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RRS *James Clark Ross* Cruise 194

12 DEC-23 DEC 2008

Drake Passage repeat hydrography: WOCE Southern Repeat section 1b – Burdwood Bank to Elephant Island

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ABSTRACT

A repeat hydrographic section (WOCE section SR1b) across Drake Passage was occupied during December 2008 aboard the RRS *James Clark Ross* (JR194). This is a section across the Antarctic Circumpolar Current at its narrowest point, with the primary objective of this cruise being to determine the currents, characteristics and transports of the various water masses.

A total of 32 CTD/LADCP stations were sampled across Drake Passage and down to Rothera, of which 30 comprised the SR1b repeat hydrographic section between Burdwood Bank and Elephant Island, and the first two were test stations. In addition to temperature, salinity and oxygen profiles from the sensors on the CTD package, water samples from the 24-bottle rosette were analysed for salinity at each station, in order to calibrate the CTD salinity profiles. Also, samples were collected from the shipís underway system to calibrate and complement the data continually collected by the OceanLogger. Full depth velocity measurements were made at every station by an LADCP (lowered acoustic Doppler current profiler) mounted on the frame of the rosette. Throughout the cruise, velocity data in the upper few hundred metres of the water column were collected by the shipsí VMADCP (vessel mounted acoustic Doppler current profiler) mounted on the hull. Meteorological variables were monitored using the onboard surface water and meteorological sampling system. Bathymetry data were also collected using a Simrad EA600 echo-sounder, and 7 Argo floats were deployed. A new addition to the scientific complement was the study of microbial abundance and dynamics within the Drake Passage section. Flow cytometry was used to compare the abundance of dominant microbial plankton groups, and a scintillation counter to assess the productivity rates of the bacterioplankton.

The work is a component of the "Sustained Observations" supported by NERC's Oceans 2025 programme. This report describes the methods used to acquire and process the data on board the ship during cruise JR194.

KEYWORDS

ADCP, Antarctic Circumpolar Current (ACC), ARGO, CTD, Drake Passage, flow cytometry, LADCP, microbial activity, Thermosalinograph, WOCE repeat line SR1b

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1. Overview

This expedition, from Port Stanley (12th December 2008) to Rothera (21st December 2008) carried out 3 separate science projects. Firstly, there was a repeat of the CTD section along WOCE line SR1b for the purpose of long-term monitoring. Secondly, the cruise provided high-resolution picoplankton analysis, continuing the AMT (Atlantic Meridional Transect) line into the Antarctic Peninsula. Thirdly, POL deployed 3 landers (with bottom pressure recorders) — the latter is only mentioned in this account in passing.

1.1 Objectives

The repeat section SR1b across Drake Passage has been occupied 13 times before by NOC/BAS. The section runs from Burdwood Bank, a shallow rise to the south of the Falkland Islands, to Elephant Island at the eastern end of the South Shetland Islands. Drake Passage is the narrowest passage through which the Antarctic Circumpolar Current (ACC) must flow, and this is a convenient "choke point" for making measurements over the entire ACC. The timing and staging of this cruise makes use of the need for BAS to replenish its station at Rothera at this time of year. Consequently all such transects have been early in the austral summer. The objective of this section is thus not to monitor variations on the seasonal time scale or shorter, which may be done with judicious mooring deployments, but to look at changes on interannual to decadal scales. The key objectives for the 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 to identify thereby the significant water masses;
(v) to calculate the total flux of water through Drake Passage by combining all available measurements.

1.2 Cruise Narrative

The science party, technical support and people destined for Rothera travelled south on the RAF flight leaving Brize Norton on Sunday 7th December (Day 342), reaching Mount Pleasant Airfield, Falkland Islands in the early afternoon of Monday 8th December, with the expectation of sailing on Wednesday 10th December. However, the *RRS James Clark Ross* (JCR) was not in harbour due to a commercial hire off the southwest of the Falklands, which had run late because of bad weather. British Antarctic Survey (BAS) arranged the billeting of personnel in various guesthouses in Stanley. The ship appeared two days later, with mobilization starting then.

BAS had decided that some freight containers were remaining in Stanley. Consequently one container had to be unloaded by forklift truck on the quayside to get at NOCS kit, and a journey was made to the container store to look for other LADCP kit that could not at the time be found. (This was later located on ship, but at the time labelling was not clear that it was the NOCS kit that we were looking for.) Also, during Thursday 11th (Day 346) the required sensors were set up on the CTD frame, and the salinometer set up in the Prep Lab (as it had been for the preceding AMT cruise). Argo floats were located and moved to the Bosun's workshop.

On Friday 12th (Day 347) we sailed at 18:00 GMT (15:00 local time). A few miles offshore we did a test dip of the CTD in 117 m of water, firing all 24 bottles. We found that the salinometer water bath could not maintain a constant temperature in the Prep Lab (even with outside door kept shut), so had it moved to the Bio Lab, where it had been the previous year, and which was not being used as a thoroughfare. The second test dip occurred early the next day. We reached Station 3, start of main CTD section at 15:00 GMT on Day 348. CTD stations 4, 5 & 6 then occur in close proximity, but were preceded by passage to location of sta. 5 for POL to recover lander and deploy replacement during daylight, before we went back to start our intense CTD work at Station 4. BAS switched on swath system at 14:30 GMT that day, as it is believed the SSU now does a good job on preventing it interfering with VM-ADCP and EA600 (depth sounder); however, it had to be switched off again at 17:00 so POL could use their pinger to communicate with the lander. However, later on Day 348 when EM120 (swath) was turned off, the EA600 was not working well, so EM120 was used on approach to station to get a good depth estimate.

A problem was noted early on with LADCP units, with no files being recorded for CTD 3, and CTDs 4 & 5 having master files but none from the slave. A fizzed connector pin was noted on the latter unit. As the early CTD stations were closely spaced, there was no time for action until Day 349 when the problematic downward-looking (slave) unit was removed and the upward-looking one moved to the downward-looking position. For most days a single early morning vertical net haul was performed using the forward crane while the CTD was going down. This net was designed to record the meso-plankton at 50-150m depth. We had acquired 7 Argo floats from the UK Met Office, with 4 floats being equipped with ice-avoidance software. The floats were deployed approximately uniformly across the section from 55.1˚S to 59.7˚S.

The second POL station was midway between CTD stations 18 & 19, with the third (at the southern end of section, being ~60 km east of our SR1b repeat line, and fitted in between stations 27 & 28. The full set of CTDs was completed by early on Friday 19th (Day 354), just before a big storm reached the area. We then had a calm passage to Vernadsky, where the

POL people were servicing a tide gauge, and a number of people visited the Ukrainian base. This was a good opportunity to finish the salinometer work and progress the packing, given uncertainties on whether we would have much time at Rothera.

In the end, we reached Rothera at 13:15 GMT on Sunday 21st Dec (Day 356) and had plenty of time to pack the kit in a freight container on the deck. Our original return flights had been planned via Punta Arenas, but due to a 2-day delay of cruise, BAS found it easier to get people back via Falklands. Thus science party flew out of Rothera on the Dash-7 at 06:00 on 22nd December, and were hostelled at Mount Pleasant for a return flight with the RAF. The Dash-7 made a quick turn around at MPA, taking 2 of scientific party on to Punta Arenas, where the next group destined for Rothera were waiting.

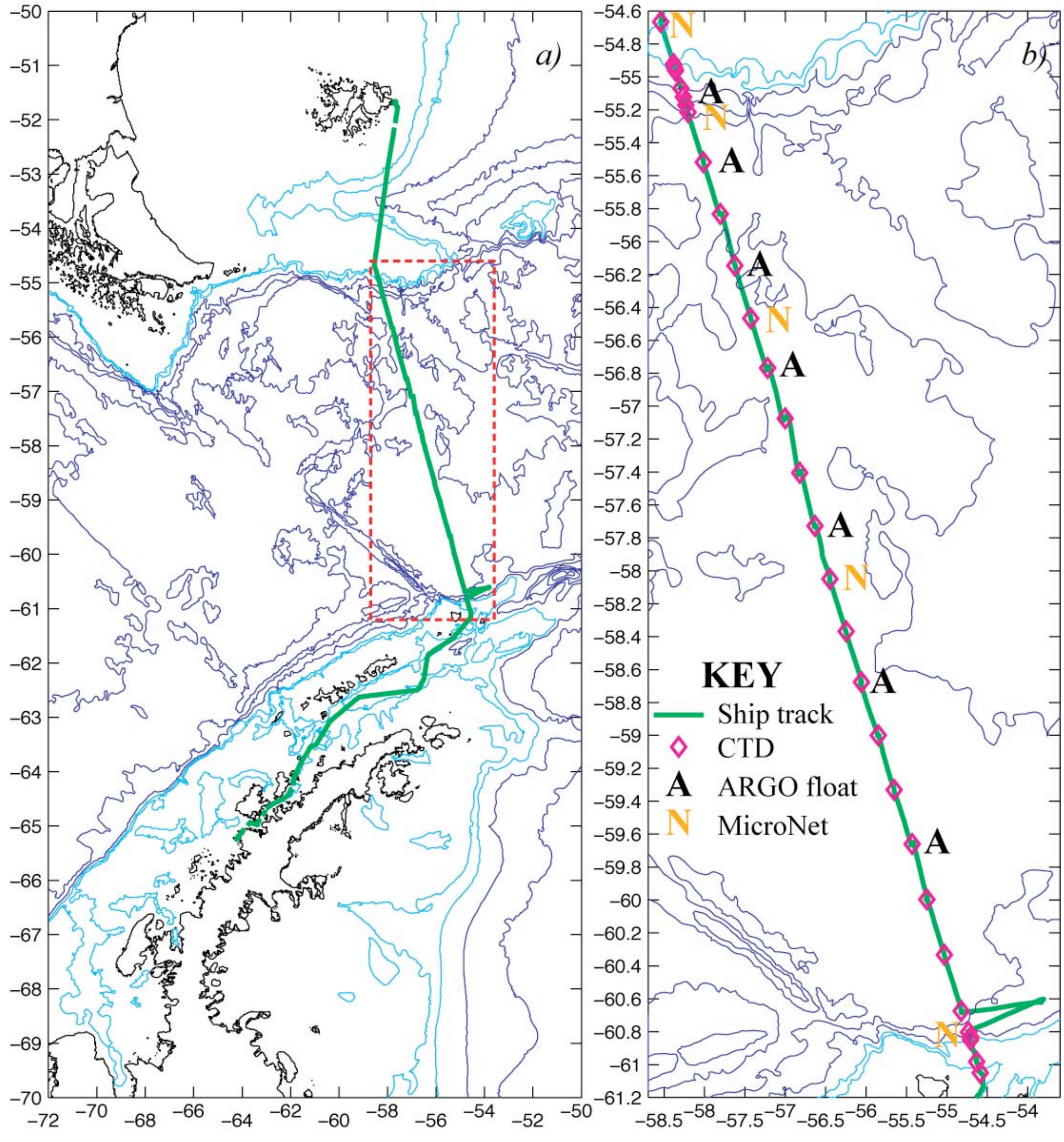

Figure 1.1: a) Route followed by RRS *James Clark Ross* during cruise JR194, with b) close-up of section. Light blue contours indicate 500m and 1000m isobaths, and dark blue the 2000m, 3000m, 4000m & 5000m ones.

Graham Quartly

2. CTD

2.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used on JR194 to produce vertical profiles of the temperature and salinity of the water column. Thirty-two stations were occupied across the Drake Passage SR1b transect, the first two of which were test dips. The nominal station locations across Drake Passage are listed in Table 2.1 and actual locations (mid-points), alongside the water depth, are listed in Table 2.2.

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

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

Table 2.2: CTD Stations during JR194. Times and positions correspond to bottom of cast. The asterisks indicate occasions when the MicroNet was deployed as well.

Station	Julian Day	Time hh:mm	Latitude °S	Longitude °W	Water depth (m)
194ctd01	347	20:34	51.772	57.582	117
194ctd02	348	07:14	53.507	58.181	2321
194ctd03 *	348	15:20	54.666	58.543	374
194ctd04	348	20:15	54.922	58.385	493
194ctd05	348	21:40	54.944	58.371	1098
194ctd06	348	23:32	54.961	58.361	1590
194ctd07	349	02:18	55.070	58.294	2051
194ctd08	349	05:14	55.121	58.262	2505
194ctd09	349	08:08	55.171	58.231	2958
194ctd10 *	349	11:15	55.214	58.204	3809
194ctd11	349	16:34	55.518	58.016	4223
194ctd12	349	22:30	55.832	57.805	4767
194ctd13	350	03:56	56.146	57.626	3395
194ctd14 *	350	08:59	56.467	57.428	3817
194ctd15	350	13:59	56.768	57.220	3317
194ctd16	350	19:27	57.074	57.001	3976
194ctd17	351	00:37	57.405	56.823	3451
194ctd18	351	05:21	57.728	56.633	3486
194ctd19 *	351	11:54	58.050	56.449	3968
194ctd20	351	16:48	58.368	56.247	3883
194ctd21	351	21:35	58.677	56.058	3764
194ctd22	352	02:35	58.999	55.848	3725
194ctd23	352	07:24	59.331	55.653	3775
194ctd24	352	12:03	59.660	55.429	3706
194ctd25	352	16:48	59.997	55.246	3491
194ctd26	352	21:24	60.333	55.031	3447
194ctd27	353	01:45	60.674	54.821	3084
194ctd28 *	353	12:45	60.803	54.730	2643
194ctd29	353	15:00	60.833	54.705	1681
194ctd30	353	16:37	60.848	54.706	1028
194ctd31	353	20:27	60.982	54.632	596
194ctd32	353	21:47	61.050	54.587	353

2.2 Configuration

We used a full-sized SBE 24 carousel water sampler, holding twenty-four 20L bottles, connected to an SBE 9 plus CTD and an SBE 11 plus deck unit were used to collect vertical profiles of the water column. The deck unit provides power, real-time data acquisition and control. The underwater SBE 9 plus unit featured dual temperature and conductivity (SBE 4) sensors, and a Paroscientific pressure sensor. A T-C (temperature-conductivity) duct and a pump-controlled flow system ensure that the flow through the T-C duct is constant to minimize salinity spiking. Files containing the data are saved in binary and ASCII format.

