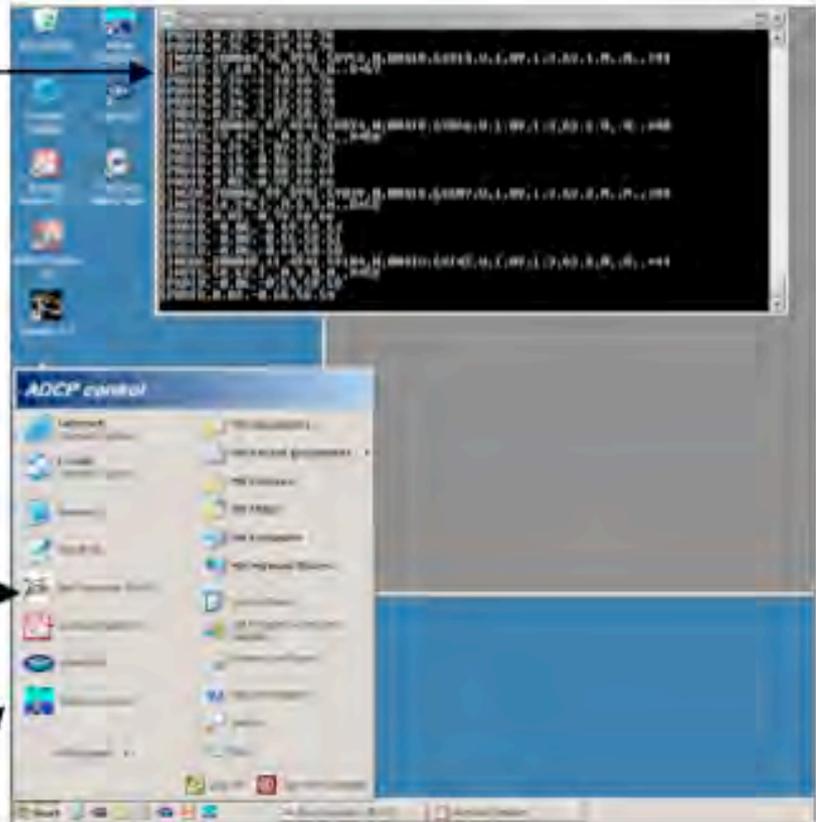
4. Run VmDas (icon on desktop and in start menu)

   If you get the following Autostart screen, click **Yes**
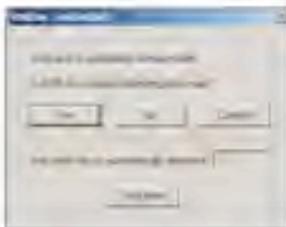
   This window should then appear.

