JR280 – Western Core Box

JCR in Cumberland Bay as taken from a quadcopter. Picture courtesy of P. Enderlein

28th November to 8th December, 2012

Western Core Box

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1. Introduction

1.1 Rationale

JR280 is a 16 day science cruise to the South Georgia region nested inside a combined logistic and science leg during voyage 22 of the RRS James Clark Ross. As part of the logistics element the ship undertook base reliefs at Bird Island and King Edward Point (South Georgia), and Signy (South Orkney Islands). During the science part of the cruise we undertook the Western Core Box survey to determine the distribution and biomass of krill northwest of South Georgia, refurbished the biological moorings in the South Georgia region and deployed a new biological mooring near Signy. In addition collaborators from the Max Planck Institute in Bremen investigated denitrification processes in the digestive system of Antarctic krill.

1.2 Western Core Box Summary

Since 1981 BAS have undertaken cruises to determine krill biomass as part of the ongoing assessment of the status of the marine ecosystem in the region of South Georgia. This unique time series, known as the Western Core Box, is part of the Ecosystem Programme contribution to BAS national capability. It comprises an acoustic grid survey of 8 transects each of 80 km in length, together with associated net and oceanographic sampling and the calibration of the acoustic instrumentation. Net sampling to catch live krill for experiments and observations was also undertaken at night.

In addition to the acoustic survey, which covers a wide area but has limited temporal coverage, there are three moorings (one in the Western Core Box, one southwest and one northwest of South Georgia) to provide a temporal context. These moorings are recovered during the cruise, refurbished and data downloaded, and then redeployed later in the cruise. To complement these South Georgia based moorings, this year a mooring near Signy is being deployed in the region where krill fishing is regularly undertaken, data from this mooring will provide temporal observations to link with regular surveys now being undertaken by Institute of Marine Research, Bergen, Norway.

Finally, during this cruise we had planned to carry out the first deployment of our new Irobot Seaglider with a 120 kHz echo-sounder. However, due to a combination of time available (logistic priorities had reduced science time by just over 2 days) and weather conditions, we decided that in-water testing of the seaglider was not practical.

1.3 PSO Narrative

(Note all times on ship refer to ship-time which is GMT -3)

7 November 2012 (Wednesday)

Advance JR280 party consisting of Peter Enderlein, Anna Totterdell, Sophie Fielding and Ryan Saunders fly out from Brize Norton to join ship.

11 November 2012 (Sunday)

Second wave of science party leaves from Brize Norton to join ship.

12 November 2012 (Monday)

Uneventful flight but everyone was glad to have a break in Ascension with the chance to see some tropical rain clouds and a rainbow. Bus ride from Mount Pleasant to Stanley interrupted by the fuel tank cover opening and being dragged along the road, the problem was solved by ripping the panel off and putting it inside the bus.

We learn that ship will be sailing on 14 November rather than 13 November as per the itinerary.

13 November 2012 (Tuesday)

Day starts with a full safety brief for scientists and base personnel, followed by a JR280 science meeting. Later we have a meeting with the Chief Engineer and Science Deck Officer to discuss the gas supplies to the chemistry lab and the location of the acetylene cylinder for the Max Planck de-nitrification work.

After lunch we learn that ship will have to leave FIPASS in mid-afternoon to make way for a ship with a medical emergency. Some of the scientists have gone walking and Pauline Sackett and I drive around town and the local points of interest to ensure everyone knows that they have to be back onboard by 15:00.

There is a partial eclipse of the sun just before sunset and quite a group gather on the monkey island with cameras to record the event as we lie at anchor in Port William.

14 November 2012 (Wednesday)

It is a beautiful sunny morning for an emergency/muster drill after breakfast followed by ship testing lifeboats, cranes and launches. Finally we haul up the anchor at 15:30 and head east for Bird Island. Even before leaving Cape Pembroke astern we are into a fog bank and a gentle swell.

15 November 2012 (Thursday)

Our first full day at sea and it is sunny with white caps on the wave crests, with the wind astern the ship motion is gentle and everyone seems to be around for breakfast.

Peter and Anna re-terminate the bio- and 17 mm wires. Louise Biddle, PhD student from University of East Anglia, interviews scientists for her blog.

There is a detailed South Georgia briefing ready for our arrival at Bird Island which covers cargo, biosecurity and conservation, and includes a 40 min South Georgia video.

16 November 2012 (Friday)

Passage to Bird Island continues, we are due to arrive tomorrow. Sea temp is now down at 2.1°C while it was up at 7.7°C yesterday. There is a much bigger swell today and wind is up at Force 6.

17 November 2012 (Saturday)

We arrive off Bird Island at 10:00 (L) and there is fog with snow and sleet. The Bird Island scientists and support staff are put ashore in the cargo tender but it is too rough for cargo work. We wait to see if conditions improve. Later in the afternoon the cargo tender is loaded with 10 tonnes of wood for the fuel tank bases but it is too rough for safe working and the wood is retrieved to the deck before recovering cargo tender and steaming out to more open water for the night.

18 November 2012 (Sunday)

Back off Bird Island by 06:00 we start on cargo, with first run of cargo tender planned for 06:30. There are 16 scientists and base staff off the ship helping ashore. The rest work cargo in the science hold and number 2 hold. Significant amounts of KEP cargo have to be shifted in the science hold before we can reach the Bird Island cargo. Cargo work finishes at 18:30 and there are still the fuel drums and fuel tanks to go ashore. We move offshore for the safety of the open sea overnight.

19 November 2012 (Monday)

The cargo tender is alongside at 06:45 and we embark 12 scientists/FIDS to help ashore. The rest of us move oil drums on the after-deck until breakfast. After breakfast the cargo tender is back and we load the first of the three 3-tonne fuel tanks. Cargo work continues through the day, a total of 182 drums of fuel and 11 cargo tender loads. It has been overcast and foggy for much of our time here, in fact it is typical Bird Island weather. Pete Enderlein flew his quadcopter from the after-deck now that there is some room to take off from.

Overnight we steam down the coast planning to enter Cumberland Bay at 07:30 on Tuesday.

20 November 2012 (Tuesday)

After a spectacular sunrise over South Georgia we enter Cumberland Bay at 07:30 and at 08:30 we are anchored in King Edward Cove. It is overcast with snow/sleet showers for most of the day. All the new people given a chance to go ashore in the cargo tender. The others are split into two teams to work cargo either in morning or afternoon. We work cargo from science hold and number 2 hold all day. The cargo tender crew finish last run at 20:30!