In addition, an altimeter, a fluorometer, an oxygen sensor and a PAR/Irradiance sensor were attached to the carousel. The altimeter gave real-time accurate measurements of height off the seabed once the instrument package was within approximately 100 m of the bottom. Calibration constants for all instruments are detailed in Appendix 1. Quartly and Venables (2010) noted that for JR193 the oxygen sensor SBE 43 had a 6-sec delay relative to the pressure sensor due to the water transit time through the instrument. A fin was added to the frame to reduce rotation of the package underwater. We also had one or two UKORS LADCPs attached to the main CTD frame (see section 4 for details).

2.3 Deployment

The CTD package was mounted on NOC's frame and deployed from the mid-ships gantry, on a single conductor torque-balanced cable connected to the CTD through the BAS conducting swivel. This CTD cable was made by Rochester Cables and was hauled on the 10T traction winch. The winch system worked perfectly throughout the cruise. The general procedure was to start data logging, deploy, and then to stop the CTD at 10 m cable out. The pumps are water-activated and should come on 60 seconds after the CTD is in the water. If the word display on the Deck Unit is set to 'E' then the least significant digit on the display indicates whether the pumps are off (0) or on (1). After a 2-5 minute soak, the package was raised to just below the surface and then continuously lowered to a nominal 10 m above the seabed.

We had mounted twenty-four 20L Niskin bottles on the CTD frame. At each station the first bottle was fired at the bottom of the downcast and subsequent Niskin bottles were fired during the upcast, with a pause of 5 seconds between the winch stopping and the bottle firing. Most of the bottles were fired at fixed depths, specified by wire out = 4500, 4000, 3500, 3000, 2500, 2000, 1500, 1000, 500, 350, 250, 200, 150, 100, 70, 50, 30 and 10m. The more frequent firing near the surface was principally for the biological samples, as most stations showed a deep chlorophyll maximum at ~50-100 m depth (see Fig. 2.3). Two bottles were fired at the top (10 m depth) enabling duplicates for analysis, and also possibly a larger volume of water if required for biological analysis.

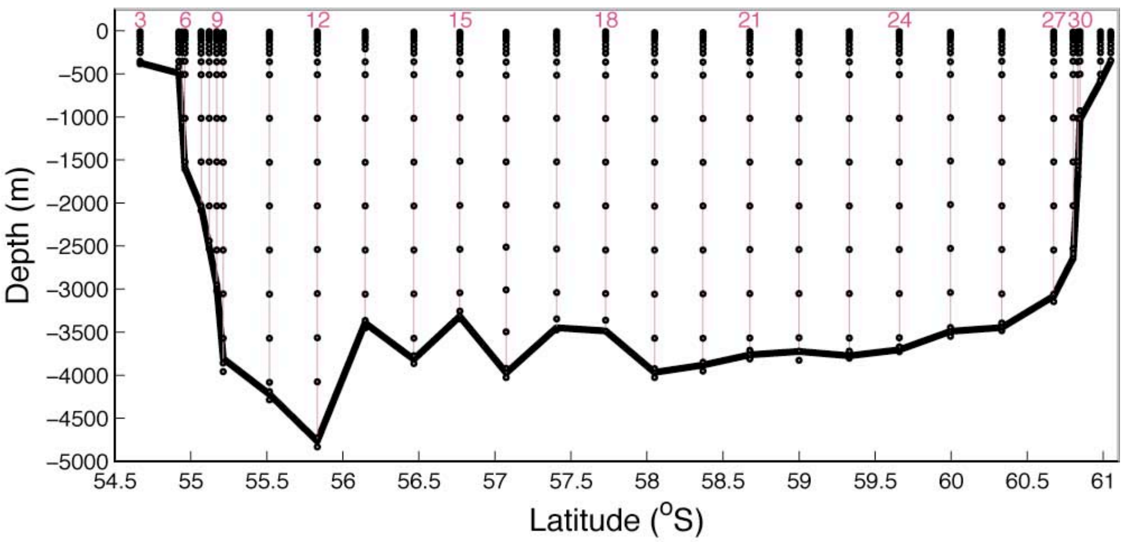

Figure 2.1: Depths of CTD bottle firing. Note the bathymetry profile is from the echo sounder (estimated in m), whereas values shown for bottles are pressure (in db), hence the fact that some bottles appear to be below the seabed. In most cases, the bottom bottle is 5-10 m above the bottom (according to the altimeter).

Table 2.3: Depth of bottles fired at each CTD station.

Sta.	Lon (˚W)	Lat (˚S)	Date (yr-mon-day)	Depth (m)	Bottle depths (db)
1	57.58	51.77	2008-12-12	117	101 102 101 102 102 102 102 102 101 73 73 73 52 53 52 33 33 32 13 12 13 3 3 3
2	58.18	53.51	2008-12-13	2321	2341 2238 2004 1522 1015 509 359 258 207 156 157 107 76 56 36 11
3	58.54	54.67	2008-12-13	374	384 356 255 205 155 104 74 53 33 10
4	58.38	54.92	2008-12-13	493	517 417 356 255 204 154 103 73 52 33 13 13
5	58.37	54.94	2008-12-13	1098	1155 1065 1015 508 355 254 204 154 104 73 53 33 13 13
6	58.36	54.96	2008-12-13	1590	1610 1523 1015 509 357 257 206 155 104 75 55 35 14 14
7	58.29	55.07	2008-12-14	2051	2088 2032 1524 1018 510 358 258 208 157 107 77 57 37 10 10
8	58.26	55.12	2008-12-14	2505	2537 2442 2033 1522 1015 510 358 258 207 157 106 76 56 35 10 9
9	58.23	55.17	2008-12-14	2958	3022 2954 2545 2034 1524 1018 511 360 260 209 159 108 78 58 38 10 10
10	58.20	55.21	2008-12-14	3809	3958 3859 3571 3058 2547 2036 1528 1019 513 362 261 208 160 110 80 59 40 19 19
11	58.02	55.52	2008-12-14	4223	4287 4189 4086 3571 3059 2546 2035 1527 1019 512 361 261 211 160 109 79 59 39 19 19
12	57.80	55.83	2008-12-14	4767	4835 4727 4078 3566 3055 2544 2034 1526 1019 513 362 261 211 161 110 80 60 39 10 11
13	57.63	56.15	2008-12-15	3395	3453 3366 3059 2546 2035 1527 1019 512 361 210 210 159 109 78 59 38 11 11
14	57.43	56.47	2008-12-15	3817	3864 3776 3571 3058 2546 2035 1526 1017 510 359 259 210 160 111 80 61 40 13 13
15	57.22	56.77	2008-12-15	3317	3348 3257 3045 2539 2027 1517 1012 507 357 257 208 158 107 77 58 38 17 17
16	57.00	57.07	2008-12-15	3976	4028 3921 3497 3010 2512 2025 1523 1020 514 363 261 210 160 110 80 59 39 19 19
17	56.82	57.40	2008-12-16	3451	3476 3348 3043 2534 2027 1523 1018 514 362 261 211 161 109 79 59 39 11 11
18	56.63	57.73	2008-12-16	3486	3492 3364 3055 2547 2036 1526 1020 514 362 261 211 161 111 80 60 40 10 10
19	56.45	58.05	2008-12-16	3968	4027 3924 3573 3060 2548 2038 1528 1022 514 362 262 212 161 111 81 60 40 19
20	56.25	58.37	2008-12-16	3883	3954 3850 3571 3058 2546 2036 1527 1020 515 363 262 211 161 111 80 60 40 19 19
21	56.06	58.68	2008-12-16	3764	3813 3712 3569 3055 2544 2034 1525 1017 509 358 258 207 157 106 76 56 36 11 10
22	55.85	59.00	2008-12-17	3725	3826 3723 3568 3055 2544 2034 1526 1019 513 361 261 211 160 110 80 59 39 13 13
23	55.65	59.33	2008-12-17	3775	3801 3723 3569 3054 2543 2035 1526 1019 512 361 260 210 159 108 79 58 38 10 10
24	55.43	59.66	2008-12-17	3706	3730 3670 3567 3054 2541 2034 1525 1019 509 360 260 207 159 108 77 57 37 11 11
25	55.25	60.00	2008-12-17	3491	3549 3447 3041 2530 2021 1514 1010 507 358 257 207 157 107 77 57 36 16
26	55.03	60.33	2008-12-17	3447	3484 3393 3058 2544 2034 1525 1017 511 357 257 207 157 106 75 56 36 9 10
27	54.82	60.67	2008-12-18	3084	3149 3058 2548 2034 1524 1020 514 361 261 209 159 111 80 59 39 10 10
28	54.73	60.80	2008-12-18	2643	2648 2532 2031 1522 1011 508 356 256 207 156 106 75 54 35 14
29	54.70	60.83	2008-12-18	1681	1694 1618 1520 1017 511 358 258 207 156 106 77 56 35 15 14
30	54.71	60.85	2008-12-18	1028	1023 929 507 357 256 205 154 104 74 52 54 34 9 9
31	54.63	60.98	2008-12-18	596	576 507 355 255 204 153 103 73 52 33 10 10
32	54.59	61.05	2008-12-18	353	345 256 205 155 104 74 54 33 9 9

2.4 Data acquisition

The CTD data were logged via the deck unit to a 1.4 GHz P4 PC, running *Seasave Win32 version 5.28e* (Sea-Bird Electronics Inc.). This software allows numerical data to be listed to the screen in real time, together with several graphs of various parameters. Initial processing is on the PC, applying the cell "thermal mass" correction, and then data were ported to the Unix system. Data were examined on-board using processing as for JR193 (Quartly & Venables, 2010) plus Matlab scripts; however, later, a full reprocessing of the CTD data was performed at NOCS.

Figures 2.2 & 2.3 show the variation of the key CTD parameters across the SR1b section.

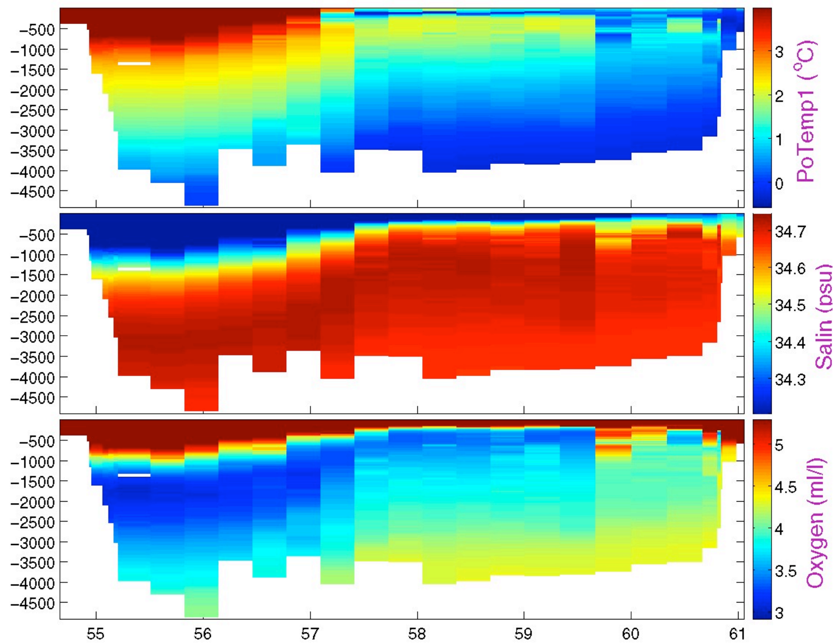

Figure 2.2: Plot of potential temperature (˚C), salinity and oxygen concentration) for Drake Passage section of JR194.

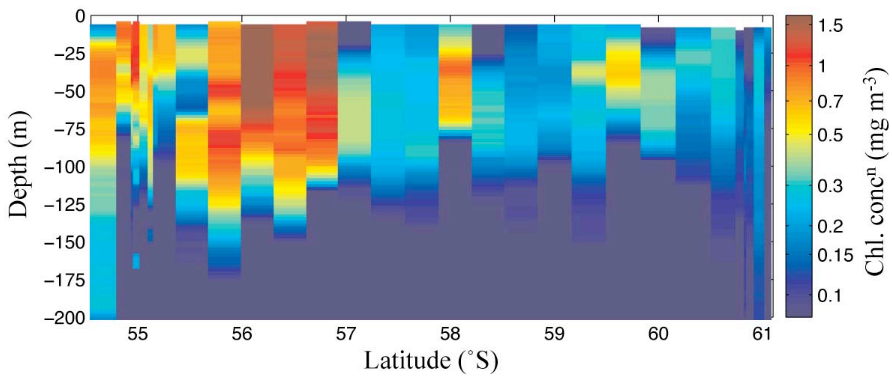

Figure 2.3: Plot of chlorophyll concentration in top 200 m for JR194.

Graham Quartly

3. Salinometer

Water samples were taken from all Niskin bottles on CTD dips, and every 4 hours from outflow of thermosalinograph (TSG, part of ocean logger, see section 6). The salinometer, a BAS Guildline Autosal model 8400B, was used in the Prep Lab, with the water bath set to a temperature just above ambient. All sample bottles were stored in that room for at least 24 hours prior to analysis.

