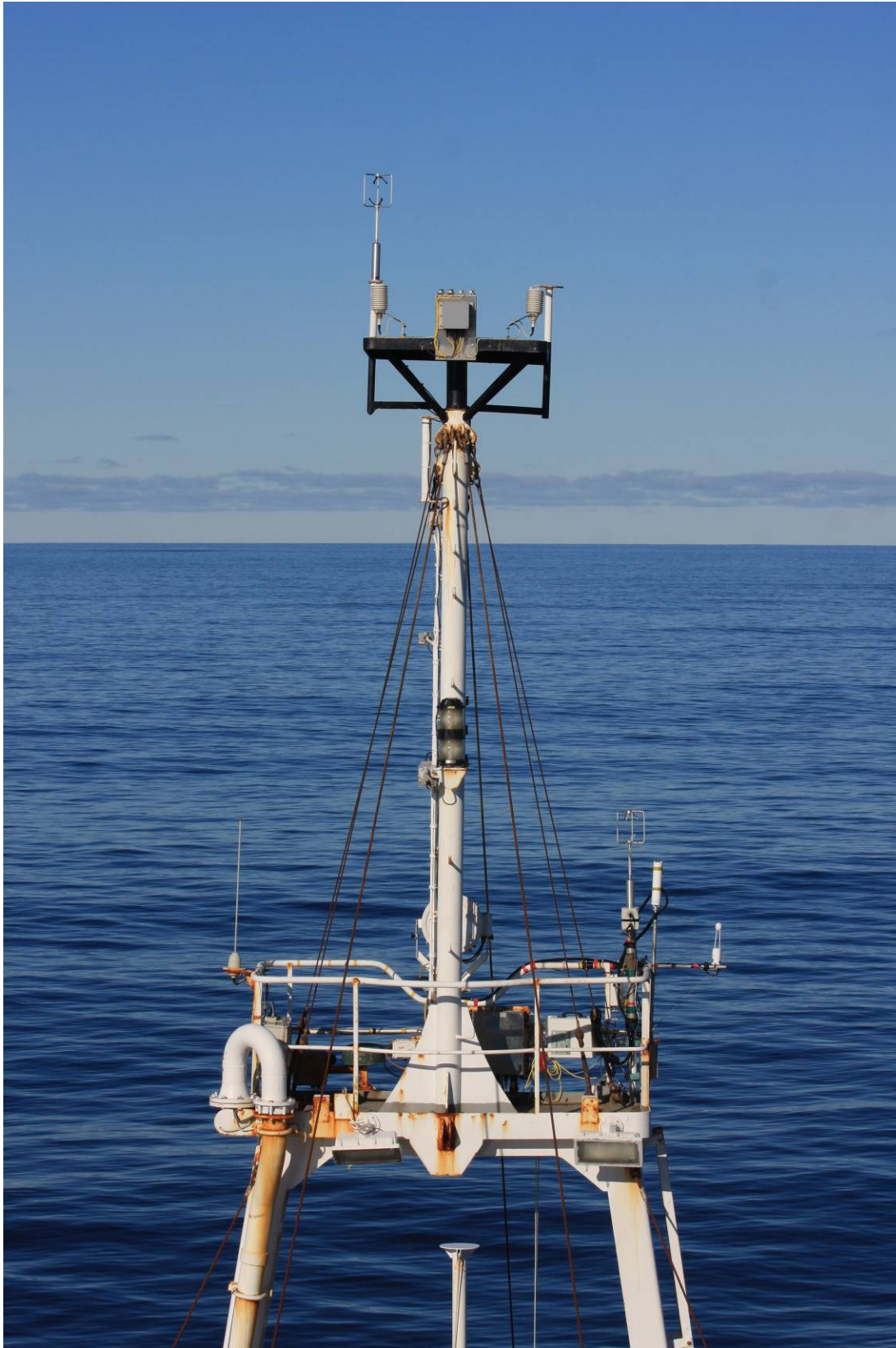


Cruise Report

JR272A Weddell and Scotia Sea hydrographic section

27th March 2012-24th April 2012 (with JR257 and JR254E)



Contents

1	Introduction	4
1.1	Rationale and context	4
1.2	Cruise Timeline	4
1.3	Cruise Track	6
1.4	Personnel	6
1.4.1	Crew	6
1.4.2	Scientists	7
1.5	Acknowledgements	8
2	CTD sampling	9
2.1	CTD Sensors, Deployment and Data Acquisition	9
2.1.1	Introduction	9
2.1.2	CTD instrumentation and deployment	9
2.1.3	Data acquisition and preliminary processing	10
2.1.4	SBE35 high precision thermometer	12
2.1.5	Salinity samples	12
2.2	CTD data processing	13
2.2.1	CTD and underway calibration	15
2.3	Cumberland Bay CTD Survey	17
2.4	CTD Deployment table	19
3	Lowered Acoustic Doppler Current Profiler (LADCP)	22
3.1	Instruments and Methods	22
3.2	Results	24
4	Vessel-mounted Acoustic Doppler Current Profiler (VM-ADCP)	28
4.1	Introduction	28
4.2	Instrumentation	28

4.3	Configuration	29
4.4	Outputs	29
4.5	Post-processing of data.....	30
4.6	Output Files	31
4.7	Command Files used	32
4.8	Bug fixes	32
5	UNDERWAY NAVIGATIONAL DATA	33
5.1	Instrumentation and data collection	33
5.2	Processing.....	34
5.3	Problems encountered	36
6	UNDERWAY OCEANLOGGER AND METEOROLOGICAL DATA.....	37
6.1	Instrumentation and data collection	37
6.2	Processing.....	38
6.3	Problems encountered	39
6.4	Salinity samples.....	39
6.5	Temperature and Salinity calibration	41
6.6	Sample plots	41
7	Mooring deployment.....	43

1 Introduction

1.1 Rationale and context

The section from the north-west Weddell Sea to South Georgia, or parts thereof, have been occupied three times previously: as part of WOCE A23 section, JR40 ALBATROSS cruise and after as part of the ANDREX recovery cruise JR235/236/239. It therefore provides an opportunity to monitor the properties of the bottom water within the Weddell Sea and as it flows through the Scotia Sea. The plan is to occupy the section every year (or as many as possible) as part of core BAS Polar Ocean work. JR272A represents the second of these occupations, after the section during the ANDREX cruise. This cruise was physics only sampling. It was combined with JR257 (coring for paleoclimate studies) and JR254E (WAGES air-sea gas exchange).

1.2 Cruise Timeline

Date		Activities (times are local)
21/3	Wed	Flew from Brize Norton. Informed of 14 hour lay-over on Ascension
22/3	Thurs	Landed Ascension 7am, spent the day at or around 'bunk bed city'. Left 11pm
23/3	Fri	Landed Mount Pleasant 4am. Taken to Lookout Lodge as the ship, in Mare Harbour, was not clear of previous cruise. Stanley and Gypsy Cove walk, night in Lookout Lodge.
24/3	Sat	Collected 9am and brought to ship, introductory briefing and start mobilising. Sailing delayed until Tuesday due to delay in bunkering. Joined by Povl who had come direct from New Zealand
25/3	Sun	Mobilising and walks
26/3	Mon	Scheduled departure date but delay due to slow bunkering. Continue mobilising and another walk.
27/3	Tues	Left berth at 9am, completed boat tests and safety drills, fixed gravity coring gantry to starboard side of ship and tested buoyancy of WAGES buoys. Set off for north-east of Falklands for WAGES short fetch studies
28/3	Wed	Close to Falklands for WAGES work
29/3	Thurs	Close to Falklands for WAGES work
30/3	Fri	Finished WAGES at midnight, headed to coring site 1 for CTD, box core and gravity core. Left and headed out overnight to site 6
31/3	Sat	Box core at site 6. Too sandy so no gravity core.
1/4	Sun	On passage to mooring site
2/4	Mon	Deployed Orkney Trough mooring. Deployed bubble buoy, CTD and then triangulated mooring.
3/4	Tues	On passage to CTD transect
4/4	Wed	Start of CTD transect, with buoy deployments
5/4	Thurs	CTD transect, with buoy deployments
6/4	Fri	CTD transect, with buoy deployments

7/4	Sat	CTD transect, with buoy deployments
8/4	Sun	CTD transect
9/4	Mon	CTD transect
10/4	Tues	On passage to coring sites around Shag Rocks area
11/4	Wed	Swath/Topas survey and coring
12/4	Thurs	Swath/Topas survey and coring
13/4	Fri	Swath/Topas survey and coring
14/4	Sat	Swath/Topas survey and coring
15/4	Sun	Bird Island call
16/4	Mon	Swath/Topas survey and coring
17/4	Tues	Royal Bay Swath/Topas and coring
18/4	Wed	Cumberland Bay CTD survey
19/4	Thurs	Bird Island pax pickup
20/4	Fri	KEP call, set off on passage afterwards (despite being informed that we'd be at anchor)
21/4	Sat	On passage, tacking in bad weather
22/4	Sun	Buoy deployments and passage
23/4	Mon	On passage to site 1
24/4	Tues	Repeat attempt at coring at site 1, alongside Fipass at 17.00
25/4	Wed	Scheduled return date. Demobilisation
26/4	Thurs	Finish demobilisation
27/4	Fri	Early flight from Mount Pleasant

1.3 Cruise Track

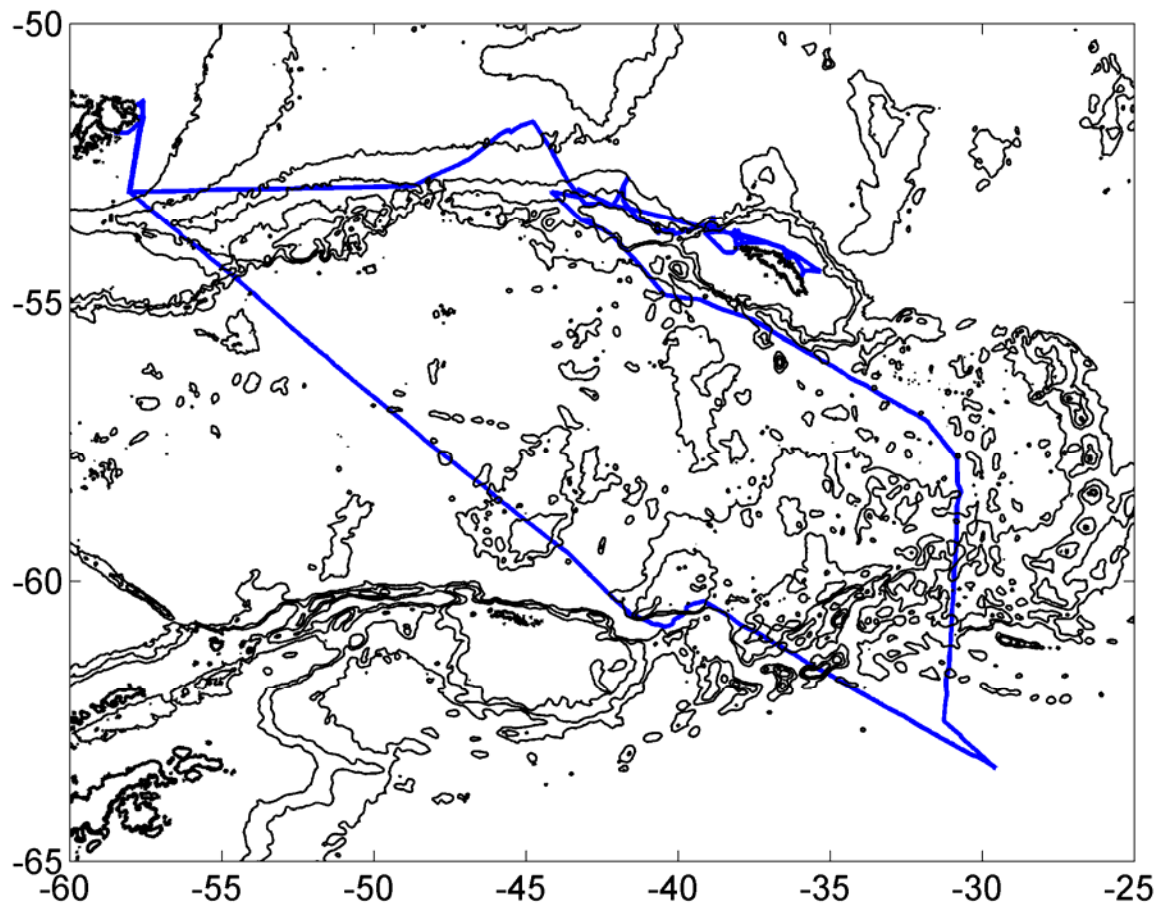


Figure 1.1 JR272 cruise track for JR272A/JR254E/JR257. Coastline and bathymetry data are from Sandwell and Smith. The track was completed anti-clockwise, for fear of sea-ice extending into our sampling area.