5. In the **File** menu, click on **Collect Data** (this actually starts the setting up to collect data)
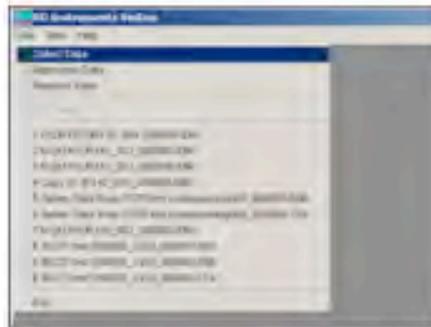
6. In the **Options** menu, select **Edit Data Options**
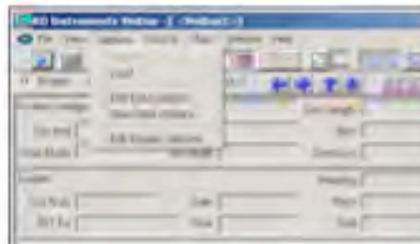
a) **Communications tab**
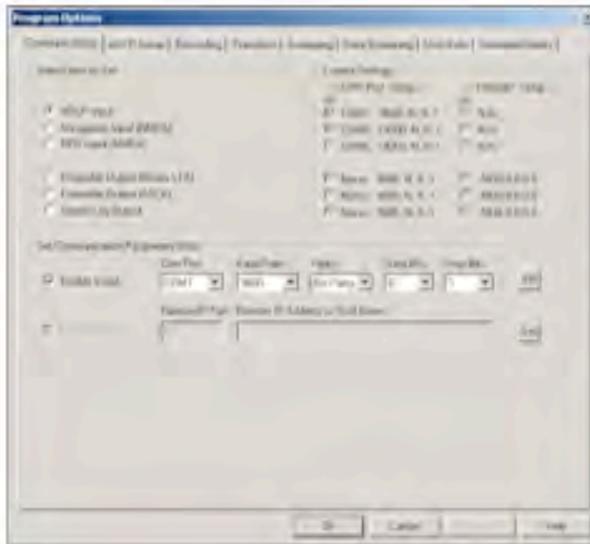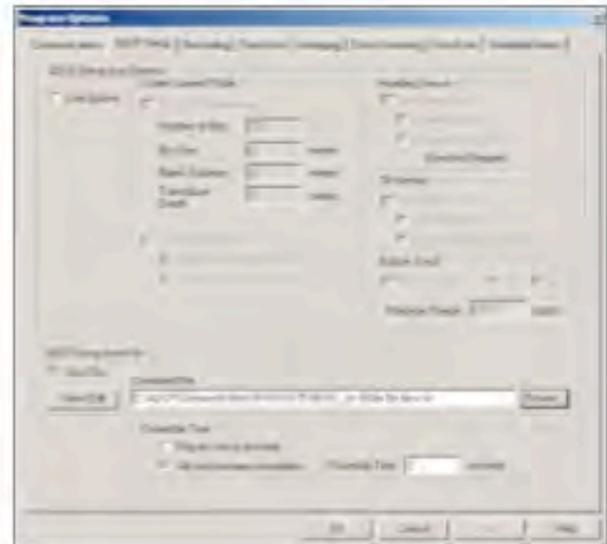
You shouldn't have to touch any of this... it should be set up as above.

b) **ADCP Setup tab**

Enable ADCP Setup from File.
Set to Ping as fast as possible (not as shown).

Click on **Browse** to pick command file. **(See note at end)**
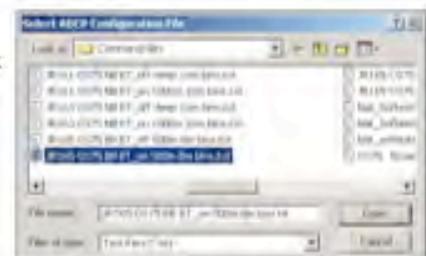
c) Recording tab
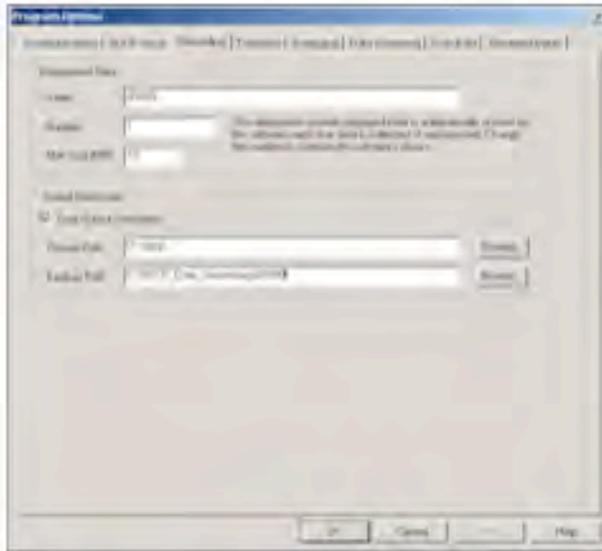
Name = JRNNN_ (where NNN = cruise number,
   e.g. JR165_)
Number = 1 or 2 or ... make sure this increments
   since last time or you will over-write data!
Max Size = 10
Primary Path = U:\data\
Backup Path = C:\ADCP_Data_Secondary\JRNNN