3.1 TSG calibration

The records from the evaluation of the TSG show agreement to within 0.01 psu. There are 3 values that look like outliers; if those values are removed there are 32 with a r.m.s. value of 0.0039 psu. There is a slight difference in the bias between the first half of cruise and the second half (Fig. 3.1b); however, we did not find it appropriate to apply different offsets to those two parts. Data were also analysed for bias as a linear trend in salinity value, but the derived correlation was not significant

3.2 CTD calibration

Assessment of the CTD salinity calibration for JR194 was carried out at NOCS after completion of the cruise. The raw CTD data and sample data were used as input files, and the data were processed using the NOCS in-house *mstar* processing routines. Corrections were calculated and applied to conductivity values, which were then reprocessed to provide corrected salinity values.

Conductivity data for CTD sensors 1 and 2 were examined, and a pressure effect was noted for sensor 2. It was hence decided to correct the sensor 1 data for the calibration. Conductivity bottle and CTD sensor values were compared and residuals were examined with respect to station number. Suspected "bad" bottles were marked in the final data file using a quality flag, and a final correction was calculated using only data deeper than 900 db, to remove surface variability.

A single uniform correction of -1.4 (±3.6) $x10^{-5}$ was applied to the conductivity values of sensor 1 in the original 24Hz *mstar* files, corresponding to an approximate correction of -0.005 (±0.001) psu in salinity. After correction the mean value of the conductivity residuals was $-2.11x10^{-6}$, with a median of $-1.39x10^{-6}$ and in inter-quartile range of $3.18x10^{-5}$. The distribution is concentrated about the mean, with 87% of values within 1 s.d. and 95% within 2 s.d.

Table 3.1: Results of salinity calibration for samples taken from thermosalinograph supply.

Datacycle	JDay	Salinometer Salinity	TSG rawsalin	TSG-Sal
1	348.0090	33.7484	33.7456	-0.0028
2	348.1701	34.0321	34.0385	0.0064
3	348.3076	34.0419	34.0483	0.0064
4	348.4722	34.0098	34.0113	0.0015
5	348.6458	33.9816	33.9876	0.0060
6	348.8222	33.9659	33.9695	0.0036
7	349.0049	33.9259	33.9310	0.0050
8	349.0410	34.0002	34.0026	0.0024
9	349.1257	33.9561	33.9591	0.0030
10	349.2958	33.8950	33.8997	0.0047
11	349.4688	33.8936	33.9071	0.0135
12	349.6535	33.9863	33.9896	0.0033
13	349.8167	34.1127	34.1168	0.0041
14	349.9833	33.9733	33.9784	0.0051
15	350.1285	34.0968	34.0999	0.0031
16	350.3514	34.0813	34.0854	0.0041
17	350.5333	34.0525	34.0572	0.0047
18	350.7083	33.9062	33.9193	0.0131
19	350.8528	33.8124	33.8140	0.0016
20	351.2201	33.8406	33.8411	0.0005
21	351.3771	33.8813	33.8808	-0.0005
22	351.5854	33.8275	33.8203	-0.0072
23	351.7819	33.9040	33.9017	-0.0023
24	351.9500	33.8962	33.8902	-0.0060
25	352.2257	33.9226	33.9205	-0.0021
26	352.4028	34.0337	34.0105	-0.0232
27	352.5250	34.0921	34.0894	-0.0027
28	352.7396	34.1875	34.1867	-0.0008
29	352.9632	34.2446	34.2388	-0.0058
30	353.0882	34.2664	34.2624	-0.0040
31	353.1840	34.1050	34.1032	-0.0018
32	353.4361	34.1848	34.1847	-0.0001
33	353.6549	34.3700	34.3682	-0.0018
34	353.7403	34.3868	34.3843	-0.0025
35	353.9271	34.3296	34.3316	0.0020

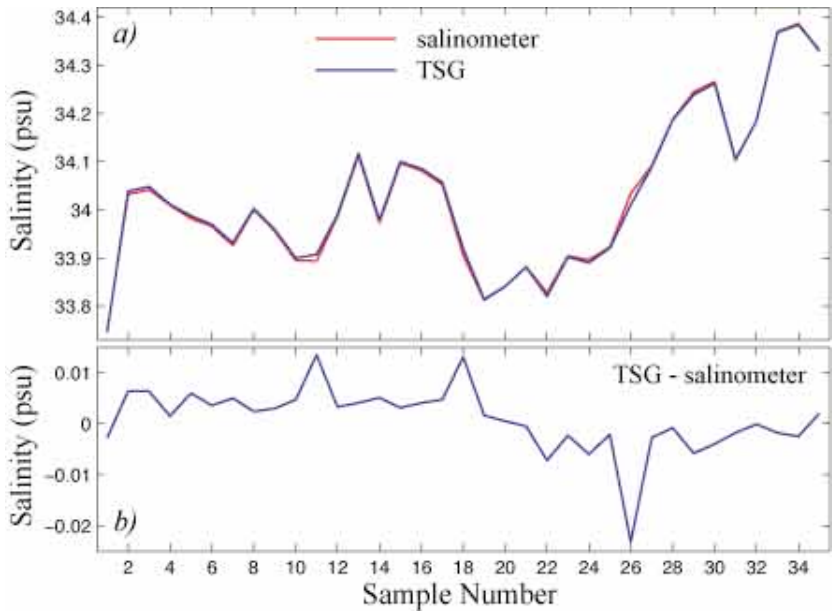

Figure 3.1: Salinity comparison for TSG records. a) Time series for each instrument, b) Difference. There appears to be a slight change in bias, but as errors are generally small no overall correction was applied to the TSG data.

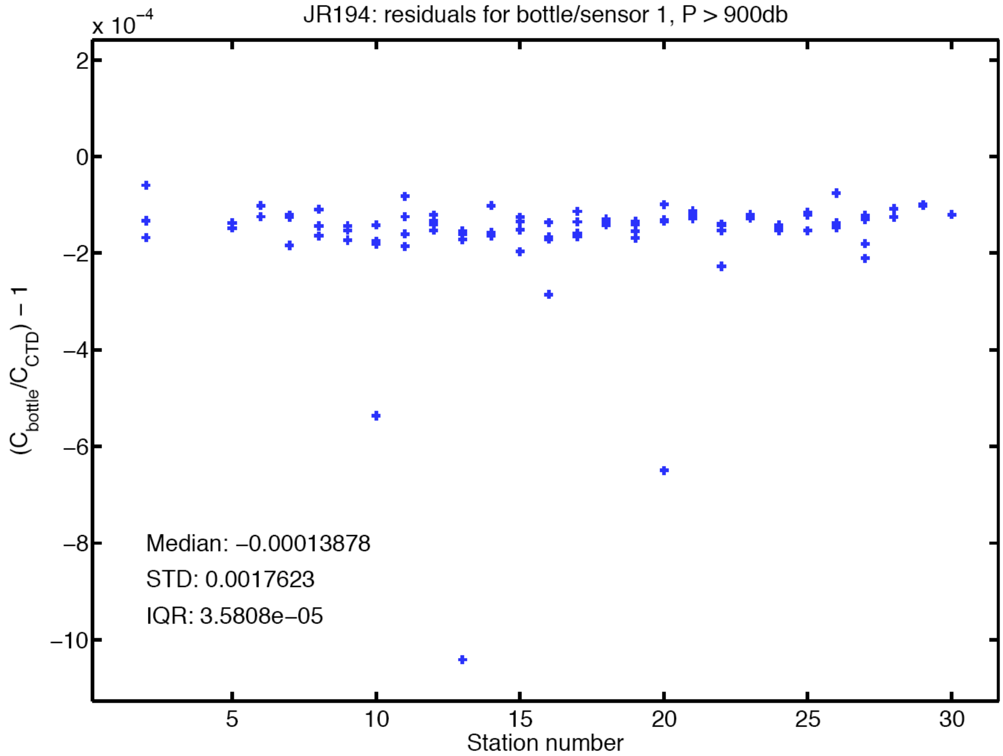

Figure 3.2: Conductivity ratio for sensor 1 on CTD frame compared with bottle assay.

Margaret Yelland and Sally Close

4. LADCP

4.1 Introduction

Cruise JR194 initially used two RDI Workhorse WH300 ADCP (WH) units to collect direct current velocity (LADCP) data during CTD casts. A single 300 kHz RDI WH unit (serial number 1855) was initially fixed in a downward-facing position mounted off-centre at the bottom of the CTD frame. A second WH unit (serial number 4275) was initially attached in an upward-facing position on the side of the CTD. A fin was attached (added during JR193) to the CTD frame to reduce spinning.

After Station 1, communication was lost with the downward WH unit (1855). For stations 2-10 inclusive, only upwards LADCP data was obtained. Following Station 10 the downward WH (1855) was removed and the upward-looking WH (4275) was moved to the downward position to enable acquisition of higher priority downwards data. This unit (4275) served as the solitary downwards WH LADCP instrument for the remainder of the cruise.

Testing and inspection of the failed unit (1855) following the loss of communication found minor corrosion on the unit's bulkhead connector.

The LADCP was deployed as in the previous cruises (see Quartly and Venables, 2010; Stansfield and Meredith, 2008; Shreeve, 2006). Between stations, the ADCP(s) were connected to a controlling PC in the Chem Lab, through a serial 'star' cable for delivery of pre-deployment instructions and post-deployment data retrieval. The battery package was recharged after each deployment, by connection to a charging unit via a power lead.

Instructions are given below for LADCP deployment and recovery during JR194. This set of instructions is based on the LADCP section of previous NOC cruise reports (e.g. JR193 Quartly and Venables 2010; JR139 Stansfield and Meredith, 2008).

4.2 LADCP deployment

Connect the communications and battery leads for both instruments.
Go to controlling PC:

A) MASTER (downward looking workhorse DWH)

1. Open BBTALK window for COM1 (or whichever com port is connected to the master).
   Ensure baud rate is 9600, and select check boxes 1,5 and 6 (counting from top) on splash screen.
   Press <**F3**> to create log file for all output: filename of the form **c:\JR194_LADCP\log_files\WHM***m.txt**,, where ### is ctd cast number, and m refers to master status. Check 'log on' status on bottom bar.
2. Press <**END**> or click on the blue 'B' (break) to wake up DWH if it has powered down
3. Type **ts?** <**ENTER**>to check DWH clock against scientific clock gives time in form YYMMDDhhmmss – 1s accuracy required.
   Type **ts = YY/MM/DD,hh:mm:ss** <**ENTER**> if required to reset DWH clock

4. Type **rs?** <**ENTER**> to check available memory of DWH
   If you need to clear memory, type **RE ErAsE** <**ENTER**>
   Only clear if backed up to UNIX drive and data processed to check they are not corrupted – all files erased
5. Type **pa** <**ENTER**> to run diagnostic checks. Due to the instruments being in air, some of these are likely to fail and deployment is likely to be successful despite this. Transmit nearly always returned a fail.
6. Type **pt200** <**ENTER**> to run further diagnostic checks. Again due to the instruments being in air, some of these are likely to fail.
7. If batteries were recharged, switch off battery charge unit and check battery voltage.

The master unit is now ready to be deployed but the slave should be started first to ensure pings start at the same time.

B) SLAVE (upward looking workhorse UWH – not available for the majority of JR194)

Repeat steps 1 - 7 in adjacent window noting:

1. UWH log file should be called **c:\JR194_LADCP\log_files\WHM***s.txt** (s refers to slave)
8. Press <**F2**> Select slave UWH configuration file (**c:\JR194_LADCP\whs_jr194.cmd -** this should be copied into the cruise directory from a previous cruise directory)– slave now ready to be told to ping by the master

Master (again)

8. Press <**F2**> select DWH master configuration file (**c:\JR194_LADCP\whm_jr194.cmd** this should be copied into the cruise directory from a previous cruise directory) Note exact time – both instruments should start pinging.

Both

9. Press <**F3**> to stop log file . Check bottom bar status of instrument.

Detach communication and charger cables and fit blanks to cable ends. Ensure blanks have sufficient silicon grease/vaseline to make a complete seal.

4.3 LADCP recovery

Remove blanks and attach communications and charger cables.

1. Open BBTALK COM1 window (for master) and COM2 window (for slave)
   Press <**END**> or click 'B' (break) in the master window first and then the slave – both instruments then stop at the same time. Time must be recorded.
2. Check battery voltage and switch on charger if needed.
3. type **ra?** <**ENTER**> to check number of deployments
   Reset Baud rate to from 9600 to 115200 to allow for faster recovery of the data by typing **cb811**
   To transfer data to PC:
   Go to FILE, RECOVER RECORDER

Select c:\JR194_LADCP\master\ for UWH and c:\JR194_LADCP\slave for DWH as destination files

Following transfer reset Baud rate by typing **cb411**

Type **cz** <**ENTER**> once data are transferred to power down LADCPs

4. Record the default names on log sheet, then rename to:

jr194***m.000

jr194***s.000

5. Copy the raw files and the log files to a memory stick and take to UIC.

6. Log on to Unix as pstar. Place raw files in:

/data/cruise/jcr/current/pstar/data_jr194/ladcp/uh/raw/jr0812/ladcp

and the log file in the /obv sub directory

4.4 LADCP problems

Numerous difficulties were had communicating with the unit initially in the downward position (1855). Several casts with this unit were returned with files too small for the cast, and at or around Station 5, communication was completely lost. Processing showed errors with all of these unit's casts except for Station 1.

Minor problems were had communicating with the other unit (4275). Often the cause appeared to have been leaving the unit in 115200 baud rate following data recovery. It was always possible to reset the baud rate to 9600 with the cb411 command even if the display was not working correctly. This solved the problem.

Slave (DW) casts: 1 (all subsequent cast data (stations 2,3,4) appear damaged).
Master (UW) casts: 1, 2, 4-10.
Master (DW) casts 11-32.

4.5 LADCP shipboard data processing

Data from the LADCP instruments was processed between each station to allow for early detection of any problems with the units. Two sets of software were utilised, firstly from University of Hawaii (uh), secondly from Lamont Doherty Earth Observatory at Columbia University (ldeo). Both should be run to allow a full picture of the LADCP performance to be obtained.