After various talks with team and Captain in early evening we decide that we should finish cargo tomorrow morning. The plan is then to depart for the P2 Southern Mooring which is 20 hours steam and pretty much on our track to Signy. Hope the weather holds!

21 November 2012 (Wednesday)

Another brilliant South Georgia sunrise greets the early risers. The ship is alongside KEP jetty by 08:00 and starts by loading rubbish from base back onto ship. Signy cargo that had to be shifted to get at KEP cargo is re-stowed before we leave jetty at midday. The ship then heaves to in Cumberland Bay while RMT blocks and wires are rigged on gantry and mooring winch is connected up. We are all ready to go by 16:00 and off to sea to hopefully arrive at P2 southern mooring by tomorrow midday.

22 November 2012 (Thursday)

I awoke this morning to find the ship was rolling heavily in increasing wind and waves. By breakfast we had altered course to the south to ease the ship's motion. No chance of recovering a mooring in these conditions. From the safety and warmth of the winch control room we watch the waves breaking across the after deck. Nobody is allowed out on upper deck or forecastle deck. Overnight we alter course as the wind and waves change direction, we are actually heading north west at some point in the night.

23 November 2012 (Friday)

Wind now going down a bit and backing, we are about halfway to Signy and heading west at 5 knots. Wind allows us back onto course during the day. Sophie is writing an article about the seaglider but we are all glad that it is not in the water in the present conditions.

We are back to making steady progress towards Signy by late afternoon. We have a team brief for the Signy relief at 16:30.

24 November 2012 (Saturday)

Still on passage to Signy we plan to run down the Inaccessible Islands trench using swath and we sight the islands, shrouded in grey cloud at 11:00. The trench with a potential mooring site at 60 35' S and 46 30' W is surveyed in the early afternoon, while the potential mooring site is ice free we encounter our first ice just a few miles to the South. There are several distinct bands with open water in between before we encounter quite dense pack ice on the southern side of Coronation Island.

After steady progress through pack we arrive off Signy by 18:40. Factory cove appears to have plenty of bergy bits and growlers which will make cargo work difficult.

25 November 2012 (Sunday)

We move into Borge Bay at 07:30. Matt Jobson and Bruce Maltman go ashore to reconnoitre the base and find a suitable landing site for cargo. The cargo tender is then launched and all scientists are occupied with cargo either ashore or onboard.

Cargo has to be landed on the shore as the jetty is blocked by ice. A somewhat hazardous route over snow and rock along the shore line is required to get to the boxes up to the base. All cargo apart from food and drink, and the Italian permafrost drilling kit is put ashore during the day. The last boat is back from the base at 18:30 and the ship then moves out of Borge Bay for deeper more open water overnight.

The Signy contingent spend the night ashore with power but no running water.

26 November 2012 (Monday)

The ship is back at anchor off Outer Island just before 08:00. All food (fresh and frozen) and bond off loaded and carried up to stores on back packs or with a sledge towed by skidoo for large non breakable items.

In the afternoon the cargo tender is used to run penguin nest marker blocks around to the Gourlay peninsula along with supplies for the Gourlay and Waterpipe huts. Near high tide the cargo tender is used to clear bergy bits from around the jetty so that the 850 kg boxes for the Italian project can be landed.

After dinner the cargo tender is recovered and we move off shore again. We will await confirmation at 07:00 tomorrow that base fully functional before we can depart to start our science.

27 November 2012 (Tuesday)

Early morning call reveals that the reverse osmosis plant is still giving trouble, so JCR engineers go ashore to work on system. Problem fixed by 14:00 and ship finally proceeding through pack ice to proposed mooring site in Inaccessible Island Trough. We hold a science meeting to discuss Western Core Box activities and during afternoon we have the seaglider out on deck to test the iridium communications.

Pack ice is thicker and more compressed than during inbound trip due to recent southerly winds pushing ice up against coast. However by 22:00 we arrive in an open pool of water 2 mile south of the proposed new mooring deployment site.

28 November 2012 (Wednesday)

It is not possible to get to the planned mooring site because of ice. However there is a lead 0.5 mile to the north that allows us to deploy the first CTD in ~730 m of water just after 06:00. Drifting ice however forces us up the side of the trench into shallower water. The ice appears to be opening up more and we find another lead with approx 700 m of water depth that is only 4 cables north of the original proposed point.

We deploy mooring plus 500 m of cable weight first (because of the lack of space) and it is deployed by 09:25 in a water depth of 695 m at 60° 34.52' S 46° 31.06' W. The ice has again closed round the ship and so we reposition in an open lead at the original site for a final CTD.
By 10:30 CTD is finished and we are proceeding through the ice to the P2 southern mooring. Our ETA is late evening tomorrow (360 miles to travel). It takes us a couple of hours to break out of the ice and exit the trough.

29 November 2012 (Thursday)

With the wind from SW at 20 knots and the swell essentially astern we charge north with relatively little ship's movement. We arrive at the P2 southern mooring at 17:45. The buoy takes several attempts before it appears to release. It is first spotted aft of the ship on the port side, not where we expected to see it. The mooring buoy is has a number of goose barnacles on it, including a one several cm long actually attached to the ADCP.

The new mooring winch works very effectively and after two hours all of the deep mooring gear (buoy, sediment trap and releases) is back on deck and we are ready for a CTD to 1500 m. The CTD is completed in 1.5 hours and then we are on our way to recover the P3 northern mooring.

30 November 2012 (Friday)

We arrive at the P3 northern mooring by 11:00. The buoy is released and quickly detected at the surface. Another efficient and rapid recovery takes less than 2 hours to recover all the equipment. The corresponding CTD is undertaken to 1500 m.

RMT8 is put in place on after-deck and a briefing for all relevant scientists and deck crew held prior to a couple of trial deployments.

We head over to shelf break looking for krill to target fish once it gets dark. After running across the shelf break and then downwind we see no sign of obvious swarms so we fish a diffuse and persistent target seen on the echo sounder. We catch *Euphausia triacantha* and a few *Euphausia vallentini* but only 20 *Euphausia superba*.

Finally we relocate to start the WCB 1.1 transect at the southern end at 06:00 tomorrow.