1.4 Personnel

1.4.1 Crew

Jerry Burgan
Timothy Page
Wendy O'Donnell
Alex White
Micheal Glostein
Richard Turner
Duncan Anderson
Bobby Slater
Robert Couper
Gareth Wale
Matthew Ashworth

Francis Boyd
Sean Fuller
David Peck
Albert Bowen
David Phillips
Ian Raper
Mark Walley
James Shearer
George Dale
Seamus MacNeil
Ashley Huntley
Jamie Lee
Lee Jones
Graham Raworth
Nicholas Greenwood
Glyndor Henry

1.4.2 Scientists

JR272A
Hugh Venables
Povl Abrahamsen
Karen Assmann
Joanna Beja de Silva
Fred Wobus

JR257
Claire Allen
Victoria Peck
Erin McClymont
Mark Robinson
Hilary Blagbrough
Alistair Graham

JR254E
Mags Yelleand
Robin Pascal
Ian Brooks
Helen Czerski

Seth Thomas - AME
Johnnie Edmonston – ICT

1.5 Acknowledgements

As PSO, on behalf of all the scientists I would like to say thank you for all the co-operation we received from the officers, engineers, crew and kitchen staff. Their day-to-day, often unseen, work is also very much appreciated. Seth and Johnnie deserve special mention for getting the Oceanlogger working again, with helpful advice from Cambridge on what supplies were on board.

2 CTD sampling

Hugh Venables

2.1 CTD Sensors, Deployment and Data Acquisition

2.1.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used to vertically profile the water column. 38 casts were carried out in total, as part of a repeat CTD transect from the Weddell Sea towards South Georgia (see A23, Albatross and Andrex reports), at the deployment of a mooring, at gravity coring stations (see JR254 report) and as a survey of Cumberland Bay.

2.1.2 CTD instrumentation and deployment

An SBE32 carousel water sampler, holding 24 12-litre niskin bottles, an SBE9Plus CTD and an SBE11Plus deck unit were used. The SBE9Plus unit held dual SBE3Plus temperature and SBE4 conductivity sensors and a *Paroscientific* pressure sensor. An SBE35 Deep Ocean Standards Thermometer makes temperature measurements each time a bottle is fired, and time, bottle position and temperature are stored, allowing comparison of the SBE35 readings with the CTD and bottle data. Additional sensors included an altimeter, a fluorometer, two oxygen sensors, a photosynthetically active radiation (PAR) sensor and a transmissometer. The altimeter returns real time accurate measurements of height off the seabed within approximately 100m of the bottom. This allows more accurate determination of the position of the CTD with respect to the seabed than is possible with the Simrad EA600 system, which sometimes loses the bottom and, in deep water, often returns depths that are several tens of metres deeper than the true bottom location.

A fin attached to the CTD frame reduced rotation of the package underwater. The CTD package was deployed from the mid-ships gantry on a cable connected to the CTD through a conducting swivel.

CTD data were collected at 24Hz and logged via the deck unit to a PC running Seasave, version 7.21d (Sea-Bird Electronics, Inc.), which allows real-time viewing of the data. The procedure was to start data logging, deploy the CTD, then stop the instrument at 10m wireout, where the CTD package was left for at least two minutes to allow the seawater-activated pumps to switch on and the sensors to equilibrate with ambient conditions. The pumps are typically expected to switch on 60 seconds after the instrument is deployed.

After the 10m soak, the CTD was raised to as close to the surface as wave and swell condition allowed and then lowered to within 10m of the seabed. Bottles were fired on the upcast, where the procedure was to stop the CTD winch, hold the package *in situ* for a few seconds to allow sensors to equilibrate, and then fire a bottle. The sensor averages these readings to produce one value for each bottle fire. Short times between firing pairs of bottles sometimes led to no SBE35 readings for the second bottle of the pair.

Salinity samples were taken from the mixed layer and other depths with low vertical salinity gradient to calibrate the CTD conductivity and salinity.

2.1.3 Data acquisition and preliminary processing

The CTD data were recorded using Seasave, version 7.21d, which created four files:

<i>jr272_[NNN].hex</i>	binary data file
<i>jr272_[NNN].XMLCON</i>	ascii configuration file with calibration information
<i>jr272_[NNN].hdr</i>	ascii header file containing sensor information
<i>jr272_[NNN].bl</i>	ascii file containing bottle fire information

where NNN is the CTD number (column 1 in Table Ocea.1). The *.hex* file was then converted from binary to ascii using the SBE Data Processing software *Data Conversion* module. The output was a file named *jr272ctd[NNN].cnv*. The *Data Conversion* module calculates parameters using the coefficients detailed in Table Ocea.2 as follows:

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

where P is the pressure (dbar), T is the pressure period in μsec , $D = D_1 + D_2U$, $C = C_1 + C_2U + C_3U^2$ and $T_0 = T_1 + T_2U + T_3U^2 + T_4U^3 + T_5U^4$ are calculated from the coefficients detailed in Table Ocea.2, where U is the temperature in $^\circ\text{C}$.

$$\textbf{Conductivity:} \quad \textit{cond} = \frac{(g + hf^2 + if^3 + jf^4)}{10(1 + \delta t + \varepsilon p)}$$

where \textit{cond} is the conductivity in Sm^{-1} , p is pressure, t is temperature, $\delta = \text{CTcor}$ and $\varepsilon = \text{CPcor}$. All coefficients are included in Table Ocea.2.

$$\textbf{Temperature: } temp(ITS90) = \frac{1}{\{g + h[\ln(f_0 / f)] + i[\ln^2(f_0 / f)] + j[\ln^3(f_0 / f)]\}} - 273.15$$

Where the temperature, $temp$, is measured in °C, g , h , i and j are coefficients detailed in Table Ocea.2 and f is the frequency output by the sensor.

$$\textbf{Oxygen: } oxy = (Soc(V + Voffset))e^{Tcor.T} Oxsat(T, S)e^{Pcor.P}$$

where oxy is dissolved oxygen in ml/l, V is the voltage output from the SBE43 sensor, $Oxsat$ is oxygen saturation (ml/l), a function of temperature, T , salinity, S , and pressure, P , and the remaining coefficients are detailed in Table Ocea.2.

$$\textbf{PAR: } PAR = \left(\frac{multiplier \cdot 10^9 \cdot 10^{(V-B)/M}}{C} \right) + offset$$

where V , B , M , $offset$, $multiplier$ and C , the calibration constant, can be found in Table Ocea.2.

$$\textbf{Fluorescence: } flsc = \frac{slope(10e^{(V/slope\ factor)} - 10e^{VB})}{10e^{V1} - 10e^{Vacetone}} + offset$$

Where $flsc$ is measured in µg/l, V is the fluorometer output voltage and the remaining coefficients can be found in Table Ocea.2.

$$\textbf{Transmission: } Light\ transmission = M \cdot output\ voltage + B$$

where light transmission is measured in % and M and B are derived from measured voltages through air and water in light and darkness, and are included in Table Ocea.2.

The SBE Data Processing *Cell thermal mass* module was then used to remove the conductivity cell thermal mass effects from the measured conductivity. This reads in the *jr272ctd[NNN].cnv* file and re-derives the pressure and conductivity, taking into account the temperature of the pressure sensor and the action of pressure on the conductivity cell. The output is another ascii file, named as *jr272ctd[NNN]_ctm.cnv*. The correction applied to the CTD data is detailed below:

$$Corrected\ conductivity = conductivity + ctm$$

where

$$ctm = -1 \times \left(\frac{1 - 5\alpha}{2s\beta + 4} \right) \times ctm_0 + \frac{2\alpha}{s\beta + 2} \times 0.1(1 + 0.006[T - 20]) \times \Delta T$$

and s is the sample interval, T is temperature, ctm_0 is the uncorrected cell thermal mass, $\alpha = 0.03$ and $\beta = 7.0$.

2.1.4 SBE35 high precision thermometer

Data from the SBE35 thermometer were usually uploaded after every cast using the *SeaTerm* program. Once the readings had been written to an ascii file (named *jr272sbeNNN.asc*), the file was opened and the contents checked to make sure the correct number of readings had been stored. The memory of the SBE35 was then cleared using the '*samplenum=0*' command. To check that the memory was clear, the command '*ds*' was entered, which displays the number of data points stored in the instrument's memory. This number should be 0.

Once all data had been downloaded and the preliminary processing described above carried out, the directory containing all data for that CTD cast was copied to the Unix system for further processing in mstar.

On JR272 the normal route of 'upload' and entering filename and data cycles only gave a file with the header details. To create the files as expected this was done and also 'capture', dd 1,24 which placed the data in another text file. These were merged with the header files but the processing could run on just the data file.

2.1.5 Salinity samples

At each CTD station 24 niskin bottles were closed at up 11 distinct depths. Up to ten salinity samples were taken (thermocline samples were also taken for organic geochemistry but these were from depths with significant salinity gradient). Sampling, storage and analytical procedures were as per those described in Section 6.4 (Underway).

Once analysed, the conductivity ratios were entered by hand into *jr272_master.xls*, converted to salinities and used for further CTD data processing.

2.2 CTD data processing

CTD data were processed using mstar scripts written by Brian King. They were run on a mac laptop. Some of the navigation pre-processing, written for linux, was not compatible with unix processing so was done using previous Unix and Matlab code and then written across to mstar format. Processing was much faster than on JR239, for unknown reasons though possibly linked to the smaller number of variables in each file.

M_setup_*** - roots and global variables (ship, cruise etc.)