Instructions are given in Appendix 2 for initial shipboard LADCP processing during JR194. This set of instructions is based on notes obtained from Brian King prior to the cruise. Additional assistance with processing was obtained from Brian King.

Subsequent processing at NOC showed credible data on most casts. Figure 4.1 shows example profiles, with the data inferred from the down- and up-casts generally agreeing. Figure 4.2 shows a simple construction of the profile across the whole SR1b section, noting that tidal signals have not yet been removed from these data.

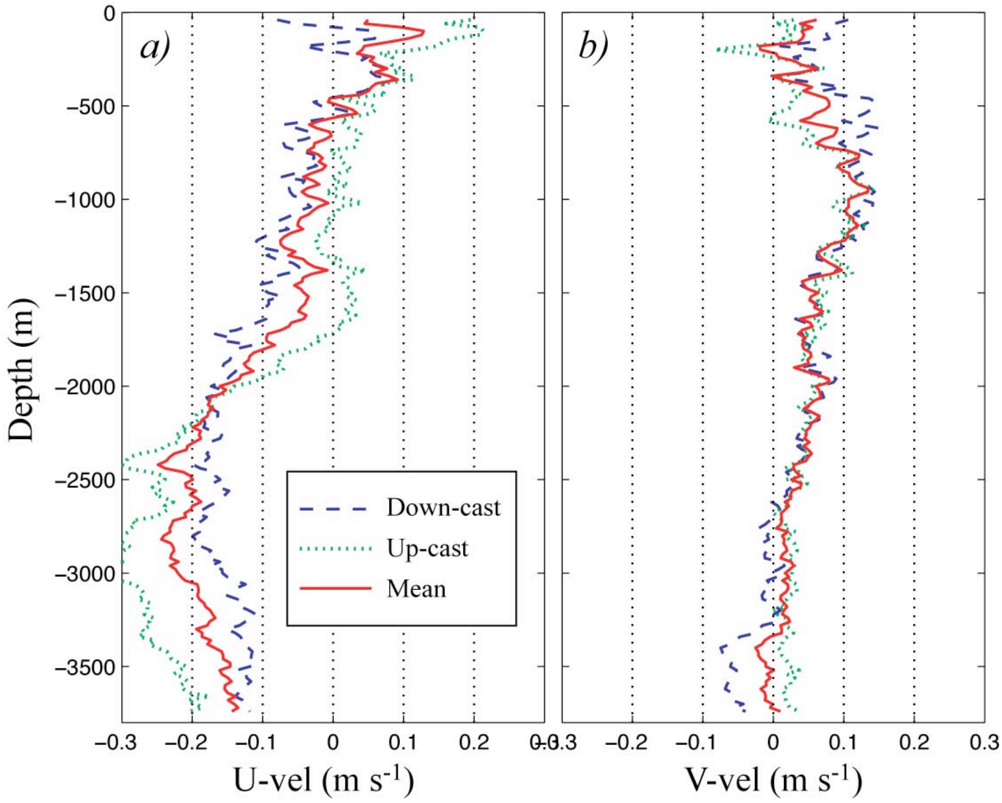

Figure 4.1: Vertical profiles of LADCP-derived velocity at CTD station 23 (depth 3775m); a) Eastward component; b) Northward component.

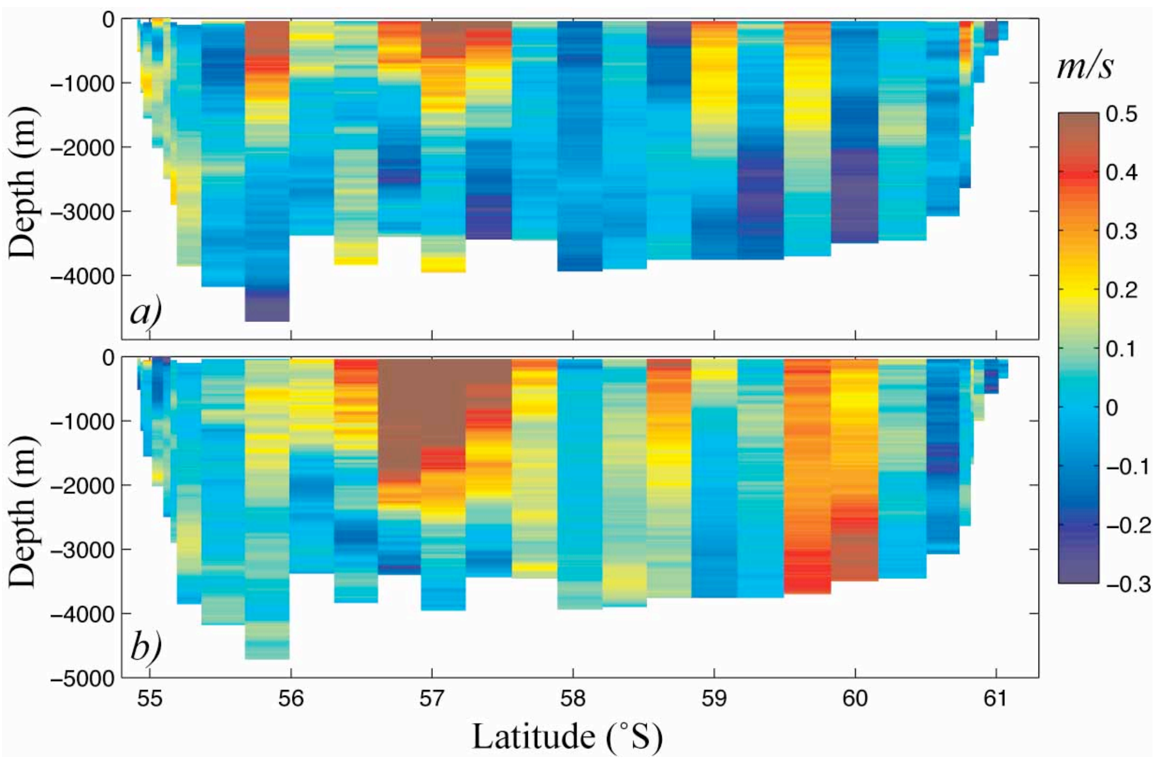

Figure 4.2: Collation of the LADCP velocity profiles for JR194, all interpolated to depth intervals of 20m; a) Eastward; b) Northward.

John Prytherch

5. VMADCP

5.1 Introduction

A 75 kHz RD Instruments Ocean Surveyor (OS75) ADCP was used during this cruise similar to JR139 (Stansfield and Meredith, 2008) and JR161 (Shreeve, 2006). The OS75 is, in principle, 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.

5.2 Instrument and configuration

The OS75 unit is sited in the transducer well in the hull of the JCR. This is flooded with a mixture of 90% de-ionised water and 10% monopropylene glycol. With the previous 150 kHz unit, the use of a mixture of water/anti-freeze in the transducer chest required a post-processing correction to the derived ADCP velocities. However, the OS75 unit uses a phased-array transducer that produces all four beams at specific angles from a single aperture. A consequence of the way the beams are formed is that horizontal velocities derived using this instrument are independent of the speed of sound within this mixture (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. After sailing for JR139, the hull depth was measured by Robert Patterson (Chief Officer), and found to be 6.47 m. Combined with a value for the distance of the transducer behind the sea-chest window of 100-200 mm and a window thickness of 50 mm, this implies a transducer depth of 6.3 m. This is the value assumed for JR194, but note that the ship was very heavily laden during cruise JR139, and for other cruises it may be shallower.

5.3 Output formats

The ADCP writes files to a network drive that is samba-mounted from the Unix system. (Should the network fail, there is an alternative write path to the local ADCP PC hard drive to preserve data until the link is restored). For use in the Matlab scripts the raw data saved to the PC have to be run through the VMDas software again to create the .ENX files from the .ENR and .N1R 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 JR194_XXX_YYYYYY.ZZZ, where XXX increments each time the logging is stopped and restarted, and YYYYYY increments each time the present file size exceeds 10 Mbyte. ZZZ are the filename extensions, and are of the form:

.N1R (NMEA telegram + ADCP timestamp; ASCII)
.ENR (Beam coordinate single-ping data; binary)
.VMO (VmDas configuration; ASCII)
.NMS (Navigation and attitude; binary)
.ENS (Beam coordinate single-ping data + NMEA data; binary)
.LOG (Log of ADCP communication and VmDas error; ASCII)

.ENX (Earth coordinate single-ping data; binary)
.STA (Earth coordinate short-term averaged data; binary)
.LTA (Earth coordinate long-term averaged data; binary)

5.4 Post-processing of data

Data quality was regularly checked on the ADCP display, but there was no processing of the VMADCP data on ship. Calibration checks and processing were performed at NOCS by Brian King.

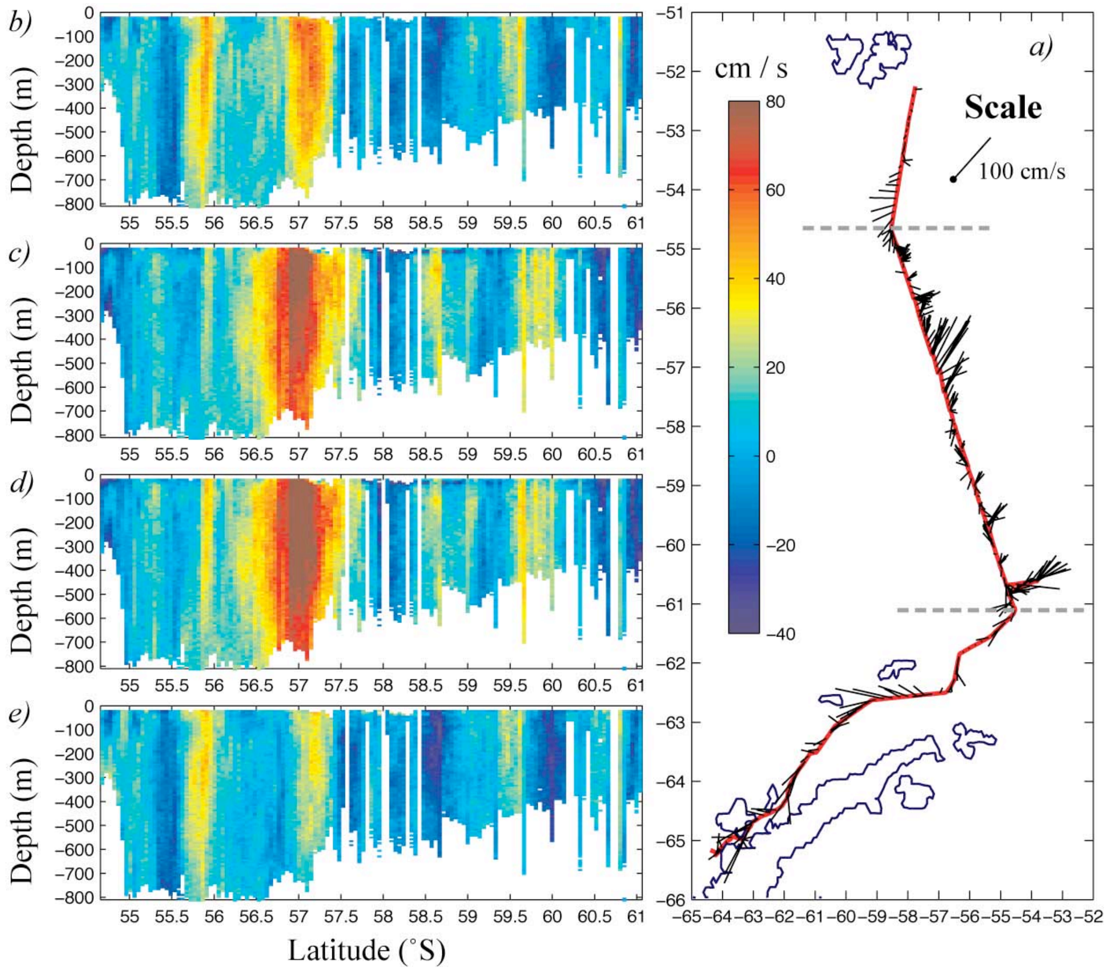

Figure 5.1: VMADCP data collected during cruise JR194; a) Vector plot of currents in 2nd bin (26-34 m depth), with dashed grey lines showing the bounds of SR1b section. Note, near 60.5˚S, there is a detour of route (for POL work), so eastward currents there are not as large as seem at first glance. Left-hand side shows depth structure of velocity field along section SR1b; b) Eastward component; c) Northward component; d) ENE component (i.e. perpendicular to line) and; e) Component along section (positive to NNW). Note in first half of section records are achieved down to 750m, but in second half only to 400m if not on station.

Graham Quartly

6. Underway Ocean Logger

6.1. Introduction

Underway data come from the meteorological sensors, situated on the forward mast, and the ocean surface layer sensors, which measure the properties of the uncontaminated water supply. The oceanographic measurements include temperature, conductivity and fluorescence. The meteorological measurements include air temperature, humidity, atmospheric pressure, total incident radiation and photosynthetically available radiation (PAR). Other parameters sampled include the temperature of the conductivity sensor and the flow rate of the uncontaminated water supply. Data from these sensors feed into the ships' oceanlogger data system. From there they are transferred to the ships' SCS scientific data collection system and hence to the UNIX and PC computer network.

According to the oceanlogger files from cruise JR194, underway data first became available on the 11th December 2008 (day of year 346) at 18:30 and were then collected continuously until 16:13 on the 20th December 2008 (day of year 355).

6.2. Data Capture and Processing

Data were processed in 24-hour sections using pstar whilst on board the ship. The scripts are based on those used during the previous JR94, JR115, JR163 and JR193 cruises (see Hawker et al., 2005; Sparrow and Hawker, 2005; Williams et al., 2008; Quartly and Venables 2010). The executables for processing the data are described below:

oclexec0: Reads the ocean-logger and anemometer data streams and stores them in a single pstar type file called 194oclXXXd.raw (where XXX = day of year).

oclexec1: Splits the data into separate ocean data and meteorological data files. It also performs some initial de-spiking of the conductivity data and calculates a raw salinity value. This creates a file called 194oclXXXd (and a meteorological file 194metXXXd.raw).

twvelexec: Merges the met data file with gyrocompass and navigation data streams in order to calculate ship motion and true wind velocity. Some de-spiking is also performed. This creates a file called 194metXXXd.