1 December 2012 (Saturday)

Start transect WCB1.1 at southern end at 06:00. First XBT does not work but otherwise no problems as we run out into deeper water and then return inshore down transect 1.2.The first WCB station CTD is at the shallow 1.2S station. The corresponding station RMT produces a large catch of *E. triacantha* which is unexpected given that it is a daytime haul in shelf waters.

Along the shelf break we successfully target fish a large swarm which produces sufficient live krill for the experiments of Arjun and Ines, and for the measurements of Sophie and Damien. It also provides the first opportunity for Sophie to try out the high precision motion compensating balance.

2 December 2012 (Sunday)

Second day of the WCB and there is a large iceberg (17 mile on 1 side) occupying the start position of transect 2.1. After plotting the position we move our start point 1 mile to the west and are able to resume our standard track line by the second XBT station 10.8 mile along the transect.

The iceberg is moving west and by the time we approach the northern end of transect 2.2 it has moved sufficiently for us to complete the full transect according to plan. After finishing the transect we move to station 2.2 N for the CTD and RMT. Shortly after finishing the station while steaming towards the shelf break to target fish we encounter a very large krill aggregation out in water over 3000 m deep. The swarm is successfully target fished and large krill are caught and used for experiments, length frequency, and krill weight and density measurements.

We complete the night time station sampling at station 2.2S before repositioning for transects 3.1 and 3.2 tomorrow morning. We also intend to pick up the WCB mooring tomorrow if weather permits.

3 December 2012 (Monday)

This is the third day of the WCB and it is foggy and overcast but with little swell, and so the transects are undertaken without problem. At the end of these transects we move up transect 3.2 to the shallow mooring position and retrieve the shallow mooring followed by a shallow CTD. We then relocate to station 3.2S to undertake the station based sampling with CTD and RMT8. We manage to find targets to fish close to the shallow station and then move up to station 3.2N. Here the CTD is completed but an increasing swell means that we do not undertake the station-based RMT8.

4 December 2012 (Tuesday)

A bigger swell today for the start of the acoustic transects but no fog. A group of humpback whales and fur seals are spotted during the CTD and they stay around for over an hour. There is much photographic activity by many scientists!

Transects 4.1 and 4.2 are steamed without problem and with XBT's on both legs. After finishing the transects we head back to station 3.2N to undertake the RMT8 that was not done last night. Our target fishing session catches large krill with many discarded moults.

As the weather is not deemed suitable for testing gliders we decide to head to Stromness overnight and carry out the calibration there tomorrow.

5 December 2012 (Wednesday)

Wednesday morning finds us about to enter Stromness for our calibration. Although we had hoped to undertake some glider trials this cruise, the reduction of time available for science (from 16 to 13.5 days) and the marginal weather meant that we decided not only was the weather not good enough for our first trials of the glider but also that there was insufficient time reserve to recover the glider if there should be any problems.

We enter Stromness at 07:00 and by 08:00 we are at anchor and on DP ready for the calibration CTD. The hull calibration of the 38, 120 and 200 kHz proceeds smoothly through the morning. After lunch an attempt is made to calibrate the portable Imagenix echo sounders that are used in the seaglider and on the RMT8 net. However although the transducers can be suspended from the tractor inner tube donut, it is too choppy to get reliable results. Calibration finishes at 15:30 and by 16:30 we leave Stromness but poor weather with strong swells prevent successful overnight target fishing.

6 December 2012 (Thursday)

Having steamed up the coast of South Georgia overnight we are on station over the WCB mooring site at 08:00. A CTD is conducted first followed by the deployment of the mooring and the mooring deployment is completed by 10:00.

We start to look for some daytime krill targets to fish but we see no fishable targets and the swell is such that we decide to head inshore to a spot near Cape North to test net monitor altimeters and the RMT25. Conditions 2 miles off the coast are slightly better than out at sea and tests proceed through the intermittent snow showers that hide all the land from us.

We swop over the RMT25 and RMT8 before leaving the sheltered waters. Although we want to undertake some final target fishing before midnight the poor weather and particularly the big swell make it too risky to deploy the net.

7 December 2012 (Friday)

Overnight we transit up to the P3 northern mooring position. At 08:00 we are positioned just 2 miles downwind from the proposed site. A deep CTD to near bottom (at the request of the Science Deck Officer) allows the cable and winch to be checked as well as the last opportunity for young scientists to pressure shrink some decorated polystyrene cups.

Meanwhile the mooring is prepared carefully in the periodically large swell. This is such that every 1-2 minutes a particularly large wave pitches the stern up and then down enough to almost ship water over the deck, this is a potential sediment trap destroyer. A phone call to Cambridge provides the possibility of putting the mooring in later in the year and so we decide to abandon activities at P3 and head down to the P2 southern mooring. P3 is 150 miles south so there is time for the swell to drop further before we arrive there tomorrow morning.

8 December 2012 (Saturday)

We arrive just off the P2 mooring site at 05:30 but wait until 07:30 to start our CTD to 2000 m. Because of concerns about the water depth we relocate 8 miles WSW to the western edge of the P2 plateau. The mooring is fully deployed by 11:30 but it takes nearly 20 minutes for the surface buoy to sink after the release of the mooring weight. The range to the acoustic unit on the release gear is ranged from three positions to detect the final position.

By 13:00 we are on course for Mare Harbour, a swath transect to fill in some unknown areas will be conducted as we steam towards the Falkland Islands. ETA for Choiseul Sound off Mare Harbour is 07:00 on Tuesday 11 December 2012.

9 December 2012 (Sunday)

On passage to Mare Harbour. Ines and Arjun have a final push to look at oxygen concentration and pH in the krill guts; they finish at 06:00. It is too rough to work on deck dismantling the nets. A cruise meeting is held to discuss cruise report, BoLs and demobilization tasks.

The end of cruise buffet provides a chance for all to both eat well and relax.

10 December 2012 (Monday)

Our last full day at sea, we continue on to the Falklands with a moderate swell and breeze. Deck work is possible this afternoon and RMT nets taken off the bars and all instruments taken off DWNM's.