d) Transform tab
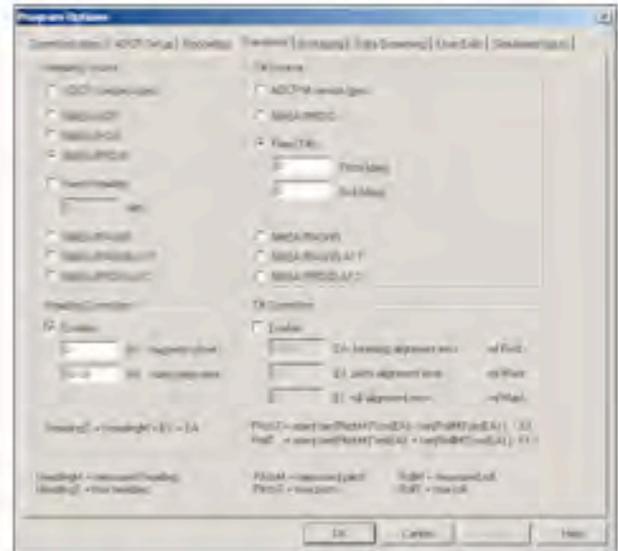
Heading Source = NMEA/PRDID
Tilt Source = Fixed Tilts (0 for both)
Heading Correction = Enable: 0 (EV), 60.08 (EA)
Tilt Correction = don't enable

e) Averaging tab
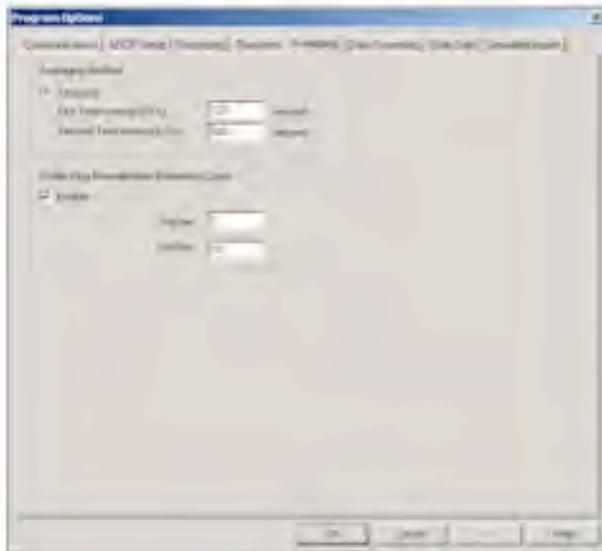
STA = 120 (for 2 minute averaged data)
LTA = 600 (for 10 minute averaged data)

f) Data Screening tab

Don't touch this.

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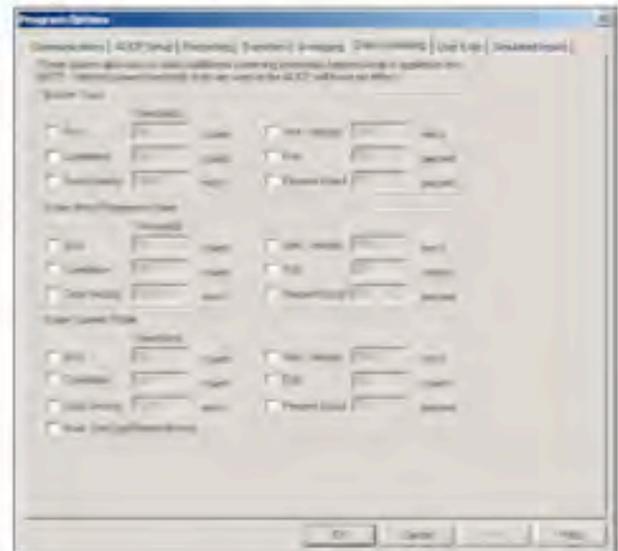
g) User Exits tab
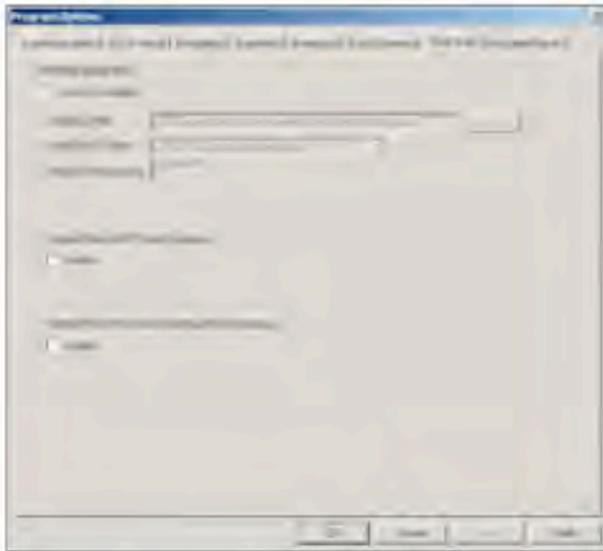
Don't enable or use any of this.