Data were then further de-spiked and plotted using Matlab and the differences between duplicate meteorological instruments calculated.

As of August 2010, additional processing has been performed on the meteorological and ocean underway data using the mstar processing suite. This suite has been used on recent cruises since JC031 (McDonagh et al. 2009), which was a Drake Passage repeat that took place in February 2009. The most recent processing that was performed using mstar consisted of appending the daily *met* and *ocl* files into a merged file which contains a continuous record of all the *met* and *ocl* data collected during JR194. This required a fair bit of processing of relevant *nav* data to ensure that the correct files needed to run certain scripts were present. An appended met file (*met_jr194_01.nc*) was needed, as was an appended nav file (*bst_jr194_01.nc*), which was created from the scripts *mbest_01.m – mbest_04.m*. These appended files were converted into 2-minute averaged data using the function *mavrge*, which is part of the mstar suite. The start, stop and step times specified were -60, $1*10^{10}$, and 120 respectively. This meant that the two-minute averages could be centred on the minute boundary, which just helped to keep the data tidy and easy to understand.

Additional processing was required for averaging the true and relative wind directions. To avoid problems associated with averaging wind direction over time, the relative wind speed, ships' heading and course made good were converted to eastward (u) and northward (v) components using the script *muvsd.m*. Initially the file *met_jr194_true.nc* was created using the script and then the subsequent averaging created a file called *met_jr194_trueav.nc*, which is a 1-minute average.

6.3. Oceanographic Parameters

Sea surface salinity (SSS) was calculated from the thermosalinograph's (TSG) measurements of conductivity and water temperature. In addition, water samples were taken every 4 hours from the ships' uncontaminated water supply.

Figures 6.1, 6.2 and 6.3 are constructed from underway data and from these, variations in sea surface temperature (SST), sea surface salinity (SSS), and fluorescence can be observed respectively.

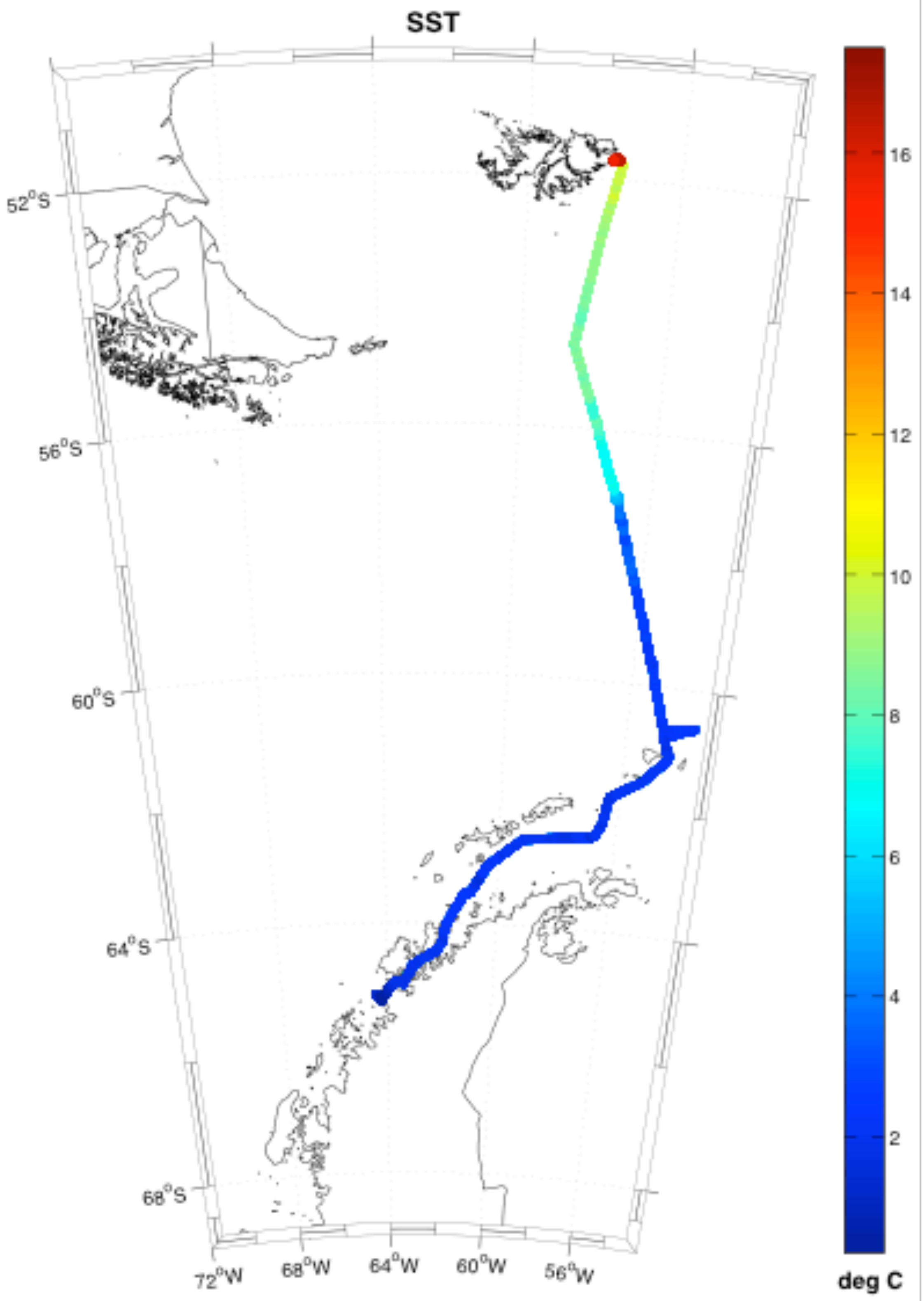

Figure 6.1: Sea surface temperature along the cruise track of JR194

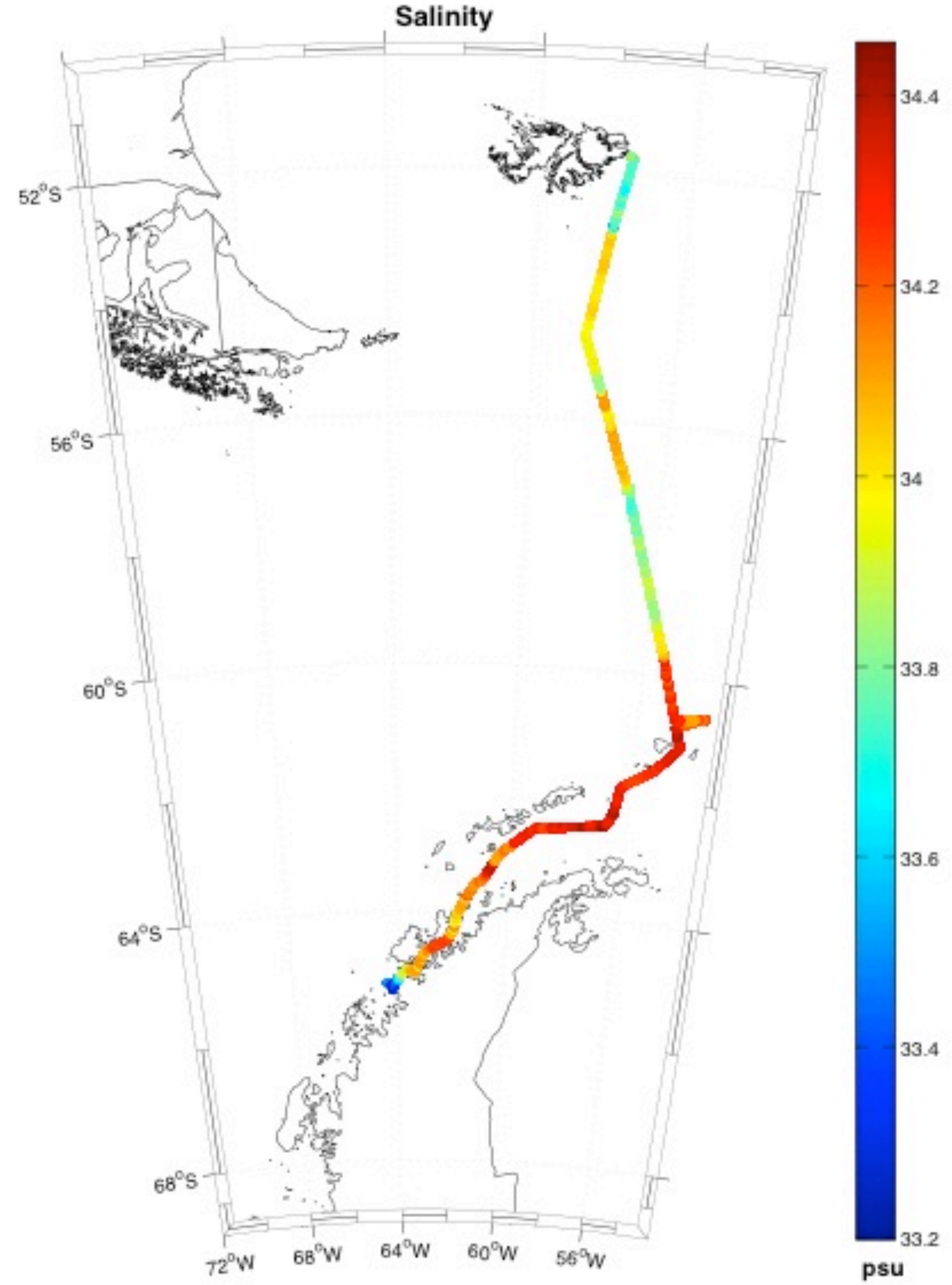

Figure 6.2: Sea surface salinity along the cruise track of JR194

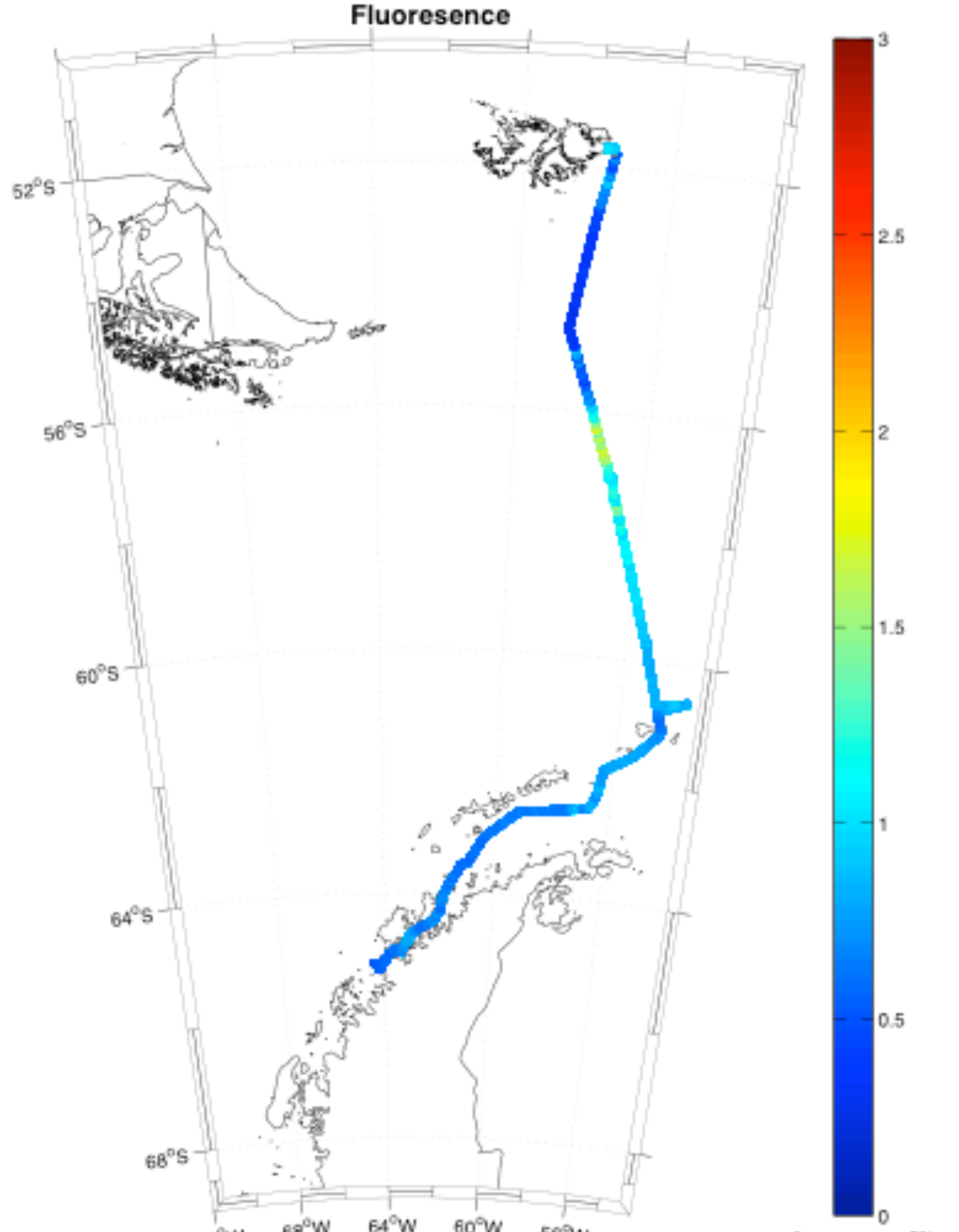

Figure 6.3: Fluorescence along the cruise track of JR194

6.4. Meteorological Parameters

Below are various time series of 2-minute averaged meteorological data. Only basic quality controls have been applied to these data. Each figure contains five plots showing different variables (Air temperature, sea surface temperature, wind direction, wind speed, air pressure, humidity, TIR and PAR) over a 4-day period.