1.4 Cruise Track

Western Core Box planned area

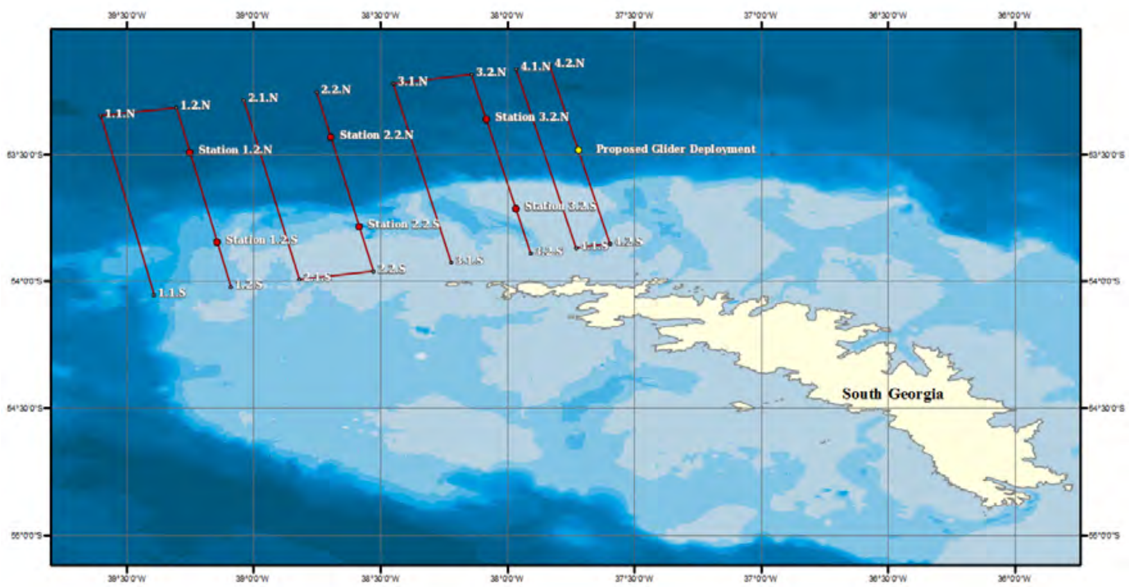

Figure 1 - Western Core Box Sampling Area

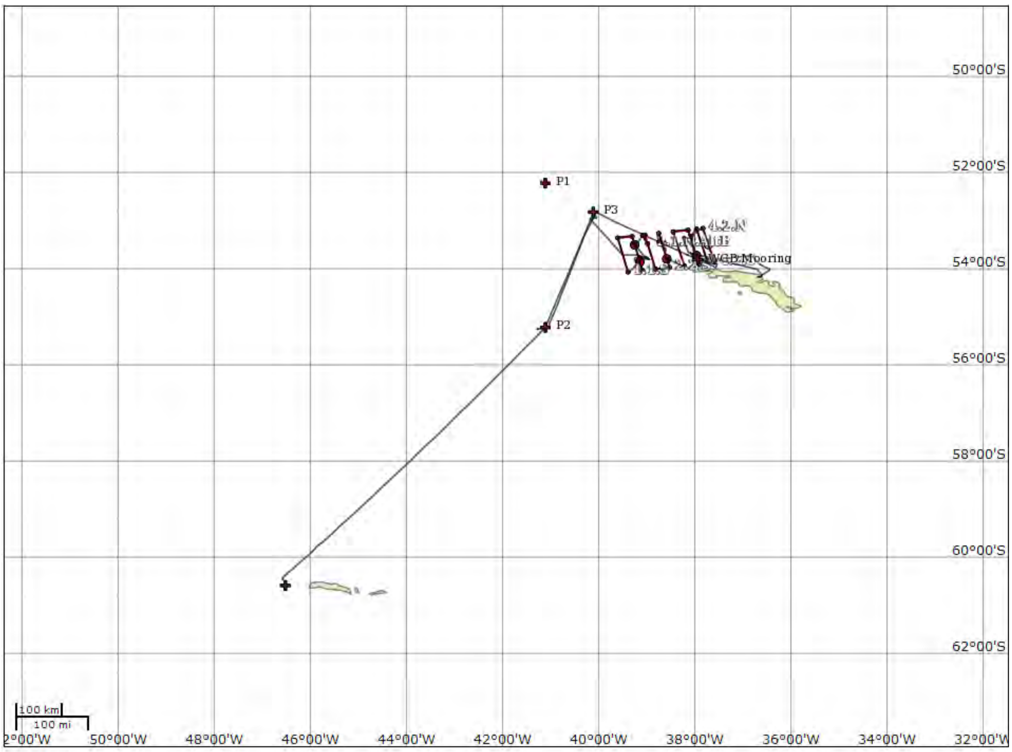

Figure 2 - JR280 Overall Cruise Track

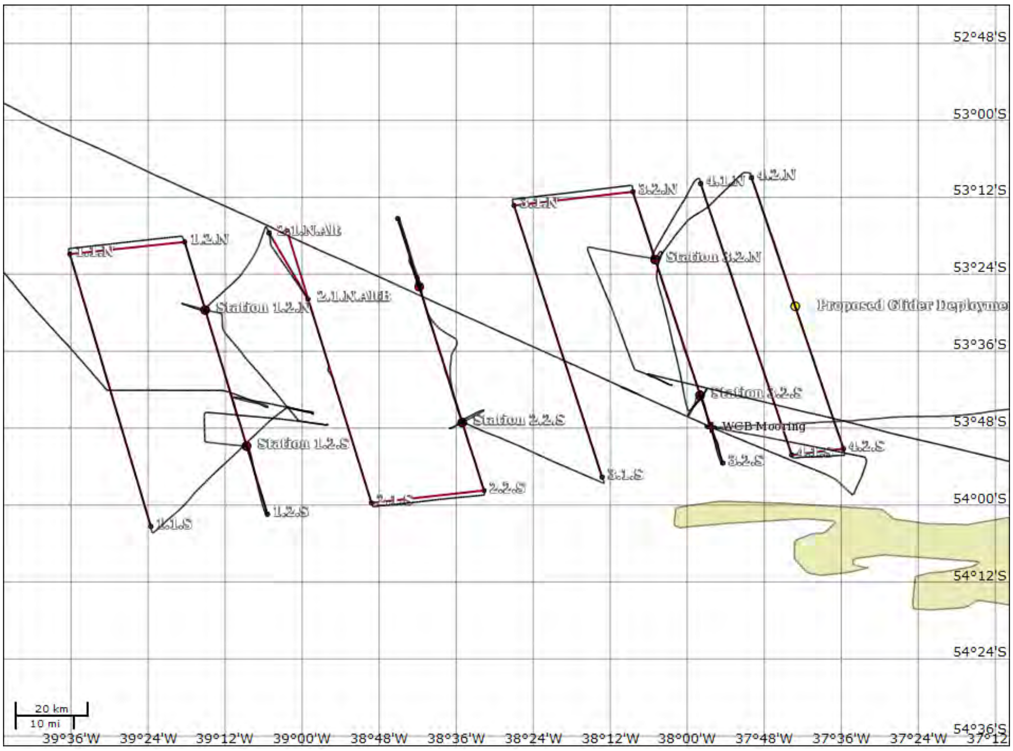

Figure 3 - JR280 Western Core Box Track Segment

1.5 Scientific Personnel

Table 1- JR280 Scientific and in transit personnel

JR280 Scientific Personnel		
Jon Watkins	BAS	PSO, Acoustics
Louise Biddle	UEA	Physical Oceanography
Arjun Chennu	Max Planck Institute	Krill physiology
Dave Connor	BAS	Data Management
Peter Enderlein	BAS	Equipment
Sophie Fielding	BAS	Acoustics
Ines Heisterkamp	Max Planck Institute	Krill physiology
Damien Guihen	BAS	Biological Oceanography
Pete Lens	BAS	ITS
Ryan Saunders	BAS	Krill & fish biology
Gabi Stowasser	BAS	Bioenergetics
Seth Thomas	BAS	AME
Anna Totterdell	BAS	Gear and equipment
BAS HQ Staff present during cruise		
Adam Dickins	BAS	Cambridge Facilities Manager
Rob Lord	BAS	Ex-Bird Island Electrical Services
Rob White	BAS	Senior Marine Engineer
Bird Island Staff in transit		
Tamsin Bell	BAS	Base Commander
Craig Brown	BAS	Electrical Services
Jeremy Gillham	BAS	Zoological Field Assistant
Stephanie Winnard	BAS	Zoological Field Assistant
Hannah Wood	BAS	Zoological Field Assistant
Signy Staff in transit		
Stacey Adlard	BAS	Zoological Field Assistant
Richard Cable	BAS	ITS
James Chong	Sheffield University	Glacier biogeochemistry
Andrew Hodson	Sheffield University	Glacier biogeochemistry
Matt Jobson	BAS	Base Commander
Bruce Maltman	BAS	Field Assistant
Michael Matthews	BAS	Mechanical Services Tech
Marie Sabacka	BAS	Biogeochemist

1.6 JCR Officers and Crew

Table 2 - JCR Officers and Crew

JCR Officers and Crew	
Jerry Burgan	Master
Timothy Page	Chief Officer
Wendy O'Donnell	2nd Officer
Philippa Bowden	3rd Officer
Mike Gloistein	ETO Comms
Duncan Anderson	Chief Engineer
Andrew Smith	2nd Engineer
Kevin Morrison	3rd Engineer
Steven McMahon	4th Engineer
Craig Thomas	Deck Engineer
Simon Wright	Deck Engineer
Bryan Gilmour	ETO
Richard Turner	Purser
Dave Peck	Bosun Scientific Operations
Martin Bowen	Bosun
Ian Raper	Bosun's Mate
George Dale	SG1A
David Phillips	SG1A
Francisco Hernandez	SG1A
Carl Brockwell	SG1A
David Gibson	SG1A
Gareth Wale	MG1
Glyndor Henry	MG1