Files in ../ctd relative to processing scripts unless stated

Mstar processing route:

ctd_all_part1 – includes:

msam_01 and **mdcs_01** (these can be created in advance but processing was fast enough for this not to be necessary)

mctd_01 ctd_jr272_NNN_ctm -> ctd_jr272_NNN_raw.nc

Reads in CTD *ctm.cnv data and gives it a dataname. No need to tell it how CTD is setup – works that out by comparing .cnv file with list of SBE output variables. Replaces special characters in name such as '/'. Writes list of SBE programs run on data into comments.

mctd_02a ctd_jr272_NNN_raw.nc (then archived) -> ctd_jr272_NNN_24hz.nc

Renames variables (from SBE names to usual names, via reference to a .csv file). Write-protects *_raw.nc and copies to *_24Hz.nc which is working version.

mctd_02b ctd_jr272_NNN_24hz.nc -> ctd_jr272_NNN_24hz.nc

Applies oxygen hysteresis correction

mctd_02c ctd_jr272_NNN_24hz.nc -> ctd_jr272_NNN_24hz_fr.nc

Calls hfallrate, which is a matlab equivalent of loopedit. It creates a NaN/1 flag variable where 1 is good (so variable.*Flag leaves good data). Bad is defined as the initial soak (which it identifies and asks for confirmation), times when the CTD package is above a previously reached depth or when the CTD package speed is <0.25 m/s downwards. It only flags data bad if >=2 consecutive points are considered bad, to allow for noise in the speed calculation at 24Hz. Datacycle for start of downcast is confirmed with user input and written to dcs_jr272_NNN.nc from where it is read on post-processing without the need for user input.

mctd_02d ctd_jr272_NNN_24hz_fr.nc-> ctd_jr272_NNN_24hz_fr_app2.nc

Applies the fallrate flag to appropriate CTD variables

End of ctd_all_part1

ctdcheckplot272 Program to plot the 24Hz profiles and T1-T2 and C1-C2 to allow for visual checking before further processing and averaging.

mplxyed Interactive editing if needed, ctd_jr272_NNN_24hz_fr_app.nc ->

ctd_jr272_NNN_24hz_fr_app.nc

ctd_all_part2

mctd_03_noave ctd_jr272_NNN_24hz_fr_app.nc → ctd_jr272_NNN_1hz.nc +
ctd_jr272_NNN_psal.nc + ctd_jr272_NNN_24hz_psal.nc

Average to 1hz – used for LADCP processing. Also calculates salinity and adds to 24hz
which is used for further processing and averaging (rather than going through 1hz data)

mdcs_02 ctd_jr272_NNN_psal.nc → dcs_jr272_NNN.nc (again)

Finds bottom of cast and adds it to datacycle file (requires pressure spikes to have been dealt
with first)

mdcs_03 user input → dcs_jr272_NNN.nc (again)

Mlists end of cast to allow user to select, copy and paste the scan number of the end of cast
(last good conductivity).

mctd_04 dcs_jr272_NNN.nc+ ctd_jr272_NNN_psal.nc→ctd_jr272_NNN_2db.nc

Use start, bottom and stop data cycles to split cast and average to 2dbar.

mfir_01 → fir_jr272_NNN_bl.nc

Read in .bl file

mfir_02 fir_jr272_NNN_bl.nc + ctd_jr272_NNN_1hz.nc → fir_jr272_NNN_time.nc

Merge times from CTD into fir file

mfir_03 fir_jr272_NNN_time.nc+ ctd_jr272_NNN_psal.nc → fir_jr272_NNN_ctd.nc

Merge upcast data into fir file.

mfir_04 fir_jr272_NNN_ctd.nc→ sam_jr272_NNN.nc

Pastes fir data into sam file

No winch data was read in (but it was logged from the SCS system).

end of ctd_all_part2

ctd_all_part3 – to be run once navigation data has been processed for the day of the cast.

Written to loop through all CTDs from the day. Includes:

mdcs_04

Merge CTD times with navigation file to add positions to dcs_jr272_nnn_pos.nc file.

Changed to merging with bestnav rather than seapos

mdcs_05

Apply positions to ctd, fir, sal, sam and dcs files

mctd_04depth

mfir_04a

Calculate depth once position known. mfir_04a actually adds depth to the sam file rather than
fir files

end of ctd_all_part3

ctd_all_part4– to be run once salinity data are available. Written to loop through CTD casts where bottle files are available. Includes:

msal_01 sal_jr272_NNN.txt->sal_jr272_NNN.nc

Reads in bottle salinities from csv file (format one row per sample; station,bottle,salinity)

msal_02 sal_jr272_NNN.nc-> sam_jr272_NNN.nc

Paste sal into sam

msbe_01/02, do same as above for sbe35 temperatures

msam_02 sam_jr272_NNN.nc ->sam_jr272_NNN_resid.nc

Calculate residuals between samples and ctd bottle averages

2.2.1 CTD and underway calibration

CTD data are used for underway data calibration (together with salinity samples taken from the underway supply). In total, 613 SBE35 temperature data points were recorded as Niskin bottles were closed, with 392 of these being deeper than 500m. 256 salinity samples were analysed from CTD sampling, with 175 of these being from deeper than 500m. 66 underway salinity samples were taken and 44 intersections between underway and 7m CTD values were used.

The order of calibration, following reading in bottle data above, is:

Find calibration for CTD temperature using SBE35 temperatures (**JR272cal_ctdtmp.m**).

On JR272 the calibration for temp1 was $temp1_cal=temp1+0.001-(0.0016/5000)*pressure$.

Apply temperature calibration to bottle files (**mcal_bott.m**, in ctd_all_part5.m)

Back calculate bottle conductivity (**mcond.m**, in ctd_all_part5.m).

Calibrate bottle conductivity (**JR272cal_ctdcond.m**). This means that any future changes in equation for salinity are easy to apply.

On JR272 the calibration $cond1_cal=cond1+0.0041-(0.0022/5000)*pressure$.

Check calibrations (**JR272cal_ctdtmp_check.m**). This makes sure calibrations have been applied in the correct direction and that calibrated salinity looks good (if it doesn't then either messed up cond calibration or there is a problem with the pressure sensor, but latter would need to be significant). Calibrated Salinity looked good, to 0.002, on JR272A.

Apply conductivity calibration to bottle files and both calibrations to 2db and 24hz files and calculate calibrated salinity and density (**mcal_bott2_272.m**, **mcal_ctd_272.m** and **mcal_ctd_272_24hz.m**, in ctd_all_part6.m or ctd_all_part5.m for reprocessing).

Pull out down and up cast 7m data from calibrated CTD 24hz profiles (**mctd_7m.m**)

Merge with oceanlogger data (**ocl_ctdmerge.m**) to get temperature and salinity differences.

Read in underway salt samples (**msal_ocl.m, ocl_botmerge.m**)

Find calibration for underway SST and salinity (**JR272_ocl_cal.m**). For JR272 CTD salinity was 0.021 higher than underway and CTD temperature was 0.19°C greater than underway temperature.

Apply calibration **mocl_cal_272.m**

2.3 Cumberland Bay CTD Survey

Karen Assmann & Hugh Venables

18 April 2012 (Julian Day 109)

We performed an opportunistic CTD survey of Cumberland Bay on 18 April 2012 due to constraints of base calls relative to desired coring locations for the geologists and calm conditions unsuitable for WAGES work. 12 CTD stations were taken over the course of 6 hrs 30 minutes. Their positions are listed below and shown on Fig.

Station	Latitude	Longitude	Depth
Section along the eastern branch (Nordenskjold glacier)			
CTD 26	54°21.3000' S	36°21.9000' W	138m
CTD 27	54°19.5000' S	36°23.1000' W	188m
CTD 28	54°18.1200' S	36°24.0600' W	239m
CTD 29	54°15.5400' S	36°26.1000' W	264m
CTD 30	54°14.1060' S	36°26.2080' W	217m
Cross-fjord section			
CTD 31	54°13.4940' S	36°25.3860' W	178m
CTD 32	54°13.4940' S	36°26.2140' W	232m
CTD 33	54°13.4940' S	36°27.0420' W	234m
CTD 34	54°13.4940' S	36°27.7800' W	137m
CTD 35	54°13.1160' S	36°27.9660' W	256m
CTD 36	54°12.5820' S	36°27.9660' W	260m
CTD 37	54°11.9880' S	36°27.9660' W	133m

The survey consisted of a section of 5 stations along the eastern branch of Cumberland Bay leading up to Nordenskjold glacier. The first two stations were taken glacierward of the moraine at the end of the fjord, the third just seaward of it. A fourth station was placed in the deepest part of the fjord and a fifth at the deepest point of the sill at its mouth. Seaward of the sill a section across both the mouths of the eastern and western branches of Cumberland Bay was taken encompassing 7 stations.

Along with the CTD data, data from a LADCP is available along with Oceanlogger surface data. A bug in the shipboard ADCP rendered its data unusable.

It was noted that the Oceanlogger SSSs, as well as SST and transmittance, were considerably (up to 0.8 psu) lower than the surface data of the first CTD casts close to the glacier and that Oceanlogger SSS, SST and transmittance increased sharply each time the ship went on station (see photo). To mitigate the churning of the shallow fresh surface layer by the ship's engine and bowthrusters, we asked the bridge to come onto station more gently which lowered the accuracy of the station positions, but helped. The position of the underway intake at 7 m below surface suggests this number as the thickness of the fresh surface layer, but subsequent CTD casts where care was taken to wait until the surface layer had time to re-establish itself suggest 4-5 m thickness.

There almost no kelp in the eastern branch of Cumberland Bay. The western part which we did not enter due to time constraints appeared to have a lot of fragmented ice in it and surface data showed low transmittance and salinity for the cruise track outside its mouth.

2.4 CTD Deployment table

CTD	Bridge		Lat	Lon	Max depth	Year	Month	Day	Hour	Minute
	Log name	Type								
1	1	3	-53.013	-58.0404	589	2012	3	30	13	23
2	2	2	-60.5649	-41.6326	2292	2012	4	2	20	27
3	3	1	-63.3467	-29.5678	4727	2012	4	4	13	59
4	4	1	-63.0728	-30.1136	4863	2012	4	4	19	27
5	5	1	-62.7832	-30.7022	4810	2012	4	5	1	22
6	6	1	-62.4916	-31.2624	4752	2012	4	5	7	23
7	7	1	-62.0835	-31.1742	4840	2012	4	5	12	58
8	8	1	-61.6612	-31.1108	3406	2012	4	5	19	17
9	9	1	-61.5578	-31.0991	4192	2012	4	6	3	7
10	10	1	-61.1707	-31.046	3470	2012	4	6	9	23
11	11	1	-61.1088	-31.0405	2556	2012	4	6	12	24
12	12	1	-60.6995	-31.0086	1609	2012	4	6	17	22
13	13	1	-60.3194	-30.961	2786	2012	4	6	21	9
14	14	1	-59.9936	-30.9255	2985	2012	4	7	1	38
15	15	1	-59.7694	-30.9062	3778	2012	4	7	5	49
16	16	1	-59.4357	-30.8612	3455	2012	4	7	10	36
17	17	1	-59.0504	-30.8328	3110	2012	4	7	15	54
18	18	1	-58.6237	-30.8212	3574	2012	4	7	23	37
19	19	1	-58.2132	-30.8222	3985	2012	4	8	9	16
20	20	1	-57.8028	-30.8304	3606	2012	4	8	14	36
21	21	1	-57.4582	-31.3273	3741	2012	4	8	20	24
22	22	1	-57.1187	-31.8154	3431	2012	4	9	2	41
23	23	3	-53.5851	-42.8366	1783	2012	4	11	9	46
24	24	3	-52.8804	-41.7869	2525	2012	4	13	13	33
25	25	3	-53.7432	-38.1548	381	2012	4	16	21	6
26	H13	4	-54.3551	-36.365	128	2012	4	18	11	11
27	H12	4	-54.3251	-36.3853	177	2012	4	18	11	51
28	H11	4	-54.3019	-36.4013	230	2012	4	18	12	22
29	H9	4	-54.259	-36.4351	254	2012	4	18	13	7
30	H8	4	-54.2353	-36.4369	199	2012	4	18	13	42
31	H7	4	-54.2251	-36.4228	136	2012	4	18	14	12
32	H6	4	-54.2249	-36.4365	221	2012	4	18	14	39
33	H5	4	-54.2251	-36.4509	223	2012	4	18	15	10
34	H4	4	-54.225	-36.4628	136	2012	4	18	15	37
35	H3	4	-54.2187	-36.4661	244	2012	4	18	16	1
36	H2	4	-54.2098	-36.4654	250	2012	4	18	16	31
37	H1	4	-54.1999	-36.4655	138	2012	4	18	17	1
38	26	3	-54.2023	-36.3745	228	2012	4	18	17	49