h) Simulated Inputs tab
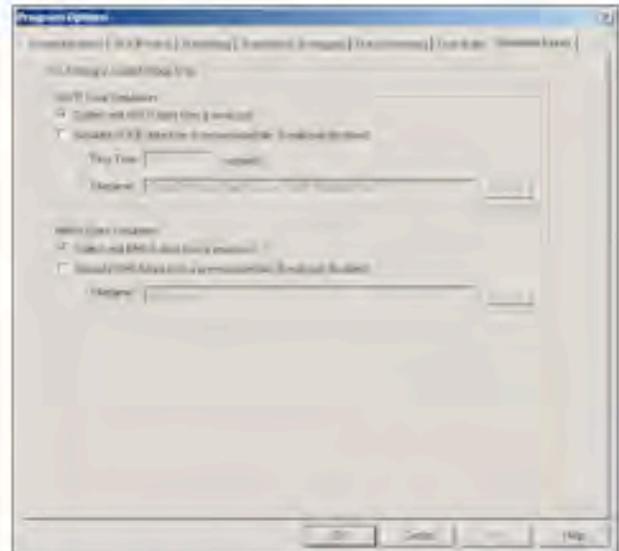
Collect real ADCP data from a serial port
Collect real NMEA data from a serial port

7. To start the ADCP pinging and collecting data, click on blue arrow (in top left corner under "File" menu, looks like a "play" button), or click on **go** in the **Control** menu.

   If it is working the log screen should run through a number of commands, and eventually say something like "ADCP pinging" and then disappear and data should appear and change regularly.
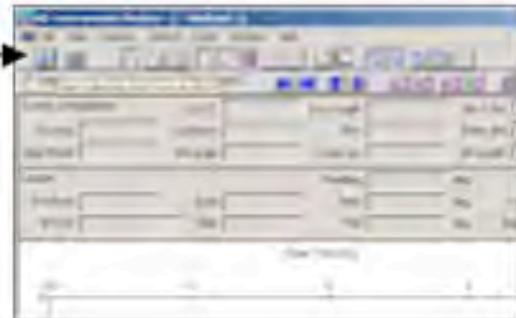

8. To stop the ADCP pinging, either

   click on **stop** in the **Control** menu

   or click on the blue square in the top left hand corner

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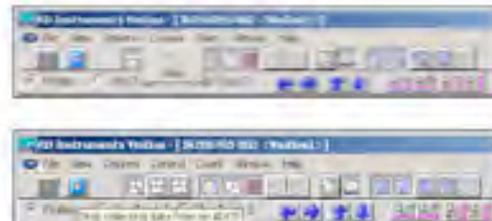
9. To change the data display, use the **Chart** menu and/or the toggle buttons
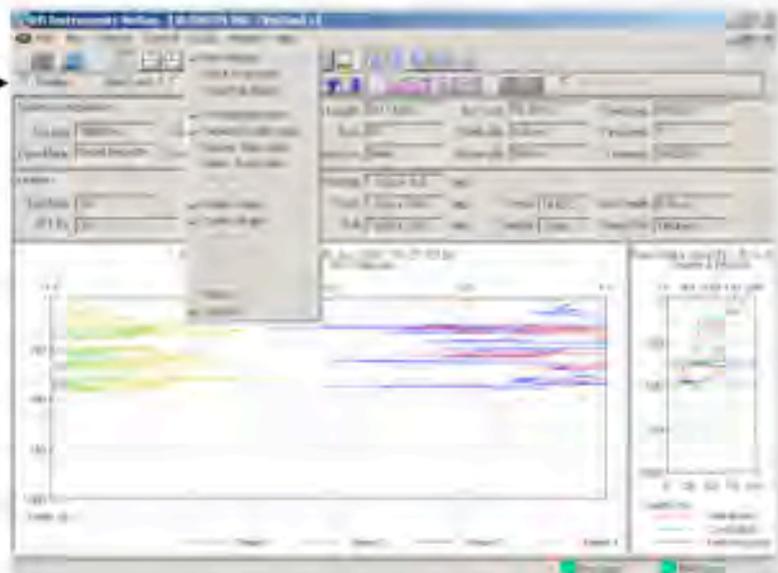
To find out more see the **VmDas User's Guide**, which is on the ship in both printed and electronic format.