Ashley Huntley	Chief Cook
Jamie Lee	2nd Cook
Lee Jones	Sr Steward
Nicholas Greenwood	Steward
Graham Raworth	Steward
Carl Piper	Steward

1.7 Acknowledgements

This cruise is part of a long term commitment to investigate the ecology of the Scotia Sea ecosystem and understand the variability and change occurring in the region by the BAS Ecosystems Programme. The cruise was undertaken by a small team of scientists and support staff who carried out both their own work and all the general cruise tasks with great enthusiasm and dedication.

This cruise also had a significant logistic element to it and the entire science team worked long and hard during the base reliefs moving cargo and in the case of Signy also helping in the variety of tasks involved in starting up a summer-only base.

Most importantly, no science cruise can be undertaken without the full involvement of the ship's officers and crew. As ever it is a pleasure to work with them and we are very grateful to all for their enthusiasm, professionalism and help making everything on the cruise work as successfully as it did.

2 Physical Oceanography

Louise Biddle & David Connor

2.1 Underway Navigational Data

2.1.1 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 ≈15m)
- 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.

2.1.2 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*, *gspglos.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*.

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 ≠ 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 ≠ 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 ≠ 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 ≠ 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 ≠ 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.

code2mstar[stream]245 - 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.

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*.

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.

2.2 Underway Oceanlogger and Meteorological Data

2.2.1 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 Quanum Sensor, Kipp & Zonen
- Photosynthetically Active Radiation (PAR) 2, Parlite Quanum 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.

2.2.2 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*.