Table 1 CTD deployment table. CTD types are: 1) Transect from Weddell Sea towards South Georgia, 2) Mooring, 3) Coring stations and 4) Cumberland Bay survey

CTD no. 272				CTD no. Andrex				CTD no. A16S			
Lat 272	Long 272	Max depth		Lat Andrex	Lon Andrex	Max depth		Lat A16	Lon A16	Depth A16	
				70	-63.9655	-28.875	4792				
3	-63.3467	-29.5678	4726	71	-63.3468	-29.5678	4728				
4	-63.0728	-30.1136	4862	72	-63.0729	-30.1151	4865				
5	-62.7832	-30.7022	4810	73	-62.7827	-30.6946	4824				
6	-62.4916	-31.2624	4752	74	-62.4916	-31.2622	4754				
7	-62.0835	-31.1742	4839	75	-62.0753	-31.1826	4852				
8	-61.6612	-31.1108	3405								
9	61.5578	-31.0991	4192	77	-61.5515	-31.1042	4060				
10	-61.1707	-31.046	3470	78	-61.1709	-31.0454	3483				
11	-61.1088	-31.0405	2555	79	-61.1094	-31.0409	2565				
12	-60.6995	-31.0086	1611	80	-60.6992	-31.0091	1630				
13	-60.3194	-30.961	2789								
14	-59.9936	-30.9255	2984	82	-59.9946	-30.9296	2984	1	-60.013833	-30.895833	2744
15	-59.7694	-30.9062	3777	83	-59.7663	-30.9054	3780				
				84	-59.6737	-30.8957	2950	2	-59.499	-30.920667	3228
16	-59.4357	-30.8612	3455	85	-59.4357	-30.8602	3451				
17	-59.0504	-30.8328	3110	86	-59.0495	-30.8312	3110	3	-58.999667	-30.921333	2941
18	-58.6237	-30.8212	3574	87	-58.6352	-30.8245	3524	4	-58.496833	-30.9225	3085
19	-58.2132	-30.8222	3985	88	-58.2131	-30.822	3985	5	-58.026833	-30.9155	3439
20	-57.8028	-30.8304	3605	89	-57.8013	-30.8326	3575				
21	-57.4582	-31.3273	3740	90	-57.4581	-31.3273	3755	6	-57.499833	-31.600167	3311
22	-57.1187	-31.8154	3430	91	-57.1186	-31.8145	3424	7	-56.9985	-32.289833	3573
				92	-56.7758	-32.3037	3226	8	-56.500333	-32.948667	3555
				93	-56.3808	-32.8724	3124				
				94	-55.9906	-33.4192	3039	9	-56.001333	-33.632833	2820
				95	-55.7257	-33.7855	3524				
				96	-55.4849	-34.1331	2460	10	-55.5995	-34.183667	2181
								11	-55.332667	-34.531667	1724
				97	-55.2598	-34.4434	1514				
								12	-55.2665	-34.632833	1007
				98	-55.2152	-34.508	546	13	-55.230333	-34.739167	391

Table 2 Positions of all occupations of hydrographic section. JR272 (April 2012), Andrex cruise (April 2010), A16S (Jan 2005), JR40 Albatross (April 1999) and JR10 WOCE A23 (April 1995). Continues next page.

CTD no. Alb	Lat Alb	Lon Alb	Max depth	CTD no. A23	Lat A23	Lon A23	Max depth
				24	-63.9655	-28.877	4831
				25	-63.3467	-29.5688	4758
				26	-63.0728	-30.1153	4916
				27	-62.7828	-30.6938	4870
				28	-62.4912	-31.2615	4794
				29	-62.0753	-31.1835	4890
				30	-61.6612	-31.111	3393
				31	-61.551	-31.1038	4086
				32	-61.1702	-31.0463	3498
				33	-61.1093	-31.0413	2481
				34	-60.6995	-31.0098	1587
102	-60.3153	-30.9588	2746	35	-60.3152	-30.9585	2718
103	-59.9938	-30.9307	2986	36	-59.9947	-30.9298	3047
104	-59.7663	-30.9062	3787	37	-59.7662	-30.9055	3845
105	-59.6733	-30.896	2966	38	-59.6738	-30.8965	2908
106	-59.436	-30.8602	3453	39	-59.4357	-30.8602	3472
107	-59.0508	-30.8307	3113	40	-59.0503	-30.8303	3180
108	-58.6317	-30.8263	3535	41	-58.6352	-30.8245	3537
109	-58.2142	-30.822	3989	42	-58.213	-30.822	3901
110	-57.802	-30.8325	3576	43	-57.8015	-30.8327	3532
111	-57.4578	-31.3273	3746	44	-57.4582	-31.3278	3792
112	-57.1187	-31.8085	3389	45	-57.1185	-31.8147	3463
113	-56.7757	-32.304	3225	46	-56.7757	-32.304	3267
114	-56.38	-32.8692	3133	47	-56.381	-32.8728	3108
115	-55.9903	-33.4198	3049	48	-55.9903	-33.4195	2953
116	-55.7253	-33.7863	3507	49	-55.7255	-33.7855	3483
117	-55.6732	-33.8628	3059				
118	-55.485	-34.1342	2453	50	-55.4847	-34.1333	2480
119	-55.2883	-34.4042	1971				
120	-55.259	-34.4432	1514	51	-55.2595	-34.4437	1524
121	-55.2285	-34.487	1082				
122	-55.2143	-34.5063	563	52	-55.2152	-34.508	537

Table 2 continued

3 Lowered Acoustic Doppler Current Profiler (LADCP)

A single downward-looking lowered ADCP was used on all CTD casts except no. 25. The data acquisition and processing are described here, along with a quick summary of the

3.1 Instruments and Methods

Two Teledyne RD Instruments 300-kHz Workhorse Monitor ADCPs were used on JR272A. The first two casts used S/N 15060. Because beam 3 showed significantly lower return strengths than the other three beams on the first cast, becoming even lower on the second, the instrument was replaced with S/N 14897 for the rest of the cruise. All beams worked well for the rest of the cruise. At the start of each cast a test script was run on the ADCP to check that everything was working well. The standard BAS script was modified by adding the “PS0” command at the beginning of the script, so the serial number and firmware version of the instrument is recorded in the transcript file.

The setup of the instrument varied slightly from the setup used on JR239; we used the standard BAS command file. In future repeat cruises this should probably be modified. The contents of the command file – with values from JR239 for comparison – are shown below. Values in italics are default settings

JR239	JR272A	
CR1	CR1	Start by resetting to factory defaults
WM15	WM15	Set to LADCP mode
	RN JR272	prefix for file names – not set on JR239
<i>EA00000</i>	<i>EA00000</i>	Set heading alignment to 0
<i>EB00000</i>	<i>EB00000</i>	Set heading bias to 0
	<i>EC1500</i>	Set speed of sound to 1500 m/s
<i>ED00000</i>	<i>ED00000</i>	Set depth to 0
<i>ES35</i>	<i>ES35</i>	Set salinity to 35
EZ0011101	EZ0111111	Use manual speed of sound. Value from JR239 makes more sense, though there is no practical difference.
EX00000	<i>EX11111</i>	JR239 used beam coordinates – JR272A used earth coordinates. Beam coordinates may be more resilient to single beam failure as the remaining three beams can be used to reconstruct the data.
TE00:00:01.00	TE00:00:01.00	Set ensemble interval to 1 second
TP00:00.00	TP00:01.00	Ping time: 1 second – possibly a typo in JR239. Shouldn't make a difference with 1 ping per ensemble
LP1	LP1	1 ping per ensemble
LN016	LN025	25 depth bins – 16 bins used on JR239
LS1000	<i>LS400</i>	4-m bins – 10-m bins used on JR239
LF0500	<i>LF0176</i>	1.76 m blanking distance. The first bin was mostly unusable, so it would be better to use 5 m as on JR239
LV250	LV170	Maximum radial speed; because of the effect of heave on the CTD package, this should be increased to 2.5 m/s as in JR239
<i>LW1</i>	<i>LW1</i>	Set ADCP to narrow bandwidth
<i>LD111100000</i>		Record velocity, correlation, echo intensity, and percent good
CF11101	CF11101	Record data to memory card – don't send to serial port
SM1		Set as master LADCP (note: only one ADCP was used)
SA001		Send synchronizing pulse before each water ping
SW05000		Wait 500 ms after sending pulse
CK	CK	Save as user defaults
CS	CS	Start pinging

Raw data, along with the transcript files from the deployment, were downloaded to a laptop in the chemistry lab, and backed up to JRLB via samba, where they were placed in the legdata/work/JR272A/ladcp directory.

Preliminary processing of the data was done both using software from the University of Hawaii (UH) and from Lamont-Doherty Earth Observatory (LDEO). The UH software uses the shear from the ADCP profiles to reconstruct a full velocity profile, while the LDEO software uses a matrix inversion technique to optimize stitching the profiles together, reconstructing the CTD package drift in the process. Generally the UH software is considerably more difficult to use, consisting of a mix of Matlab and Perl scripts, while the LDEO software, written entirely in Matlab, is much more straight forward to use, and written much more transparently.

All of the processing was run on the Sun linux workstation “nosea2”, using versions of the UH and LDEO software that had been modified, at various times, primarily by Brian King. The UH software was from 2008, while the LDEO software was based on version 7.

The processing steps are listed in the cruise reports from JR139 (by Nuno Nunes) and JR239 (Loic Jullion). However, many things have changed since the former report, and there are a few steps missing in the latter report; therefore a summary of the processing is provided here, for reference on future cruises.

A new directory for this cruise was created on nosea2; a symlink to this directory was provided from /local/users/pstar/cruise. It is very important to provide symlinks to the software in this directory, or the paths will not be set up correctly when logging in. Both software versions use the same input files (LADCP, CTD, and GPS) – so once these files are set up, either can be run independently of the other.

Creating navigation files: input: SCS streams; output: cruise/data/ladcp/uh/raw/jr1203/gps/sm.mat. Ensure data/scs_raw points to the scs/Compress directory (e.g. /mnt/20120324/scs/Compress), and create data/scs_sed. From the scs_sed directory, run “./exec/jcr/sedexec_startall” – this creates all of the processed .ACO files within the current directory. To create sm.mat, go to data/ladcp/uh/raw/jr1203/gps, open Matlab, and run “m_setup; make_sm”.