A description of the figure plots follows:

- Top panel – plot of air temperature and SSTs from the oceanlogger.
- Second panel – downwelling radiation from the two shortwave TIR and PAR sensors, all in Wm^{-2}.
- Third panel – relative wind direction and true wind direction from the anemometer. The ships' true heading is also shown.
- Fourth panel – relative and true wind speeds in ms^{-1} from the anemometer.
- Bottom panel – atmospheric humidity and atmospheric pressure.

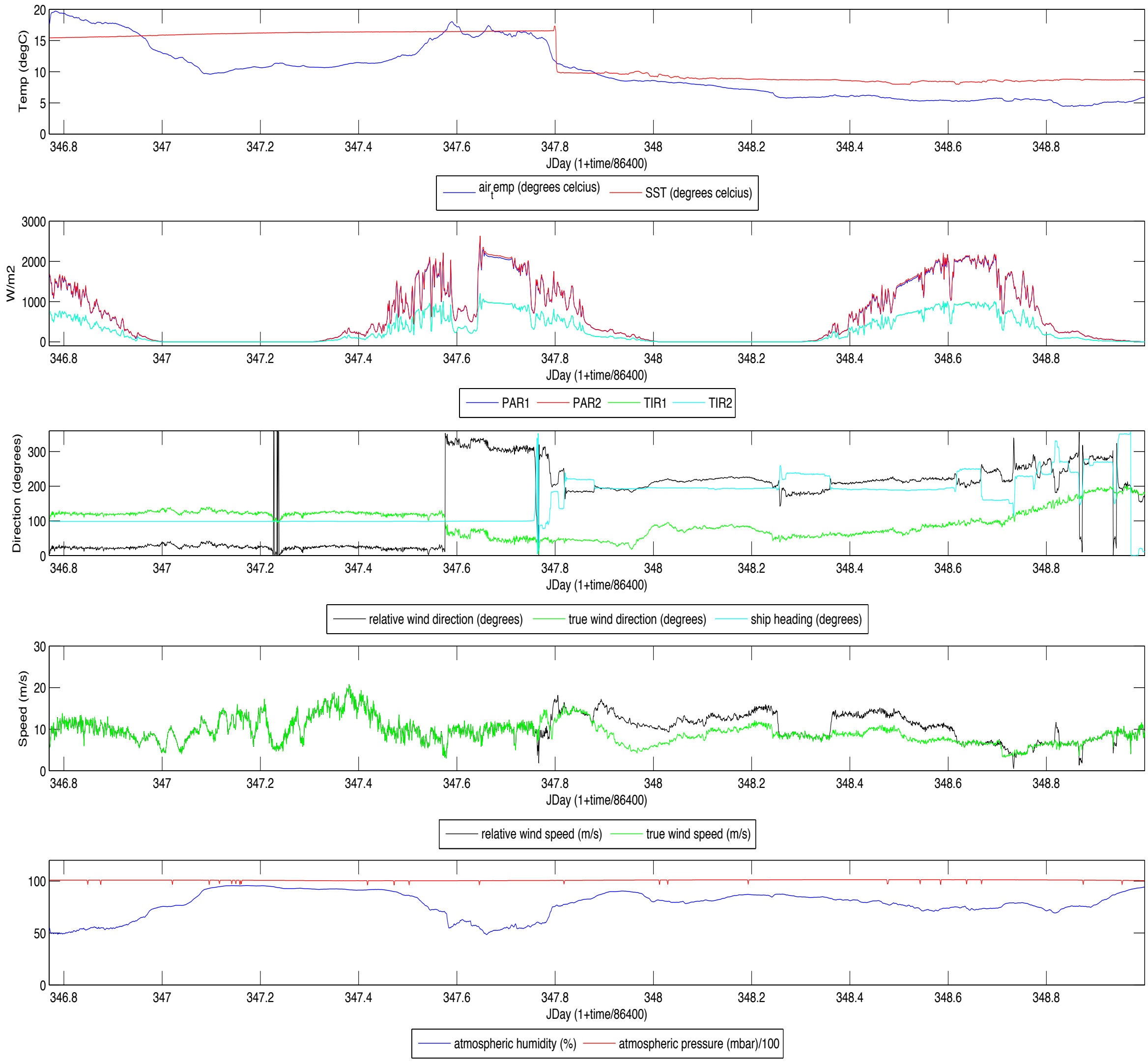

Figure 6.4: Meteorological data for days 346 to 349.

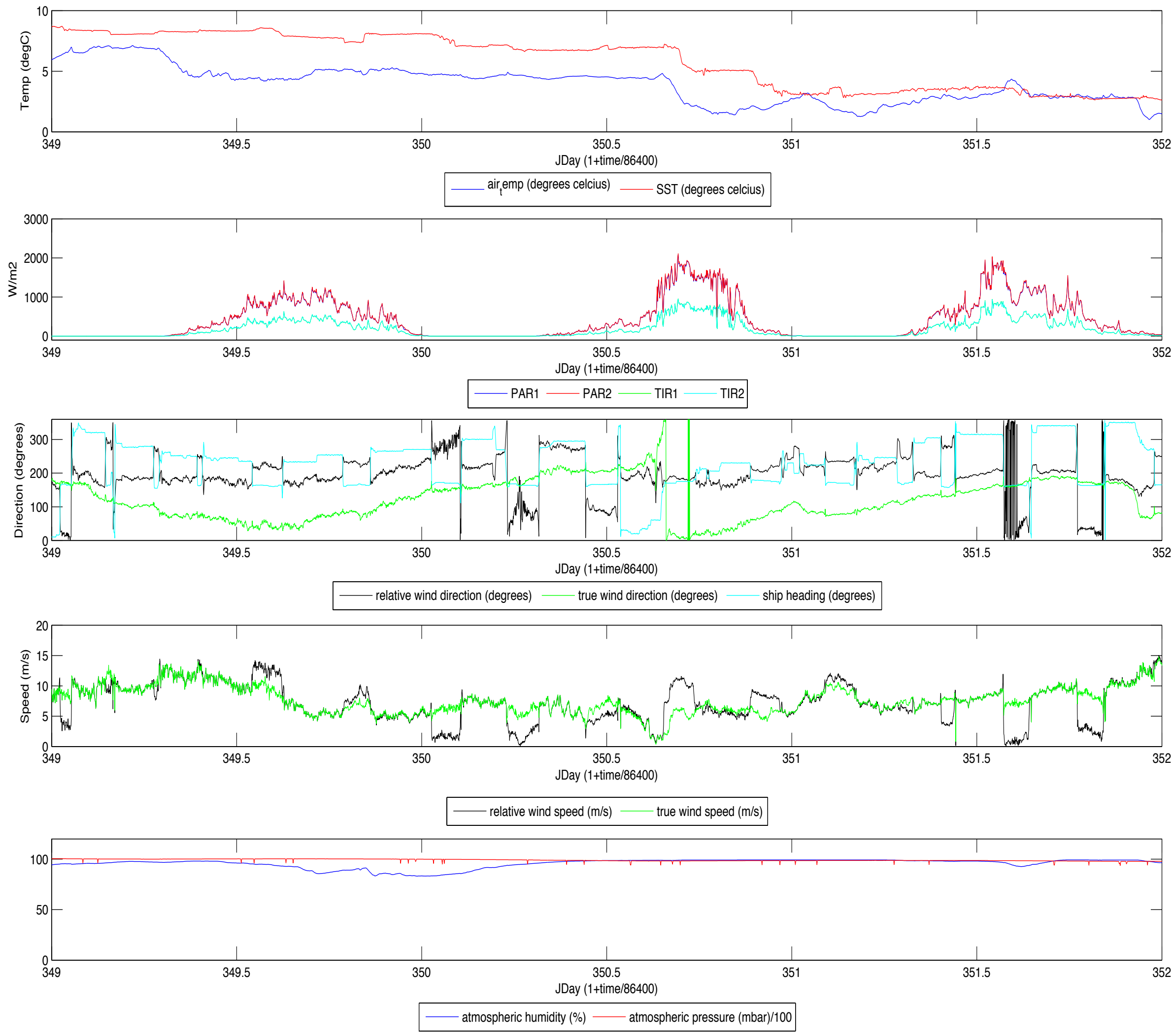

Figure 6.5: Meteorological data for days 349 to 352.

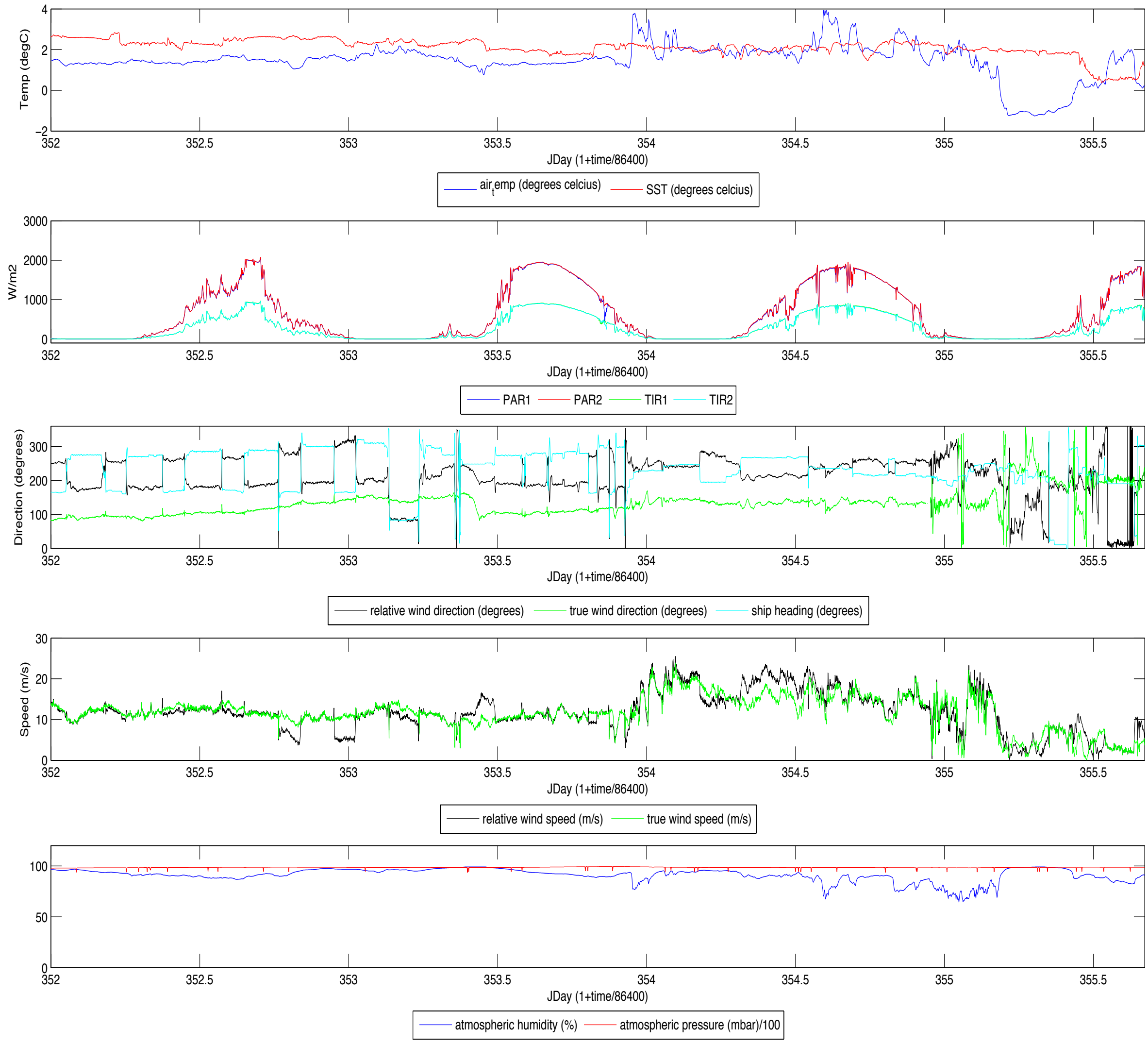

Figure 6.6: Meteorological data for days 352 to 356.

David Hamersley

7. Echo Sounder

The main depth information came from the single beam echo sounder, EA600 made by Kongsberg; however its datastream retains the name 'sim', after Simrad, the previous instrument. Data were collected as for JR193. In principle, the echo sounder records a range every 30-34s, and in the post-processing (in this case done at NOCS) a travel-time correction is applied to give the calibrated values shown below.

There were several periods when data were not collected or were not of good quality because other acoustic instrumentation was in use. The deep values shown at 63˚W (Fig. 7.1c) are not solitary spikes, but correspond to 84 returns of depths greater than 1500m.