2.2.3 Sample Plots

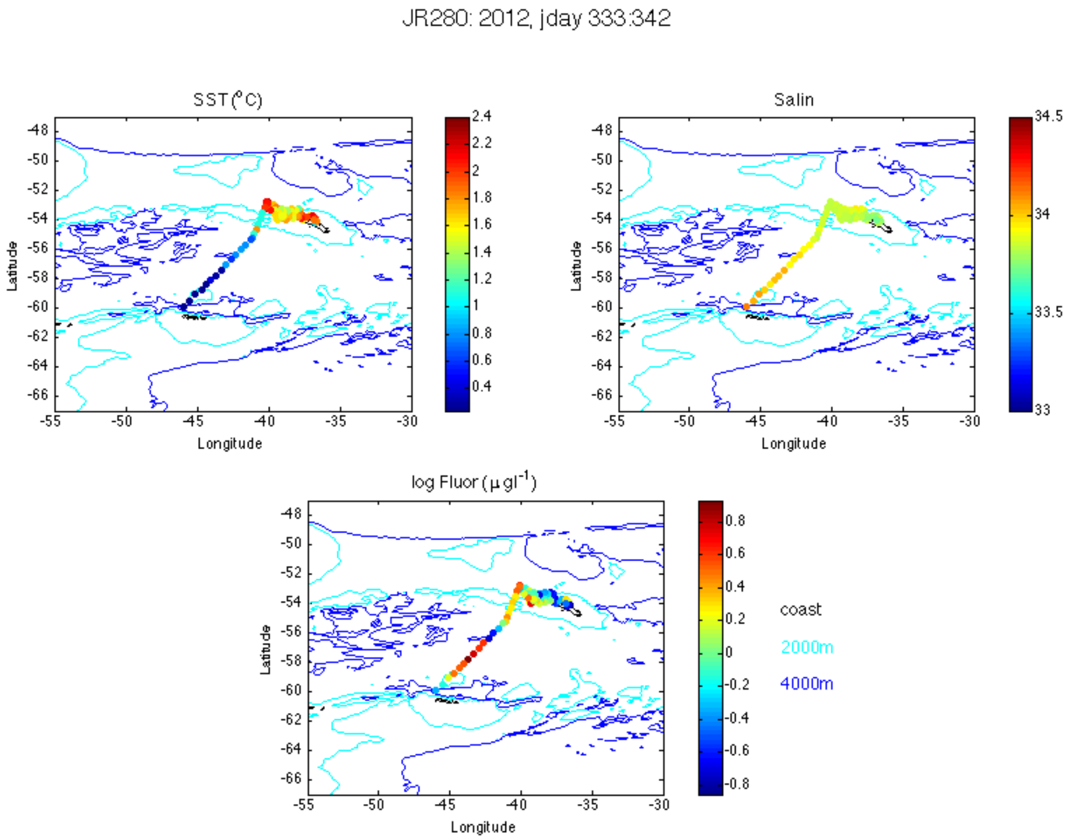

Figure 4 - Sample Oceanlogger output plots

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

Hugh Venables

Note: No ADCP data processing was done on this cruise and this report is from JR245 to summarise the ADCP instrumentation.

2.3.1 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) and JR239 (Renner). 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.

2.3.2 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.

2.3.3 Configuration

The OS75 was controlled using Version 1.42 of the RDI VmDas software. The OS75 ran in two modes during JR245: narrowband with bottom-tracking on and narrowband with bottom-tracking off. Sixteen, thirty-two or fifty 16 meter bins were used depending on the water depth. The instrument was always synchronized with the other acoustic instruments through the SSU with a 2 second ping rate. With fifty bins the ADCP pings every 4 seconds but with fewer bins it can ping every 2 seconds. When on bottom tracking mode the bottom track ping does not synchronise with the SSU and so interference occurs in the EK60, this can therefore only be run when loss of data quality from that instrument is acceptable. Narrowband profiling was enabled with an 8 meter 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.

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

2.3.4 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 JR245_XXX_YYYYYY.ZZZ, where XXX increments each time the logging is stopped and restarted, and YYYYYY increments each time the present filesize exceeds 10 Mbyte.

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

.N1R (NMEA telegram + ADCP timestamp; ASCII)

.ENR (Beam 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.

2.4 CTD Deployment and Data Acquisition

2.4.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used to vertically profile the water column. 16 casts were carried out in total, as part of the Western Core Box, at the deployment of a mooring, and at target fishing locations.

2.4.2 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.

Bottle firing depths were determined by water sample requirements for target fishing.

2.4.3 Data acquisition and preliminary processing

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

JR280_[NNN].hex	binary data file
JR280_[NNN].XMLCON	ascii configuration file with calibration information
JR280_[NNN].hdr	ascii header file containing sensor information
JR280_[NNN].bl	ascii file containing bottle fire information

where NNN is the CTD number (column 1 in Table 3). 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 *jr280ctd[NNN].cnv*. The *Data Conversion* module calculates parameters using the coefficients detailed in Appendix H as follows:

Pressure:

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

where *P* is the pressure (dbar), *T* is the pressure period in µsec, $D = D_1 + D_2U$, $C = C_1 + C_2U + C_3U$ and $T_0 = T_1 + T_2U + T_3U_2 + T_4U_3 + T_5U_4$ are calculated from the coefficients detailed in Appendix H, where *U* is the temperature in ˚C.

Conductivity:

$$cond = \frac{\left(g + hf^2 + if^3 + jf^4\right)}{10\left(1+\delta t + \varepsilon p\right)}$$

where *cond* is the conductivity in Sm^{-1}, *p* is pressure, *t* is temperature, *δ* = CTcor and *ε* = CPcor. All coefficients are included in Appendix H.

Temperature:

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

Where the temperature, *temp*, is measured in ˚C, *g*, *h*, *i* and *j* are coefficients detailed in Appendix H and *f* is the frequency output by the sensor.

Oxygen:

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

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 Appendix H.

PAR:

$$PAR = \left(\frac{multiplier.10^9.10^{(V-B)/M}}{C}\right) + offset$$

where *V*, *B*, *M*, *offset*, *multiplier* and *C*, the calibration constant, can be found in Appendix H.

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 Appendix H.

Transmission:

$$Light\ transmission = M.output\ voltage + B$$

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 Appendix H.

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 *jr280ctd[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 *jr280ctd[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,

α = 0.03 and β = 7.0.

2.4.4 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 *jr280_NNN_sbe35.cap*), 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 matlab.

2.4.5 CTD data processing

CTD data were processed using mstar scripts written by Brian King. They were run on a mac

Further processing of CTD data was carried out in Matlab using existing programs, predominantly written by Mike Meredith and Karen Heywood, with modifications by numerous others, and further significant changes made on JR177 & JR245 by Hugh Venables. The processing routines were those that could be done without integrating full salinity measurements. The processing was to put the files in a state for initial analysis with out of water data removed.

The first subset of Matlab routines applied to the CTD data is as follows:

- *ctdread200-* invokes the *cnv2mat* routine written by Rich Signell to read in the *jr800_ctdNNN_ctm.cnv* file. ***cnv2mat was designed to read header files created in the 5.x version of software. The 7.2x version has an XML based header and cnv2mat required slight changes to read sensor information.*** Data are stored in Matlab arrays and named accordingly. The event number was captured and added to the end of gtime (as a convenience to avoid adding it to all scripts as a separate variable to be resaved). Start, bottom and end times, latitudes and longitudes are entered manually. The start time is entered into a) t2pos in a jrua window (ssh pstar@jrua, password=pstar) using the syntax: t2pos –d seatex yydddhhmmss or b) The www.jcr.nerc-bas.ac.uk/scs/ data interface. This gives latitude and longitude, which are checked against the logsheet. This time, and the resulting position are then copied and pasted into the matlab window. The output file is of the form *jr280_ctdNNN.cal*.