Creating CTD files: input: 1Hz processed NetCDF files. output: ASCII files in cruise/data/ladcp/uh/raw/jr1203/ctd. Modify linkctd script in this directory to create links to the raw files. Run mk_ctdfile(NNN) in Matlab for each CTD cast.

LADCP file links: modify and run script cruise/data/ladcp/uh/raw/jr1203/ladcp/linkscript. This should create symlinks to the raw LADCP files.

UH processing: easiest to run from inside Matlab.

First go to `cruise/data/ladcp/uh/pro/jr1203/ladcp`. Type “source LADall” in shell. Then go into “proc” directory, and run Matlab:

```
for n=[your station numbers here]
system(sprintf('perl -S scan.prl %.3d_02',n));
putpos(n,2);
magvarsm(n+.02);
system(sprintf('perl -S load.prl -a %.3d_02',n));
system(sprintf('perl -S domerge.prl -c0 %.3d_02',n));
plist=n+.02;
do_abs
system(sprintf('cp matprof/h/j%.3d_02.mat matprof/noctd/',n));
interactive=1;
fd
system(sprintf('perl -S add_ctd.prl %.3d_02',n));
system(sprintf('perl -S btmsrch.prl %.3d_02',n));
system(sprintf('perl -I/local/users/pstar/cruise/sw/ladcp/lad_uhsoft/programs/ladcp/perl -S
prependz.prl %.3d_02',n));
system(sprintf('perl -S domerge.prl -c1 %.3d_02',n));
do_abs
end
```

The processing listed here differs slightly from that described in the JR139 and JR239 reports. One major problem with the original processing was that the CTD and LADCP casts were not aligned correctly using the automated algorithm. Therefore they had to be aligned by hand – a fairly straight-forward option, enabled by setting the variable `interactive` to 1 before calling `fd`. While there still are some problems with the resulting profiles on some stations, on most the LDEO and UH solutions do agree fairly well.

LDEO processing: run from inside Matlab. Go to `cruise/data/ladcp/ldeo`

```
for stn=[your station numbers here]
run_letter='m';
sp
lp
end
```

3.2 Results

Overall the raw data look reasonable. More bins (or longer bin lengths) could have been used, to achieve a range longer than 100 m. RDI's bottom track data have frequent dropouts, but the LDEO software is good at reconstructing the bottom track from the water track pings, so this doesn't affect the end result much. Interference can be seen on cast 21, when a different altimeter, s/n 7742.163162, was used. It could be that this altimeter pinged closer to 300 kHz than the other two altimeters used (2310.26993 and 2310.27001). The chirps visible in this cast are all short, and appear to be quite closely spaced. In the shallow casts in Cumberland Bay (26-38) a different type of interference can be seen, consisting of much longer pulses. As

these pulses were only visible when we were in shallow water near South Georgia, the best possible explanation would be that the two JRC JFE-585 200-kHz echo sounders, which are operated from the bridge and positioned at the bow and stern, were causing this interference. In a relatively shallow fiord environment, the bridge is highly unlikely to be willing to switch these off, so for coastal work a higher-frequency LADCP (e.g. 600 kHz) might be a better option than the 300 kHz version.

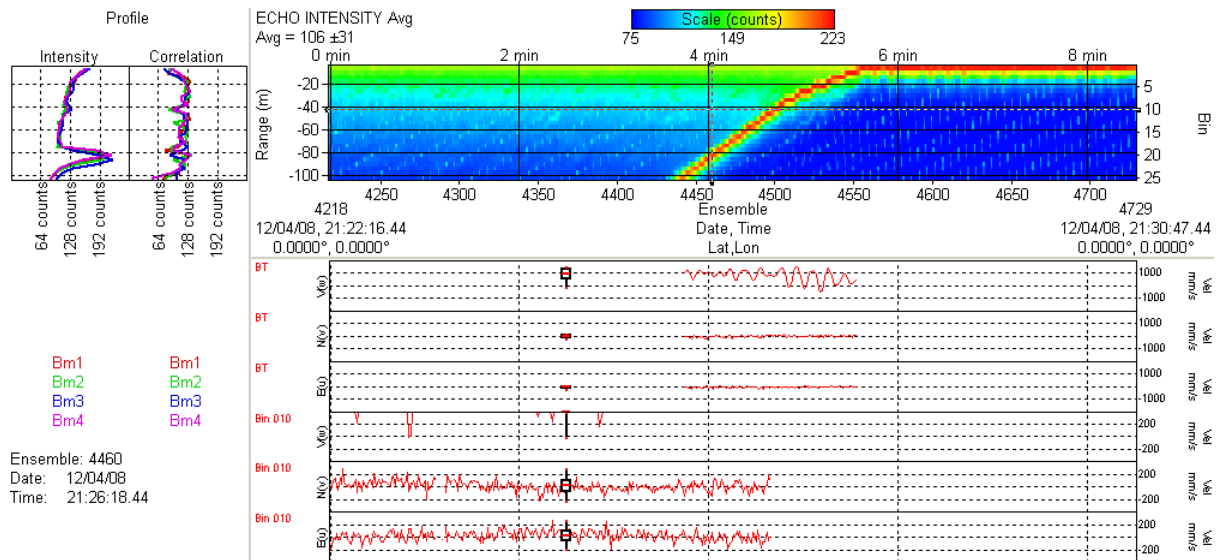


Figure 3.1 Subset from cast 21, showing possible interference from the altimeter.

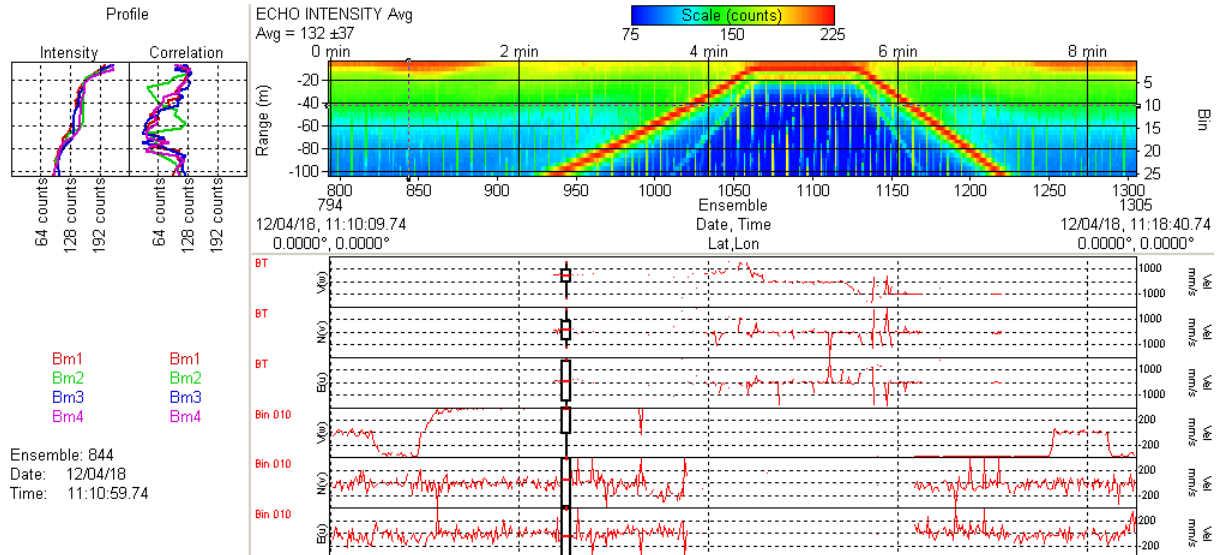


Figure 3.2 Subset from cast 26, showing possible interference from the bridge echo sounders. Note the patchy bottom track velocities.

In the shallow water casts the results from the LDEO and UH methods agree well. Because of the smaller bin size used in the LDEO processing, the profiles do extend farther toward the bottom.

In the deeper casts (especially casts 2-8) there are significant disagreements between the two methods, with the UH profiles showing unrealistically large currents near the bottom in some casts. Here the improved bottom track from the LDEO software has probably constrained the bottom velocities. Near the surface there is increased uncertainty in both sets of profiles. An upward-looking ADCP would be useful to constrain the near-surface currents, while merging in the ship-mounted ADCP would also be helpful.

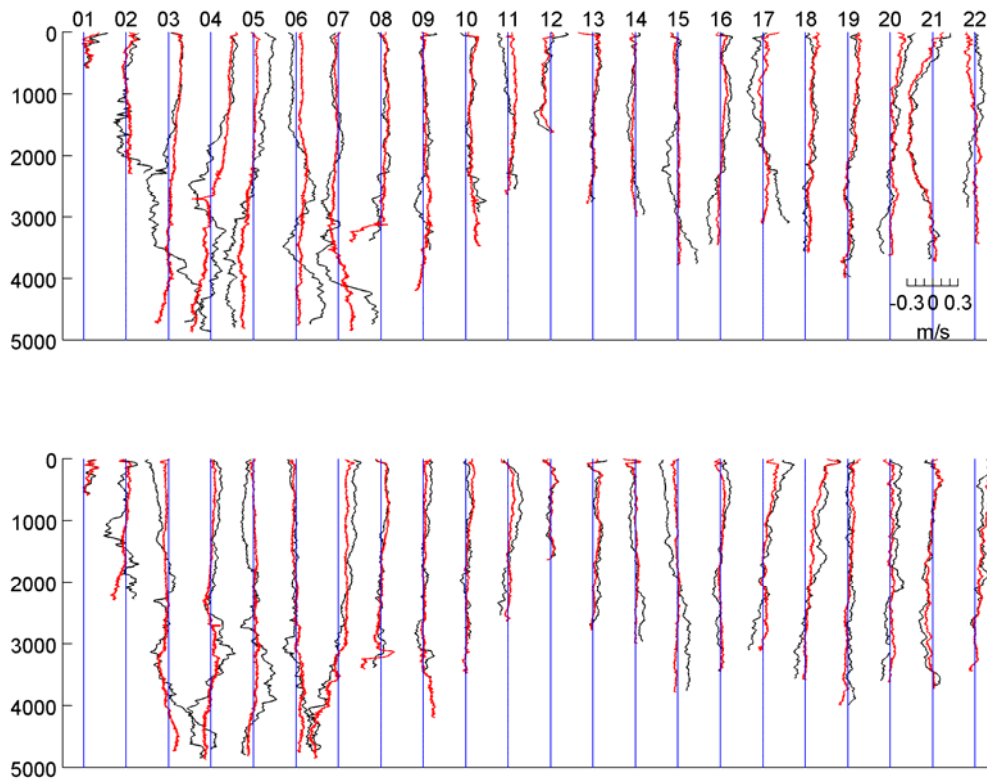


Figure 3.3 Velocity profiles (upper: zonal, lower: meridional) from UH (black) and LDEO (red) processing.