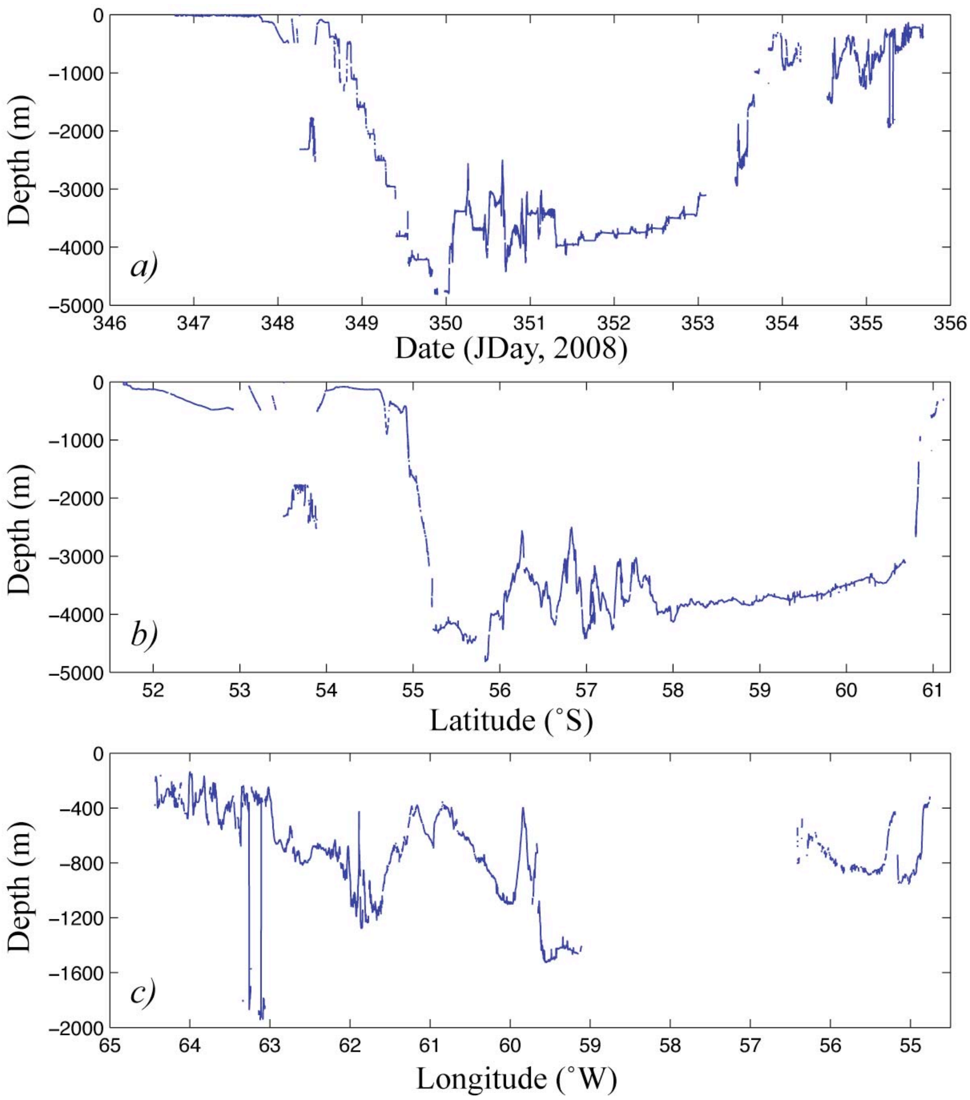

Figure 7.1: Corrected data from EA600 for cruise JR194. a) All data, plotted against day of year. b) Data from SR1b section (including start from Falklands, but omitting deviation to POL's last lander), c) Data from section along Antarctic Peninsula.

Graham Quartly

8. Microbial Abundance And Dynamics

The aim of this work is to compare abundance of dominant microbial plankton groups in the Drake Passage. This will be achieved via the following objectives:

i) determine the vertical distribution of the smallest (0.4-5.0 μm) planktonic organisms, prokaryotes and protists using CTD collected samples analysed by flow cytometry;
ii) determine spatial variability of their abundance in surface waters at <10 km scale on a latitudinal transect using underway water supply system;
iii) test deploy experimental MicroNet instrument in order to sample, and size fractionate microplankton populations in situ prior to their live analysis using FlowCam microscope.

8.1 Flow cytometry

Seawater samples were collected and analysed for determination of microbial concentration, biomass and composition. Fresh seawater samples were collected in acid washed 50 mL polypropylene tubes from a CTD system containing 24 x 20 L Niskin bottles. Samples were stored in a refrigerator and microorganisms were preserved with paraformaldehyde (1% final concentration) within 1-2 hours of collection. Samples were stained with SYBR Green I nucleic acid dye. The samples were then left in the dark for at least 1 hour before enumeration of communities by a flow cytometer (FACSort BD). The depths of the bottles fired at each station are detailed earlier (Table 2.3). Only the shallowest four depths were stained and analysed on board ship. In order to maintain an intensive underway survey, time constraints meant it was necessary to freeze the remainder of the depths in a -80˚ freezer; these have been analysed subsequently, during a later cruise.

Samples were also drawn every 30 mins from the ship's underway supply system by a Tecan Miniprep 60 robot from 21:00 on day 347 till 08:30 on day 355. The samples were preserved with 1% paraformaldehyde for later analysis by the FACSort flow cytometer. The timing of sampling was combined with the ship's navigational data in order to construct large-scale spatial variation in community structure.

8.2 MicroNet

The MicroNet was an experimental vertical tow net developed at NOC. The top has a pressure-controlled aperture to enable sampling only over a fixed depth range, and is accompanied by a flow meter to record the volume of water sampled. Within the net are a series of meshes to separate the plankton out into different size classes. During cruise JR194 the MicroNet was deployed from the forward crane of JCR at the same time as the CTD package was being used midships; as the net was only being lowered to 50 m there was no concern about the two instruments getting entangled.

The MicroNet apparatus was deployed daily between 13/12/08 and 16/12/08, and once more on 18/12/08, corresponding to CTD stations 3, 10, 14, 19 and 28. The nets collected in 40 and 100 μm size fractions, and these were analysed live using the FlowCam microscope within ~1 hour in order to enumerate microplankton within those fractions. The aperture control did not function as intended, so the best samples were achieved on the last deployment, when the aperture was left open throughout the haul.

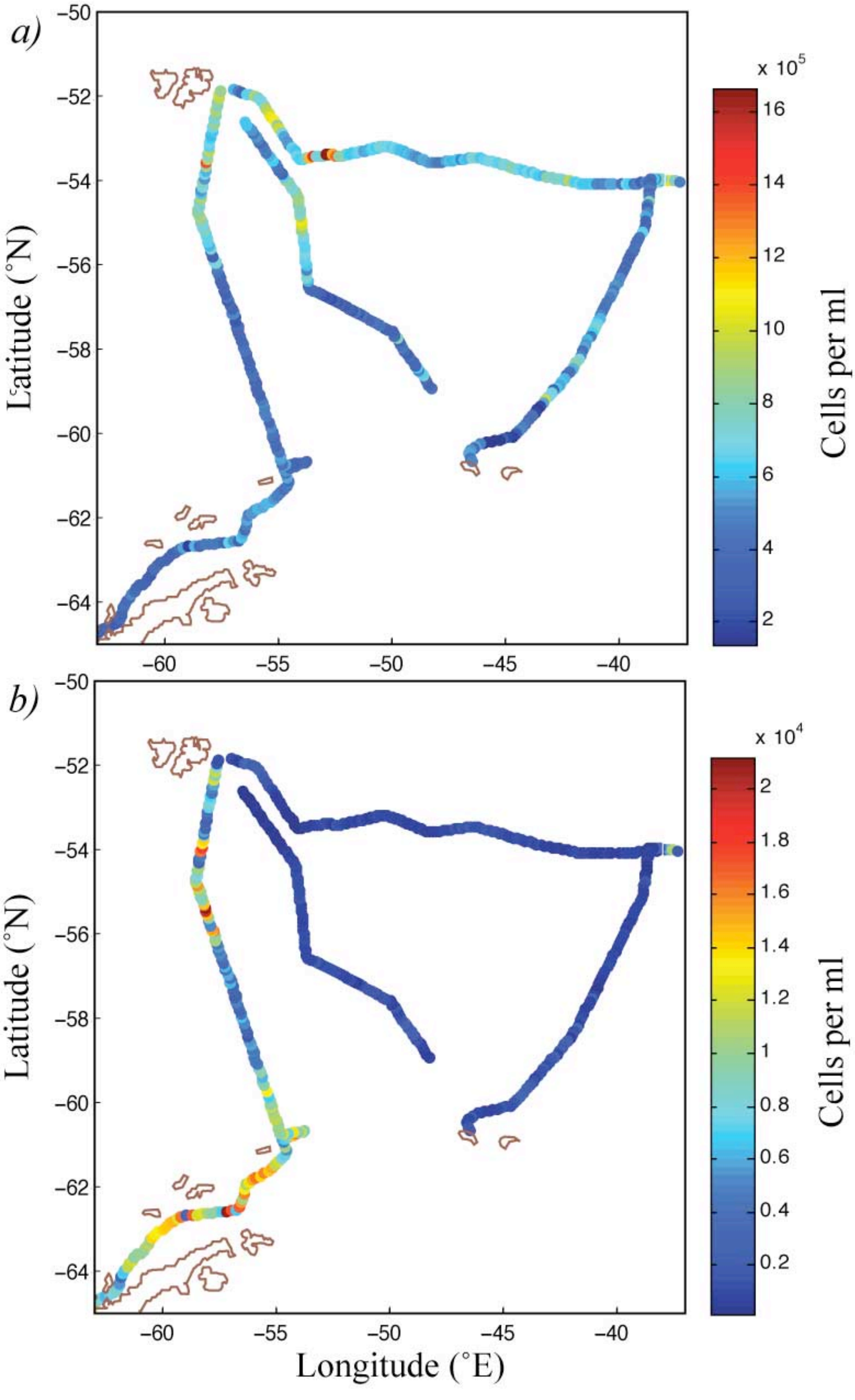

Figure 8.1: Surface counts of key phytoplankton groups in the southern S. Atlantic, from the combined JR187 and JR194 cruises; a) bacterioplankton abundance; b) large picoplankton abundance.

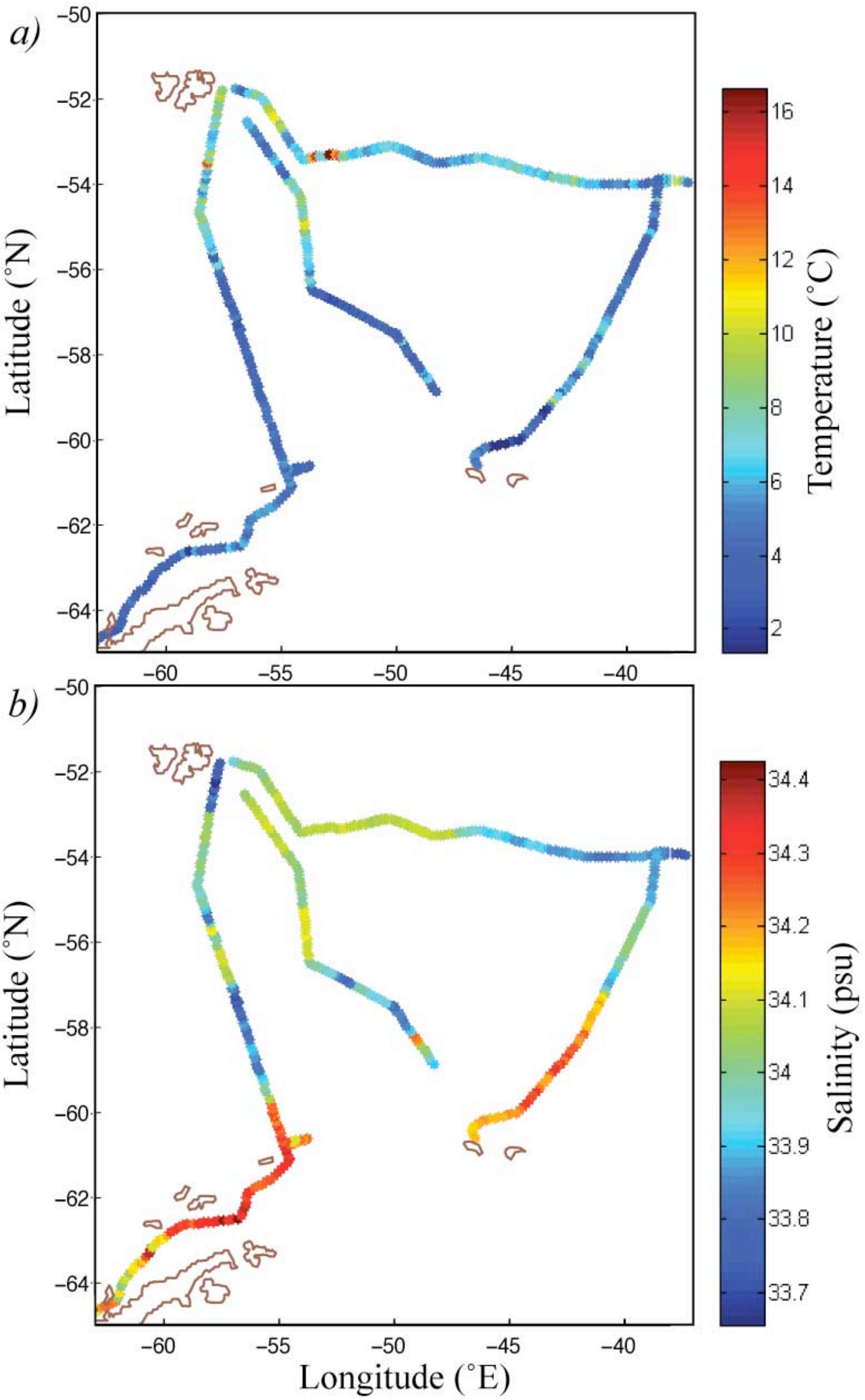

Figure 8.2: Physical surface parameters in the southern S. Atlantic, from the combined JR187 and JR194 cruises; a) Temperature; b) Salinity.

8.3 Microbial Activity

At four of the CTD stations (nos. 2, 11, 15 & 20) water samples from the near-surface bottle were taken to assess the level of total microbial activity. The samples were spiked with 3H-Leucine, an essential amino acid. Samples were incubated under laboratory lights at in situ temperature. Subsets of samples were fixed with paraformaldehyde (1% final concentration) after discrete periods of time, and microbes were collected on 0.2 μm polycarbonate filters. The filters were placed in a scintillation vial and subsequently filled with the scintillation cocktail. The vials were placed in a liquid scintillation counter to determine sample radioactivity that provided an estimate of the total microbial activity. The results (Table 8.1) show a marked reduction in bacterioplankton production from the tip of S. America to the Antarctic Peninsula.