- *offpress200* - reads in *jr280_ctdNNN.cal* and sets variables to NaN if pumps were off, and allows the application of an offset pressure. As yet, no offset has been applied to the data because the aim is to determine a single offset for the entire cruise, which will be determined once the CTDs have been completed. Output is *jr280_ctdNNN.wat*. ***For this cruise no offset has been applied to any of the output data.***

- *editctd200* reads in *jr280_ctdNNN.wat* and allows manual removal of both the 10m soak prior to the CTD cast, and any data collected at the end of the upcast when the CTD was out of the water. The selected data points are set to NaN for all variables. Primary and secondary conductivity and temperature are then despiked using the interactive editor, with selected data points being set to NaN. These points are also set to NaN for PAR, fluorescence, oxygen and transmission. Output is *jr280_ctdNNN.edt*.
- *interpol200* reads in *jr200_ctdNNN.edt* and uses linear interpolation to fill data gaps generated by *editctd200*. Output is *jr280_ctdNNN.int*.

- *salcalapp* checks whether bottle files have been generated from salinity samples (see the second subset of routines, below). If it does not find the required file, it loads *jr200_ctdNNN.int* and calculates salinity, potential temperature and σ_θ, σ_2 and σ_4 as per the UNESCO 1983 algorithms by invoking the routines *ds_salt*, *sw_ptmp* and *sw_pden*. θ and salinity are calculated for both the primary and secondary sensors, whilst σ is calculated using primary temperature and conductivity, except for casts 23 and 38 where the secondary sensors are used. Output is *jr280_ctdNNN.var*. ***No salinity data was provided for this cruise.***

- *splitcast* reads in *jr280_ctdNNN.var* and splits the downcast and upcast into *jr280_ctdNNN.var.dn* and *jr280_ctdNNN.var.up*.

- *fallrate* was added on JR200 (after retrospectively being applied to JR161 and JR177 data). It is a matlab version of the seapath loopedit script. It has to be run after the initial soak is removed as it removes any datapoint on the downcast where pressure is less than one previously recorded or if the fall rate is <0.25 ms^{-1}. Loopedit flags such points (excluding the initial soak if set to) but these flags were not subsequently used in the processing and often did erroneously include the initial soak. This process results in smoother density profiles with fewer apparent overturns. Input and output is *jr280_ctdNNN.var.dn* – it is not run on the upcast as it will remove bottle stops.

- *gridctd* reads in both *jr280_ctdNNN.var.dn* and *jr280_ctdNNN.var.up*, and averages the data into 2dbar bins. Data are padded with NaNs to 5999dbar, thereby ensuring that 48 arrays for all CTDs are the same size. Outputs are *jr280_ctdNNN.2db.mat* and *jr200_ctdNNN.2db.up.mat*.

- *fill_to_surf* reads in *jr200_ctdNNN.2db.mat* and *jr200_ctdNNN.2db.up.mat* and allows any missing data at the surface to be filled with values from the next non-NaN line. This should only be carried out where the upper water column is well mixed. Missing values for the time stamp and PAR are left as NaNs. The output file is the same as the input file.

- *ctdplot200* reads in *jr280_ctdNNN.2db.mat* and plots profiles of θ and salinity (both primary and secondary), σ_θ, fluorescence, transmission, oxygen and PAR. Plots are output for the entire CTD depth and for only the upper 200m of the cast. These plots are saved as png files and printed.

2.4.6 CTD Casts

16 total casts.

Table 3 - CTD Depths and Positions

Cruise	Site	Event	Lat	Lon	Depth	Bottles
JR280	Inaccessible Trench	1	-60.56205	-46.535	735	0
JR280	Inaccessible Trench	3	-60.58433	-46.501	735	9
JR280	P2	5	-55.20594	-41.104	44	0
JR280	P3	7	-52.80761	-40.122	1500	4
JR280	Station 1.2 South	21	-53.84623	-39.144	270	12
JR280	Station 1.2 North	25	-53.4931	-39.251	1000	12
JR280	Station 2.2 North	33	-53.43201	-38.696	1000	14
JR280	Station 2.2 South	37	-53.78508	-38.584	195	12
JR280	WCB Mooring	46	-53.79519	-37.94	300	0
JR280	Station 3.2 South	47	-53.7142	-37.966	125	12
JR280	Station 3.2 North	50	-53.35955	-38.084	1000	12
JR280		67	-53.66658	-38.087	150	12
JR280	Stromness	68	-54.15884	-36.696	50	0
JR280	WCB Mooring	70	-53.79781	-37.944	290	0