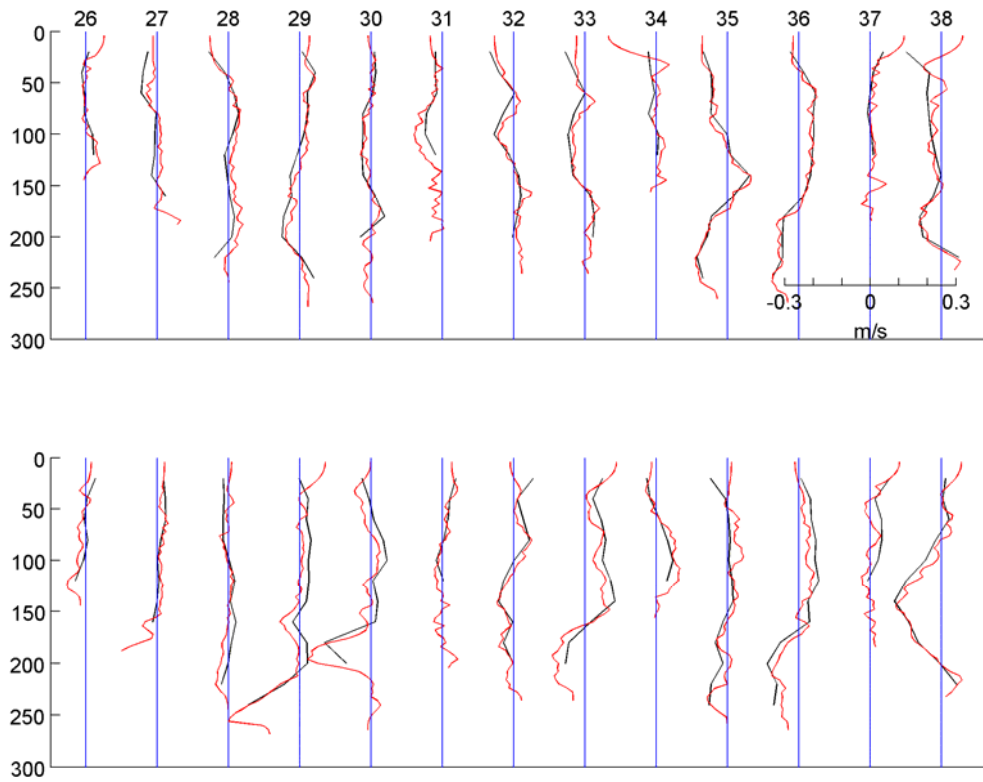


Figure 3.4 Velocity profiles (upper: zonal, lower: meridional) from UH (black) and LDEO (red) processing

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

Hugh Venables

4.1 Introduction

A 75 kHz RD Instruments Ocean Surveyor (OS75) ADCP was used during this cruise. This has also been used on JR139 (Stansfield 2006), JR161 (Hawker 2006), JR165 (Shoosmith/Renner 2007) and JR193 (McCarthy and Venables 2007), JR177, JR200 and JR218 (Venables), JR239 (Renner) and JR245 (Venables). The OS75 is capable of profiling to deeper levels in the water column than the previous 150kHz 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 generally assumed, but note that the ship was very heavily laden during cruise JR139, and for other cruises it may be shallower.

During the trials cruise, it was noted that the OS75 causes interference with most of the other acoustic instruments on *JCR*, including the EM120 swath bathymetry system. To circumvent this, the ADCP pinging was synchronised with the other acoustic instruments using the SSU, however this acts to reduce the pingrate. As noted by Dr. Sophie Fielding, when in deep water the swath can take 20 to 30 seconds from ping to end of listening, as a result this means the ADCP only pings once every 25 or so seconds. A further problem is that the ADCP appears to “time out” every other ping when it has to wait a long time between pings (i.e when running in deep water alongside the EM120). This results in it rebooting and waking the ADCP instrument up every other ping, which simply exacerbates the problem. A fix is promised by BAS AME, but requires a firmware upgrade from RDI which is not presently available. To circumvent these problems, the swath was not used during the cruise. The EK60

was set as master through the SSU and the single-beam echosounder (EA600) and OS75 were set as slaves.

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

4.3 Configuration

The OS75 was controlled using Version 1.42 of the RDI VmDas software. The OS75 ran in one mode during JR272: narrowband, water tracking. Sixteen, thirty-two or fifty 16 meter bins were used depending on the water depth. Narrowband profiling was enabled with an 8 metre blanking distance (Note that this blanking distance is larger than the 2m initially used by the RDI technician during the trials cruise. This change was adopted following advice from Dr. Mark Inall and Dr. Deb Shoosmith, who voiced concerns over the quality of data in the top bin). Despite this, there were still periods, especially in bad weather, where the data in the top bin looked bad.

The instrument was mostly left free running, either due to Topas and Swath being run in deep water with very long intervals between pings (on passage) or due to the Swath and Topas being switched off for the CTD transect. On the South Georgia shelf the ADCP was run through the SSU as the intervals between Swath and Topas pings were much shorter.

Salinity at the transducer was set to zero, and Beam 3 misalignment was set to 60.08 degrees (see above discussion). The full configuration files for each of the modes used are given at the end of this section.

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 JR272XXX_YYYYYY.ZZZ, where XXX increments each time the logging is stopped and restarted, and YYYYYY increments each time the present filesize exceeds 10 Mbyte.

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

.N1R (NMEA telegram + ADCP timestamp; ASCII)

.ENR (Beam 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).

The .N1R and .LTA files are streamed back to Cambridge for use in google earth real time plotting.

4.5 Post-processing of data

OS75 data were processed on JR272 using Matlab code originated by IFM Kiel. This was adapted by Dr. Mark Inall, Dr. Deb Shoosmith, Angelika Renner, Mark Brandon and Hugh Venables for use with the *JCR* system. The master file for the processing is “OS75_JCR_jr272.m”, which calls a lengthy sequence of routines to execute the following steps. Angelika Renner made changes to the main program following JR165, to calibrate narrowband and broadband data separately. These changes are adopted, though no broadband data has been collected. Further improvements to the code, to deal with bugs and special cases have been made during the cruises listed above.

- 1) Read RDI binary file with extension .ENX and ASCII file with extension .N1R into Matlab environment.
- 2) Remove missing data and data with bad navigation
- 3) Merge Seapath attitude data with single-ping ADCP data.
- 4) Correct for transducer misalignment and velocity scaling error (calculated during first run-through of code, applied during second)
- 5) Derive ship velocity from Seapath navigation data
- 6) Perform quality control on data, such that four-beam solution is only permitted. Other screening is performed based on maximum heading change between pings, maximum velocity change between pings, and the error velocity.
- 7) Average data into ensembles of pre-defined length (120 seconds for JR272). The version of the function average_pings.m was the one modified for JR193 from that used during JR165. These changes were modified on JR177 to cope with a change of year.
- 8) Calculates transducer misalignment and velocity scaling error (computation done on first run-through of code, to be applied during second

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

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

11) Plots the eastward and northward velocities. Details of this plotting were tidied during JR193 and JR177. In particular, code was added to deal with plotting files that spanned the new year. There is still an issue that for short files too many times are plotted on the x axis, causing them to overlap.

4.6 Output Files

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

1) JR27200A_00000B_raw.mat, where A is the highest number of the user-incremented files. This is the number that VmDas increments every time logging is stopped and restarted. The version number is B, which increments with the .ENX files, when they reach 10Mb. This contains structured arrays “c” (ensembled-averaged data), and “b” (absolute velocities)

2) JR27200A_00000Bd_att.mat, where A and B are as above. This contains the ship’s attitude data.

3) JR27200A_00000B_sgl_ping.mat, where A is as above, and B is the number VmDas increments every time filesize exceeds 10 Mbyte. This contains single-ping data in structured array “d”.

4) JR27200A_000000_ATT.mat. As (3), but for the whole section of data in the user-incremented series A

5) JR27200A_00000B_bad_heading.mat. Record of the data points removed due to bad heading

6) JR27200A_00000B_bad_nav.mat. Record of the data points removed due to bad navigation.

7) jr272000_000000_A_ave_ping. Two minute averaged data, including ship velocity.

8) jr272000_000000_A_abs. Two minute averaged data, water velocities.

9) adcp_vel_contours_A.ps Individual plots of data in jr272_000_000000_A_abs, “A” here is the first in any list of files given to OS75_JCR_jr272.m. This was introduced at A=43 so is only present before that if data has been reprocessed.

10) adcp_vel_contours.ps A file with each of the individual plots appended, each as an extra page when converted to pdf.

4.7 Command Files used

Command files created during JR218 (modified on JR239 to 16m bins) were used. In deep water the ADCP was run independently of the SSU (800m water track, not through SSU) as the TOPAS and Swath were running, with long periods between pings. On the South Georgia shelf the ADCP was run through the SSU (500m water track through SSU), pinging approximately every 4.5 seconds.

4.8 Bug fixes

On processing, some sections of data were full of NaNs for several hours at a time. This was due to

```
OS75_sgl_ping=subst_bad_seatex(OS75_sgl_ping,sea_file) ;
```

taking out data with NaN heading. These NaNs were caused by

```
[OS75_sgl_ping add_to_ensnum] =  
include_att_jcr(OS75_sgl_ping,add_to_ensnum,which_prdid_fix,lfile);
```

where line 55

```
att.ens_num(ii(jj)+1:end)=att.ens_num(ii(jj)+1:end)+att.ens_num(ii(jj));
```

should have been (and now is)

```
att.ens_num(ii(jj)+1:end)=att.ens_num(ii(jj)+1:end)+1+att.ens_num(ii(jj))-  
att.ens_num(ii(jj)+1);
```

This caused jumps in `att.ens_num`, which is then used for allocating seatex heading to an array, leaving large gaps (the array is created empty first so the gaps are NaNs rather than zeroes)

5 UNDERWAY NAVIGATIONAL DATA

Karen Assmann

5.1 Instrumentation and data collection

Navigational data were collected continuously throughout the cruise. Data from the following instrumentation was processed:

Ashtec ADU-5 GPS: antenna 1 used to determine the ship's position; antennae 2-4 used to determine pitch, roll and yaw.

Ashtec GLONASS GG24 (accurate to $\approx 15\text{m}$)

Sperry Mk 37 Model D Gyrocompass

Seatex GPS (Seapath 200)

VT-TSS DMS-05 (heave, pitch, roll)

Hull-mounted Simrad EA600 Hydrographic 12kHz Echosounder (transducers located approximately 5m below the water level). **It must be noted that the datastream is still called 'sim500', so all programs are named according to this, despite the instrument being an EA600.**

Also on board were:

Furuno GP32 GPS

Chernikeef Aquaprobe Mk5

Sperry Marine Doppler log

Navigational data were collected every second, whilst the bathymetric data were logged every 10 seconds.

5.2 Processing

Navigational data were processed in Unix and Matlab using modified versions of programs developed by Mike Meredith and then read over into mstar netCDF format (still within Matlab). Data were initially read into the Unix system, then transferred to Matlab, where the bulk of the processing was carried out.

Unix

get_nav_test Calls the scripts *get_gyro*, *get_gpsash*, *get_gpsglos*, *get_seatex* and *get_tsshrp*, which invoke the *listit* command to retrieve 24 hours of gyrocompass, bestnav, Ashtec (ADU2), Ashtec Glonass (GG24), GPS NMEA, Seatex and tsshrp (heave, pitch and roll) data. Data are saved in subdirectories ‘gyro’, ‘gpsash’, ‘gpsglos’, ‘seatex’, and ‘tsshrp’ as *gyro.NNN*, *gpsash.NNN*, *gpsglos.NNN*, *seatex.NNN* and *tsshrp.NNN*, where NNN is the jday.

get_sim500 Invokes the *listit* command to retrieve 24 hours of EA600 data. Data are saved as *sim500.NNN*.

get_winch Invokes the *listit* command to retrieve 24 hours of winch data. Data are saved as *winch.NNN*. Days where the winch was not used have blank files. The data were not processed further.