Note on command files

Command files have been created for different scenarios - personnel on cruise, depth, need to calibrate instrument. These can be found in C:\ADCP\Command Files\SetModes

JCR_BT250.txt = 250m Bottom Track 8mBins Through SSU
JCR_BT500.txt = 500m Bottom Track 8mBins Through SSU
JCR_BT_opp.txt = 500m Bottom Track 8mBins Not Through SSU
JCR_WC_opp.txt = 800m Water Track 8mBins Not Through SSU
JCR_WC800.txt = 800m Water Track 8mBins Through SSU

Note: Bottom tracking data (BT_on) is very important for calibration purposes, but reduces the temporal resolution and does not work when ADCP is synchronised with other acoustic devices on the ship.
Note: These all use Narrowband mode, which is recommended unless there is a specific requirement for broadband, at which point you will know what you're doing anyway.

To switch mode for different depths; stop data collection; options – edit data options – ADCP setup – change command file – appropriate depth, bottom track on/off, (not) through SSU

Should be 16 m bins rather than 8 m. Under C:\ADCP\Command Files\ there are files from JR193 (2007 Drake Passage) OS75NB BT_om 1000m 16mBon

Potential Problems

The ADCP can run into problems, mostly if it does not receive a trigger from the SSU to ping, causing it to timeout. This causes a white window to appear and start scrolling. Sometimes the ADCP recovers and continues pinging, though the ensemble number may reset to 1, though the actual data file recorded is fine despite this. Other times the instrument stops recording and it should be stopped and restarted immediately. If this fails then check the SSU, it may have crashed.

Outputs

The ADCP writes a series of files to the unix drive (the primary path) and the raw data to the secondary path (sufficient to recover the data, but needs to go through VmDas again to be processed in matlab). The file types and numbering is:

JRNNN_XXX_YYYYYY.EEE

Where:

XXX is a number that increments when the data collection is stopped and restarted. The matlab processing expects this to change so data collection has to be stopped and restarted before matlab processing (as things stand with the code). This is usually done once per day.

YYYYYY is a number that increments once the file size has reached 10Mb, the matlab code scrolls through these for each XXX. Different file types (see below) have different rates of data collection so YYYYYY may be different between them. This is fine.

EEE is the file extension:

.N1R (NMEA telegram + ADCP timestamp; ASCII)
.ENR (Beam co-ordinate single-ping data; binary). These two are the raw data, saved to both disks
.VMO (VmDas configuration; ASCII)
.NMS (Navigation and attitude; binary)
.ENS (Beam co-ordinate single-ping data + NMEA data; binary)
.LOG (Log of ADCP communication and VmDas error; ASCII)
.ENX (Earth co-ordinate single-ping data; binary). This is read by matlab processing
.STA (Earth co-ordinate short-term averaged data; binary)
.LTA (Earth co-ordinate long-term averaged data; binary). This is used for google earth real time plotting

The matlab code expects the XXX number to increment so the data collection should be stopped and immediately restarted each day if the data is being processed during the cruise. The file number should be changed in OS75_JCR_JRNNN and the program run. Data can then be checked for problems or used.