Table 8.1: Microbial activity in surface waters of Drake Passage during JR194, determined using bioassay experiments. (Uncertainties given in brackets represent 1 std. dev.)

Lat (˚S)	Lon (˚W)	CTD Station	Bioavailable concentration (nM Leu)	Uptake Rate at ambient concentration (nM Leu day^{-1})	An estimated turnover time (h)
53.506	58.181	2	0.166 (±0.026)	1.966 (±0.066)	2.02 (±0.32)
55.518	58.016	11	0.178 (±0.029)	1.05 (±0.039)	4.06 (±0.66)
56.768	57.220	15	0.129 (±0.033)	0.693 (±0.029)	4.43 (±1.14)
58.368	56.247	20	0.420 (±0.044)	0.652 (±0.037)	15.5 (±1.62)

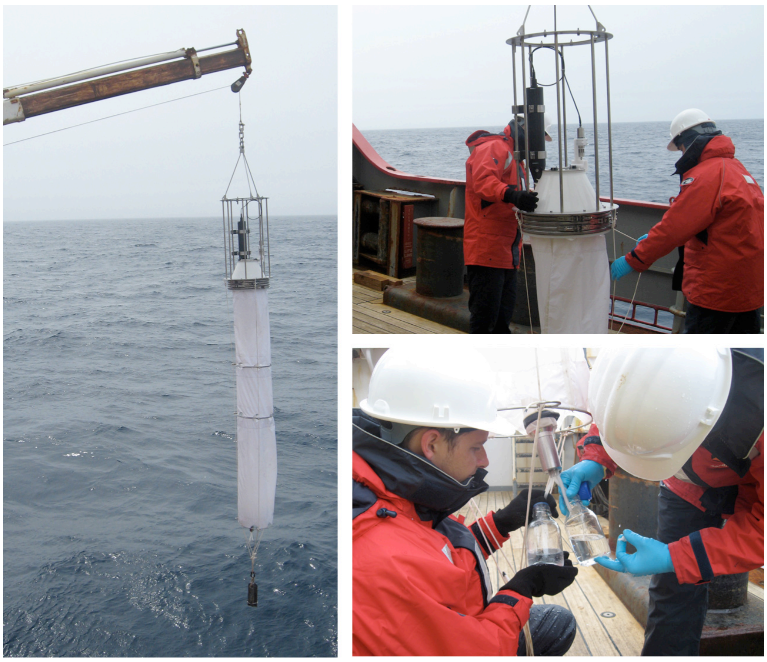

Figure 8.3: Use of experimental MicroNet on JCR. Left panel shows deployment from aft crane; top right shows close-up of flow meter and aperture; bottom right shows collection of size-fractionated samples after deployment.

Ross Holland & Mike Zubkov

9. Float Deployment

The UK Met Office provided us with 7 Argo floats, 4 of which were equipped with ice-avoidance software, so that they could be deployed further south than normally used. There were instruction sheets for initialization and deployment in each crate; these instructions were closely followed, and all deployments appeared to go satisfactorily. The process involved deployment off the aft of the RRS *James Clark Ross*, using a strop and crane, with a fiddle removed to release buoy once floating at the surface of the water. We were stationary for all deployments, allowing the current to take the float away from the ship.

The times and locations of the deployments are given in the table below. Shortly after deployment, both the Met Office and BODC were informed. Figure 9.1 shows the trajectories of the floats in the succeeding 2 months i.e. initial surface record plus next 6 surfacing events. The initial Argos fixes for float 1901226 (the 6th) are nowhere near the location it was deployed; however subsequent records show a credible pathway, so it is unlikely that all location determinations for his float are in error.

Table 9.1: Location and time of Argo deployments, and the associated weather conditions.

Buoy No.	3855	3856	3853	3848	3847	3849	3850
Argos ptt.	81200	81201	81198	81203	81202	81204	81205
WMO No	1901222	1901223	1901221	1901225	1901224	1901226	1901227
JDay / UTC	349 / 06:30	349 / 18:45	350 / 05:30	350 / 12:45	351 / 07:00	351 / 20:18	352 / 13:40
CTD sta.	8	11	13	15	18	21	24
Lat (S)	55˚ 07'	55˚ 31'	56˚ 09'	56˚ 45'	57˚ 43'	58˚ 40'	59˚ 39'
Lon (W)	58˚ 16'	58˚ 01'	57˚ 37'	57˚ 13'	56˚ 37'	56˚ 03'	55˚ 25'
Air temp	4.8˚C	5.1˚C	4.9˚C	4.4˚C	1.6˚C	2.5˚C	1.4˚C
Wind speed (m/s)	< 5	10	< 5	10	~12	10	10
Knocks or bangs?	No	No	No	Minor	No	No	No
Oil / plankton bloom?	No	No	No	No	No	No	No
Remain at surface?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

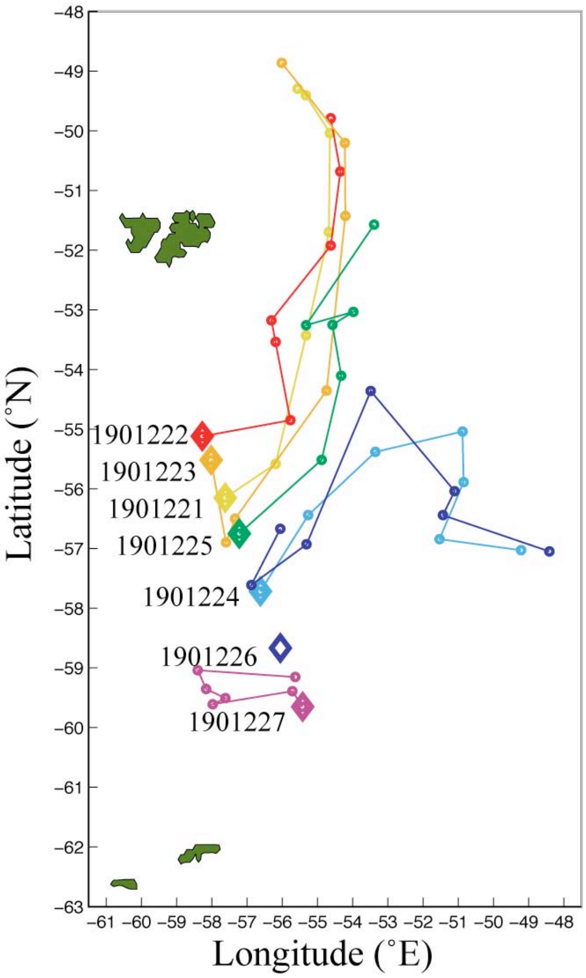

Figure 9.1 Trajectories of the released Argo floats in the first 60 days since deployment. Note initial Argos-determined location for 6th float did not match deployment site.

Graham Quartly

10. Computing, Setup & Support

Cruise: JR194 - POL/NOC Drakes Passage
Leg: 20081211
PSO: Graham Quartly
ICT : Douglas Willis
Captain : Jerry Burgan
Logging: Started 18:46 on 11/12/08.

13 December 2008 14:30 GMT PCO2
DNS server entry still set to 10.104.2.252. Changed to 10.104.2.253 and mail is now working.

16 December 2008 14:30 GMT PCO2
Perl script on SCS machine not initialising the serial port before sending data.
Sending an SCS message with the correct baud, data and stop bit configuration will reset the serial port and the perl program will then work OK.

16 December 2008 22:29 GMT ADU5 lost heading. Reset

19 December 2008 12:00 GMT EA600 GPT replaced and new unit installed into the control software. System seems to be stable now.

19 December 2008 13:55 GMT EM120 lost comms. On restart the operator interface failed the BIST tests. Resetting from the remote did not bring the unit back on line so a full power off was done with the units below decks. Waited until the 50v indicator showed 0 volts and then powered it on again. System now operating.

Doug Willis

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Appendix 1 – Instrument Calibration Constants

```
ASCII file: D:\data\JR194\jr194_001\jr194_001.con
Configuration report for SBE 911/917 plus CTD
---------------------------------------------
Frequency channels suppressed :   0
Voltage words suppressed      :   0
Computer interface            :   RS-232C
Scans to average              :   1
Surface PAR voltage added     :   No
NMEA position data added      :   No
Scan time added               :   No
```

1) Frequency, Temperature

```
Serial number :    4302
Calibrated on :    18/07/07
G             :    4.37269298e-003
H             :    6.42004858e-004
I             :    2.19025784e-005
J             :    1.81767398e-006
F0            :    1000.000
Slope         :    1.00000000
Offset        :    0.0000
```

2) Frequency, Conductivity

```
Serial number :    2875
Calibrated on :    18/07/07
G             :    -1.01634295e+001
H             :    1.40348275e+000
I             :    8.99756645e-005
J             :    5.82471200e-005
CTcor         :    3.2500e-006
CPcor         :    -9.57000000e-008
Slope         :    1.00000000
Offset        :    0.00000
```

3) Frequency, Pressure, Digiquartz with TC

```
Serial number :    0541-75429
Calibrated on :    18/07/07
C1            :    -4.398881e+004
C2            :    -5.551403e-001
C3            :    1.279490e-002
D1            :    3.603000e-002
D2            :    0.000000e+000
T1            :    2.986716e+001
T2            :    -5.274889e-004
T3            :    4.092900e-006
T4            :    1.616590e-009
T5            :    0.000000e+000
Slope         :    0.99994000
Offset        :    0.52570
AD590M        :    1.287420e-002
AD590B        :    -8.793390e+000
```

4) Frequency, Temperature, 2

```
Serial number :    4235
Calibrated on :    20/07/07
G             :    4.34551464e-003
H             :     6.45183995e-004
I             :    2.21076034e-005
J             :    1.74507310e-006
F0            :    1000.000
Slope         :    1.00000000
Offset        :    0.0000
```

5) Frequency, Conductivity, 2

```
Serial number :    2813
Calibrated on :    17/07/07
G             :    -9.75792279e+000
```

```
H             :    1.45435632e+000
I             :   -5.07100074e-003
J             :    4.16613153e-004
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        :     26/07/07
M                    :     1.00000000
B                    :      0.00000000
Calibration constant :     35335689045.00000000
Multiplier           :     1.00000000
Offset               :     0.00000000
```

7) A/D voltage 1, Free

8) A/D voltage 2, Oxygen, SBE 43

```
Serial number :   0676
Calibrated on :   03/06/06
Soc           :   4.3630e-001
Boc           :   0.0000
Offset        :   -0.5460
Tcor          :   0.0001
Pcor          :   1.35e-004
Tau           :   0.0
```

9) A/D voltage 3, Altimeter

```
Serial number :   7742.163162
Calibrated on :
Scale factor  :   15.000
Offset        :   0.000
```

10) A/D voltage 4, Fluorometer, Chelsea Aqua 3

```
Serial number :   088-249
Calibrated on :   13/09/07
VB            :   0.181700
V1            :   2.097600
Vacetone      :   0.202800
Scale factor  :   1.000000
Slope         :   1.000000
Offset        :   0.000000
```

11) A/D voltage 5, Free

12) A/D voltage 6, Transmissometer, Chelsea/Seatech/Wetlab CStar

```
Serial number :   CST-527DR
Calibrated on :   14/08/07
M             :   21.7287
B             :   -1.2735
Path length   :   0.250
```

13) A/D voltage 7, Free

Appendix 2 –LADCP Processing Instructions

To place raw LADCP files on the Unix system, log on as pstar/pstar and copy files (in jr194_***m.000 format) to: pstar/data/ladcp/uh/raw/jr0812/ladcp

1) Log on as pstar, password pstar. You must be logged on to the jruh station to get access to the matlab licence.

2) **cd ladcp**
setup matlab
cd uh
source LADall *setup paths*

3) **cd proc**
cd Rlad
linkscript; *check the raw ladcp data; there should be a raw file called j194_NNNm.000. Linkscript will make a symbolic link from jNNN_XX.000 to the real raw file. We use _XX for compatibility with other cruises when there is more than one LADCP. The convention adopted on CD139 was that 02 is a downlooking WH and 03is an Upward looking WH. Hence until the instruments are changed, use 03 in the following XX's..*

4) **cd proc**
perl –S scan.prl NNN_XX *check times and depth is sensible*

5) **putpos2 NNN XX** *should collect start and stop times, positions, and get mag var correction using a matlab routine. Updates stations.asc and magvar.tab*

6) **perl –S load.prl NNN_XX** *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. These are found in proc/casts/jNNN_02/scdb.*

7) **perl –S domerge.prl –c0 NNN_XX** *merge single pings into long shear profiles*

8) **cd Rnav**
updatesm.exec *updates a nav file; calls matlab*
cd proc

8) *first look at profile:*

in **matlab**
plist = NNN.XX *(this is a decimal number in matlab)*
do_abs

Check for X ey profiles.

9) *When the CTD has been processed as far as a 1hz file*

cd proc
cd Rctd

mk_ctdfile NN *makes ascii version of CTD 1hz file in preparation for ladcp use*
in **matlab**
  cd to proc/Pctd
  ctd_in(NNN,02)
  cd to proc/Fitd directory
  plist = NNN.02 *decimal number*
  fd *check vertical velocities from ctd and adcp agree*
cd proc *in unix*
perl –S add_ctd.prl NNN_02
perl –S domerge.prl –c1 NNN_02
matlab
  plist = NNN.02
  do_abs

10) ldeo processing (easiest check of ladcp beam strength).
Do UH processing first (though don't need to do 1hz CTD processing).
cd to
pstar/data/ladcp/ldeo/jr0812

in **matlab**
sp – input NNN and XX when prompted
lp

Beam strength and correlation figures should show good agreement between the three beams