Matlab

load_daily.m Reads in navigation files output by the Unix processing (above) by calling the following functions:

- *load_daily_gpsash*: reads in text file *gpsash.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag $\neq 50$ are poor, and thus discarded. Output is *gpsash/gpsashNNN.mat*.
- *load_daily_gpsglos*: reads in text file *gpsglos.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag $\neq 50$ are poor, and thus discarded. Output is *gpsglos/gpsglosNNN.mat*.
- *load_daily_gyro*: reads in text file *gyro.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag $\neq 50$ are poor, and thus discarded. Output is *gyro/gyroNNN.mat*.
- *load_daily_seatex*: reads in text file *seatex.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag $\neq 50$ are poor, and thus discarded. Output is *seatex/seatexNNN.mat*.

- *load_daily_tsshrp*: reads in text file *tsshrp.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag $\neq 50$ are poor, and thus discarded. Output is *tsshrp/tsshrpNNN.mat*. For a quick visual check, the program then plots *bestnav*, *gpsash*, *gpsglos*, *gpsnmea* and *seatex* data over one another (after plotting each dataset the user must hit return to continue), *gyrocompass heading*, and *pitch and roll*.

plot_seatex_all Plots entire cruise track. Loads *seatexNNN.mat* for all jdays and GEBCO bathymetry data.

loadsim500 Reads in *sim500.NNN* and stores data in Matlab structure array. Saves *sim500_NNN.mat*.

cleansim500 Loads *sim500_NNN.mat* and sets values ≤ 0 to NaNs, then uses 1D linear interpolation to fill data gaps. Data are then despiked by calling *dspike* and data gaps are filled by linear interpolation. Data are then cleaned using an interactive editor and gaps filled by linear interpolation. Output is *sim500_NNNclean.mat*. As the Swath was running this data were not fully processed

scatter_depth Loads *sim500_NNNclean.mat* and calculates 1 minute averages to make plotting easier, then loads 1 minute average latitude and longitude data from *oceanlog_navNNN_1minave.mat* (see Oceanlogger section) and plots 1 minute average depth data. Output is *sim500_NNN_1minave.mat*.

plot_sim500_all Reads in *sim500_NNN_1minave.mat* for all jdays and GEBCO bathymetry data. Plots 1 minute average depth data along entire cruise track.

Mstar

code2mstar[stream]272 Reads the .mat files from *load_daily* into mstar format. This route was used as an alternative to the full mstar underway data processing (see JR239 cruise report for details of this). After this step all files are in the expected format and merge with other data such as CTD casts as expected.

mday_02 Appends daily files into one file for the whole cruise. Run for *seatex* and *gyro*

mbest_01 Averages appended *seatex* file to 30 seconds *seatex_jr272_01.nc* -> *seatex_jr272_ave.nc*

- mbest_02* Calculates speed, course and distrun (distance covered over ground)
seatex_jr272_ave.nc -> seatex_jr272_spd.nc
- mbest_03* Creates 30 second average file from appended gyro file *gyro_jr272_01.nc ->*
gyro_jr272_ave.nc
- mbest_04* Merge *gyro_jr272_ave.nc* and *seatex_jr272_spd.nc -> bst_jr272_01.nc*

5.3 Problems encountered

The netCDF files produced by *code2mstar***.m* on two Macs that ran Matlab Versions 2011b and (mstarmac) were corrupted. This part of the processing was therefore run on a PC on Matlab version 2007b.

6 UNDERWAY OCEANLOGGER AND METEOROLOGICAL DATA

Karen Assmann

6.1 Instrumentation and data collection

Surface ocean and meteorological data were logged continuously throughout the cruise. Ocean data were collected from the ship's uncontaminated seawater supply, whilst the meteorological data were measured by instruments on the forward mast. Instruments were as follows:

Oceanlogger

SeaBird Electronics SBE45 CTD

Chelsea Technologies 10-AU 005 Fluorometer

Litre meter F112P Flow meter

Meteorological data

Photosynthetically Active Radiation (PAR) 1, Parlite Quantum Sensor, Kipp & Zonen

Photosynthetically Active Radiation (PAR) 2, Parlite Quantum Sensor, Kipp & Zonen

Wetlabs C-star Transmissometer

Kipp & Zonen SPLite2 (TIR 1)

Kipp & Zonen SPLite2 (TIR 2)

Air temperature/humidity 1, Rotronic MP402H-050300

Air temperature/humidity 2, Rotronic MP402H-050300

Anemometer (this logs wind speed relative to the ship. At this time there is no datastream for true wind, but this can be calculated from relative wind and navigational data, if required).

Both surface ocean and meteorological data were collected at 5 second intervals. Jday in the data starts at 0 at the beginning of 1st January.

6.2 Processing

Initial processing was carried out in Unix, which generated files that could be further processed in Matlab.

Unix

get_underway_test Calls the scripts *get_oceanlog*, *get_anemom* and *get_truewind*, which invoke the *listit* command to retrieve 24 hours of underway data. Output files are *oceanlog.NNN*, *anemom.NNN* and *truewind.NNN*, where NNN is the jday.

Matlab

loadunderway Calls functions *loadoceanlog* and *loadanemom* to read *oceanlog.NNN* and *anemom.NNN*. Data are stored in structure arrays and saved as *oceanlogNNN.mat* and *anemomNNN.mat*. The program then calls the function *cleanoceanlog*, which sets unrealistic values to NaNs, uses *dspike* to remove large spikes in conductivity, housing (CTD) temperature and remote (hull) temperature. Linear interpolation is used to fill data gaps. Data from periods of flow >1.5 l/min or <0.4 l/min are also set to NaNs, as are data from 5 minutes after a drop in flow to allow variables to return to normal. Surface ocean data are further cleaned using an interactive editor, which allows manual removal of data considered bad. Salinity is then calculated using *ds_salt* and the interactive editor is used to remove spikes and flier points. The output is *oceanlogNNNclean.mat*.

plot_oceanlog_daily Loads *oceanlogNNNclean.mat* and *seatexNNN.mat*, calculates 1 minute averages and plots maps of sea surface temperature, salinity and fluorescence. Bathymetry data from GEBCO are included in the plots. Output files are *oceanlog_navNNN.mat* and *oceanlog_navNNN_1minave.mat*.

Mstar

Code2mstarOceanlog1min245

Converts the .mat *oceanlog_navNNN_1minave.mat* to *oceanlog_navNNN_1minave.nc* mstar netCDF files. These are of the

form that would be produced using the complete mstar processing (as in JR239) so can be merged as before with CTD and salinity files for calibration of underway SST and salinity.

6.3 Problems encountered

The netCDF files produced by code2mstar***.m on two Macs that ran Matlab Versions 2011b and (mstarmac) were corrupted. This part of the processing was therefore run on a PC on Matlab version. The reasons for this are not clear. Interestingly, a quick inspection by nc_dump showed sensible limits for the data, but reading the data showed some of it to be corrupt.

Anemometer data for the second part of Jday 97 and the first part of Jday 98 were discarded, because the instrument was covered in ice.

Oceanlogger data was only logged not logged between the start of the cruise (jday 86.5, zero origin for jday) and the end of Jday 88, because of a failure of the logging computer. This was fixed with spares on board for other equipment.

Transmissometer data was logged and is available in the raw instrument files, but was not processed as it was not available as an output variable.

Underway sea surface data was also not collected for two prolonged periods during jdays 112 and 113 due to bad weather causing bubbles to block the internal piping. The pump was also switched off when the ship was anchored close to shore to avoid sediment building up in the system.

6.4 Salinity samples

Throughout the cruise, water samples were collected for salinity analysis in order to calibrate the underway conductivity sensor. The water samples were collected in 200ml medicine bottles. Standard procedure was to rinse the bottle three times, before filling it to just below the neck to allow room for expansion during warming and to facilitate mixing of the bottle's contents prior to analysis. The rim of each bottle was wiped dry with a tissue, then a plastic seal inserted and the screw cap replaced.

The Guildline Autosal 8400B measures the conductivity of a water sample with very high precision. As conductivity is a strong function of temperature the measurement takes place in a water bath of known temperature. The readout is given as twice the conductivity ratio between the sample and standard seawater with salinity 35 at 20 degrees, and 1 atm. pressure.

At the beginning of the cruise the two shipboard salinometers (serial numbers 65763 and 68533) were evaluated for their functionality. Instrument 65763 did initially exhibit problems

with bubble formation in the glass tube leading up to the conductivity cells. The issue could be resolved by repeatedly flooding and flushing the tube with decon90 diluted approximately 20:1 with milliQ water for 30 minutes until the bubbles were dislodged. This instrument was then found to be faultless, so the other instrument 68533 remained unused. Instrument 65763 was used for the entire cruise.

Ocean Scientific International Ltd (OSIL) standard seawater was used to provide calibration readings in regular intervals: before each crate of 24 salt water samples and after each crate so that corrections can be applied to the intermediate measurements. OSIL standard seawater of the batches P151 and P152 was used. The instrument was standardized (black dial with locking ring) with a standard from the P151 batch at the beginning of the cruise and then locked into position. Nothing was changed with the instrumentation subsequently (e.g. no change in water bath temperature or water bath replacement) that it was not necessary to re-standardize at any point during the cruise. The water bath was kept at a constant temperature of 24°C during the entire cruise.

Each crate of sea water samples was kept in the salinometer room for at least 24 hours before analysis to ensure the equalisation of the water to a known room temperature (a thermometer was placed inside the lab for this purpose). The bottles of standard water had been stored in the salinometer room anyway, so did not require any further temperature equilibration. The temperature of the room was initially at a constant 22.5°C, i.e. just slightly cooler than the water bath in the salinometer. The heating lamp inside the water bath worked well to bring each water sample up to the water bath temperature of 24°C during analysis. This could be seen by the heating lamp turning on and off constantly. Other cruise scientists were instructed not to use the salinometer room as a thoroughfare to prevent a draught from adjacent rooms which could compromise a constant room temperature.

On or shortly before the 9th April 2012 the ventilation fans in the salinometer room failed (due to a broken belt) leading to a rise in room temperature to just over 24°C. This was first noted by a small build-up of bubbles in the bottle of milliQ which is routinely kept in the salinometer during stand-by periods. The deck engineer was called and the ventilation fans were repaired the next day. During the period when the ventilation fans were out of service, the room temperature was regulated manually by opening and closing the doors to the adjacent laboratories which were cooler. After the fan repair, the room temperature remained constant at between 22.5 and 23.0°C for the remainder of the cruise.

Standard procedure was to invert each sample bottle a few times in order to mix the contents but avoid the introduction of a large number of air bubbles into the sample. Before the analysis of each sample, the system was flushed (i.e. flooded and drained) three times with the sample, before the readings were taken. For standard sea water, the system was also flushed three times with an old standard (from a previously opened bottle) before flushing with the fresh standard that was to be analysed. At least three readings were taken from each sample bottle (standard water as well as sea water). Care was taken to allow sufficient time for the readout value to stabilise on a final value. Out of the three readings, a manually chosen median value was then picked, which in most cases could be given with sufficient

certainty: ± 0.00002 in the readout or ± 0.00001 in the ratio, equivalent to approx. 0.0003 salinity, which is less than the accuracy of the CTD salinity measurements. In rare cases the spread of readings was larger (up to ± 0.00010) so a fourth or fifth reading was taken.

From these conductivity ratios, the practical salinity of the sample can be calculated using the equation of state from UNESCO (1978). The measurements were loaded into an Excel spreadsheet, where salinities were calculated; text files with station number, Niskin bottle number, and salinity were exported for use in the CTD data processing.

6.5 Temperature and Salinity calibration

See section 2.2.1 for details of CTD and underway calibration.

6.6 Sample plots

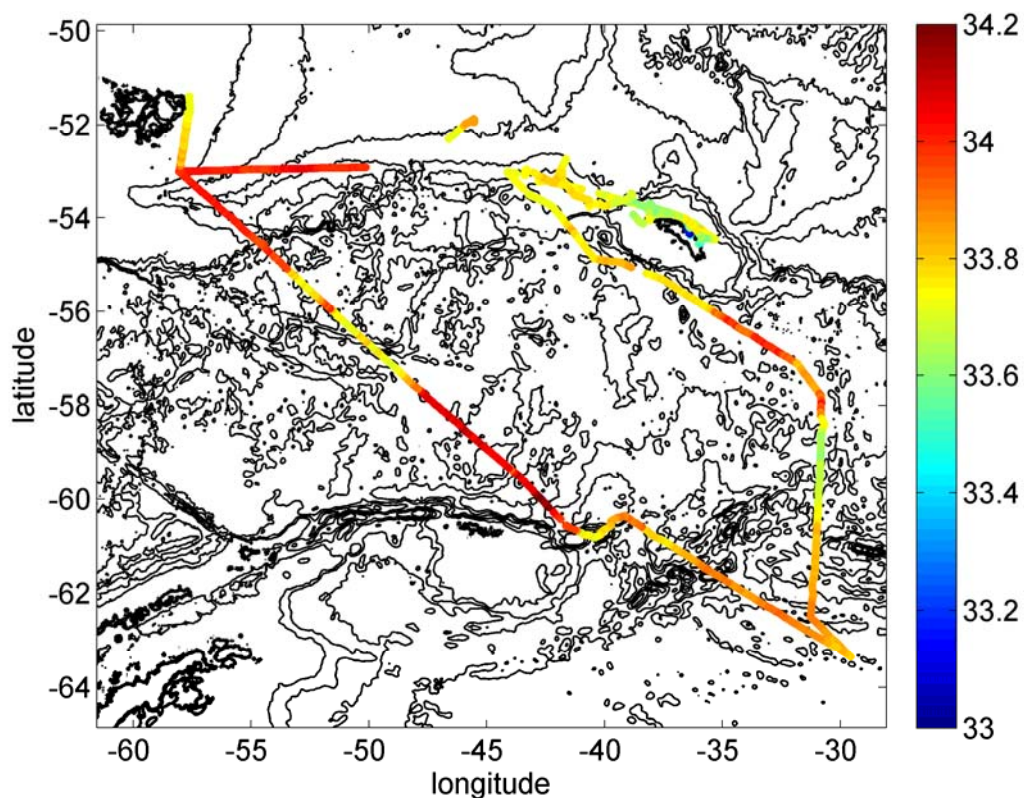


Figure 6.1 Underway salinity. The gap at the start of the cruise is not obvious as we stayed close to the Falklands to do short fetch work for WAGES. The gaps during bad weather on the return from South Georgia are obvious as the ship was still moving.

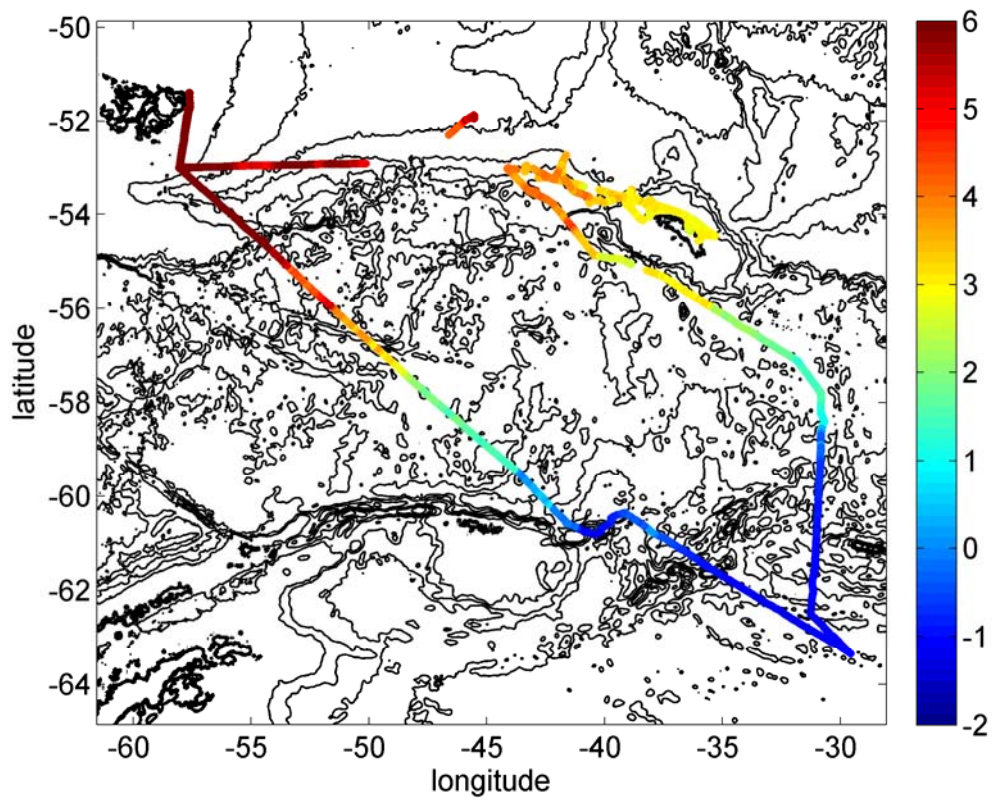


Figure 6.2 Underway SST, calibrated against CTD temperature.

7 Mooring deployment

Povl Abrahamsen

On JR272A a sixth mooring was deployed on the eastern side of Orkney Passage, to supplement the five that were deployed during JR252 in 2011. These moorings form part of BAS's long-term monitoring and survey (LTMS) work, monitoring the outflow of Weddell Sea Deep Water through Orkney Passage.

The mooring was deployed buoy first, and streamed out behind the ship, which was heading towards SW. The anchor was dropped when the stern was approx. 50 m past the target position, with the mooring landing approx. 100 m behind the drop position.

The mooring, named OP6, was deployed on 2/4 2012 at 19:31 UTC, and landed on the bottom at 20:01; the triangulated position is 60° 33.740' S, 041° 37.930' W.

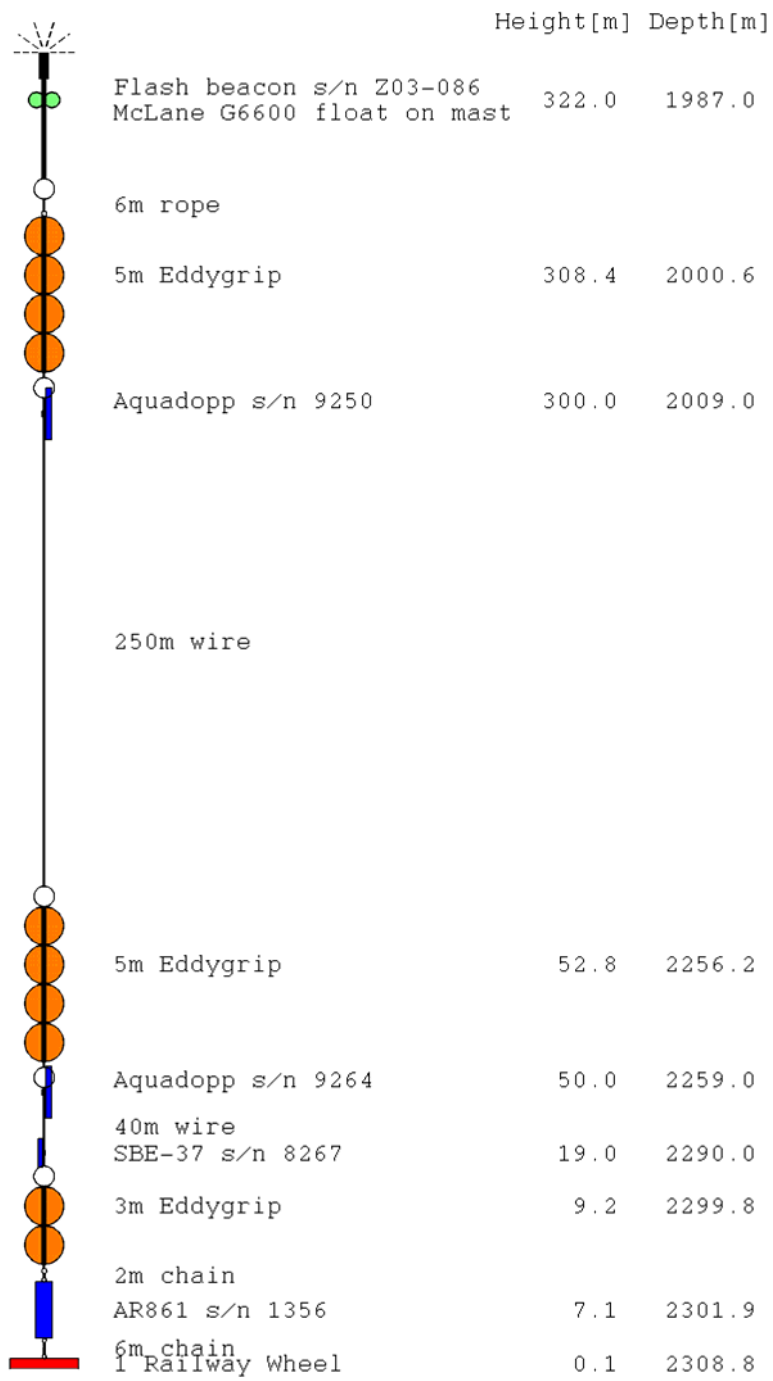


Figure 7.1 Schematic of deployed mooring

OP6 instrumentation list:

Parameter abbreviations:

TE: temperature PR: pressure CO: conductivity U: zonal velocity V: meridional velocity W: vertical velocity

SPD: current speed DIR: current direction TILT: tilt SNR: signal strength (RCM11) TEarctic: Arctic temperature (RCM8)

For Nortek Aquadopps, the serial number given is the “instrument ID” (AQD number); the “head ID” (A6L number) and order number are listed under comments.

OP6 deployed

Height (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	START TIME, GMT (DD/MM/YY HH:MM)	Comments
322	1987	Novatech ST-400A Z03-086	xenon flash beacon			
300	2009	Aquadopp DW 9250	U,V,W,TE,PR, TILT	15	01/04/12 00:00	A6L 4753, P23954-2
50	2259	Aquadopp DW 9264	U,V,W,TE,PR, TILT	15	01/04/12 00:00	A6L 4754, P23954-1
19	2290	SBE37 8267	TE, CO	15	01/04/12 00:00	Accidentally ordered with 8mm (5/16") wire clamp instead of 6mm
7	2302	IXSEA AR861 1356	acoustic release			Arm: 092B, Rel: 0955, Rel w/ping: 0956, Ping on: 0947, Ping off: 0948, Diag: 0949