JR280	P3	73	-52.80906	-40.05	3729	0
JR280	P2	74	-55.20243	-41.057	2000	0

2.4.7 Sample Plots

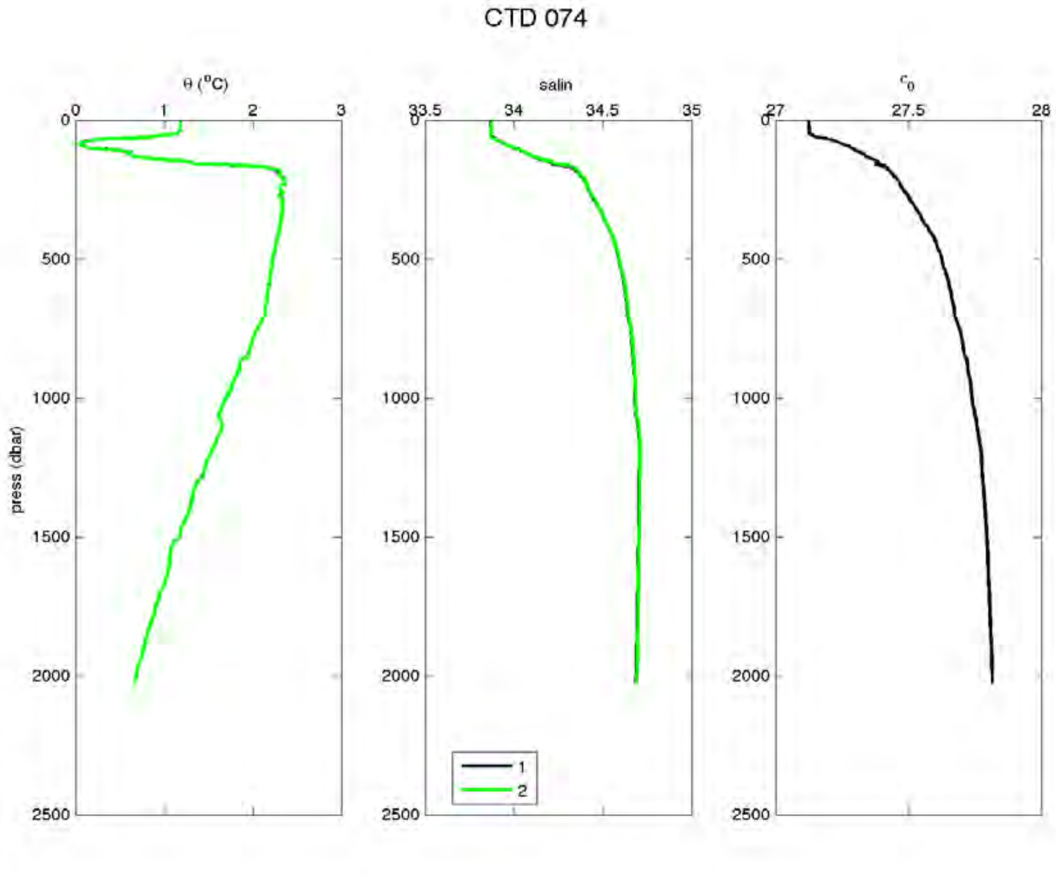

Figure 5 - CTD Sample Data Plot

2.5 Code & Processed Data

2.5.1 Matlab Code

All code used to generate the processed data has been packaged up into JR280_underway_processing.zip under the /data/cruise/jcr/20121114/work/underway_processing/ path at the British Antarctic Survey.

2.5.2 Processed Data

The initial processed underway data is available under the /data/cruise/jcr/20121114/work/underway_processing/ directory at the British Antarctic Survey. This processed data will be transferred to the British Oceanographic Data Centre along with the raw data and cruise report.

3. Acoustics

Sophie Fielding, Peter Enderlein, Dave Connor

3.1 Acoustic instrumentation

3.1.1 Introduction

The EK60 was run throughout JR280 to collect information on the horizontal and vertical distribution of krill and to derive estimates of krill biomass for the Western Core Box and to contribute data from transects from the Falklands to South Georgia.

3.1.2 Aim

Collection of acoustic data to accompany all transects, acoustic surveys, and net tows during the South Georgia survey.

The acoustic data is backed up and the processing of the acoustic data will occur at a later date.

3.1.3 Methods/System specification

Software versions

- Simrad ER60 v. 2.0
- Sonardata Echolog 60 v 4.10.1.6230
- Sonardata Echoview v 4.20.59.8698 Live viewing
- Sonardata Echoview v 4.20.59.8698 Processing

HASP Dongle BAS3 licensed for base, bathymetry, analysis export, live viewing, school detection and virtual echogram was used to run the echolog and echoview in live viewing mode. The echosounder pc AP10 and the EK60 workstation 2 are integrated into the ship's LAN. ER60 .raw data files were logged to a Sun workstation jrua, using a Samba connection, which is backed up at regular intervals. All raw data were collected to 1010 m. Echolog was run on workstation 2 and wrote compressed files also directly to the Sun workstation via a Samba connection.

Echolog compression settings

Final compression settings used in Echolog for all frequencies were:

1) Power data only (angle data is still available from the raw files)
2) From 0 - 1000 m (38 kHz), 0 – 1000 (120 kHz) and 0 – 1000 (200 kHz) data only (data from greater depths are available from the raw files)
3) Average samples where both Sv below –100 dB and TS below –20 dB
4) Maximum number of samples to average: 50
5) DO NOT use average samples below echosounder detected bottom unless sure of bottom detection

File locations

All raw data were saved in a general folder [JR280 data directory]/ek60/Raw, all echolog data were saved in the folder [JR280 data directory]/ek60/Echolog. All files were prefixed with JR280. Calibration data were additionally saved to the [JR80 data directory]/ek60/ Calibration_122012 calibration folder. The [JR280 data directory] exists in the BAS Cambridge SAN under /data/cruise/jcr/20121114/

EK60 (ER60) settings

The EK60 was run during the whole cruise using default settings (Table 4- EK60 default settings), the only change made at the beginning of the cruise was to the environment constants (set to 3 degrees C and 33.8 PSU). The EK60 was calibrated on the 5th December 2012, and the calibration was NOT applied to the transducers.

Table 4- EK60 default settings

Variable	38 kHz	120 kHz	200 kHz
Ping interval (per sec)	2	2	2
Sound velocity (m/s)	1465	1465	1465
Mode	Active	Active	Active
Transducer type	ES38	ES120-7	ES200-7
Transceiver Serial no.	009072033fa5	00907203422d	009072033f91
Transducer depth (m)	0	0	0
Absorption coef. (dB/km)	10.072	28.156	41.245
Pulse length (ms)	1.024	1.024	1.024
Max Power (W)	2000	500	300
2-way beam angle (dB)	-20.70	-20.70	-19.60
Sv transducer gain (dB)	25.51	21.15	23.61
Sa correction (dB)	-0.52	-0.41	-0.22
Angle sensitivity along	22	21	23
Angle sensitivity athwart	22	21	23
3 dB Beam along	7.15	7.47	6.72
3 dB Beam athwart	7.05	7.43	6.75
Along offset	-0.06	-0.14	-0.10
Athwart offset	-0.05	-0.02	-0.06

The EK60 was controlled through the SSU, under a group EK60&EA600&ADCP. The EK60 was the master, with a ping rate set to 2 seconds. The ADCP was run in water column mode (as a slave with an external trigger). Within this setup the ADCP only pings every other trigger, therefore its resolution is slightly reduced at 1 ping every 4 seconds.

SSU settings

EA600 external trigger Tx pulse

EK60 external trigger Calculated (Set to 2 seconds in ER60 software)

ADCP external trigger Tx pulse (this setting only works if the bottom tracking mode is off)

3.2 EK60 Calibration

An acoustic calibration was carried out in Stromness Harbour, South Georgia on 05/12/2012. The ship was anchored, its movement balanced by minimal DP usage, and all over the side water deposits stopped. The EK60 and EA600 were triggered through the SSU and the ADCP was switched off. Each transducer was calibrated in turn, although all transducers were operating at the time. Standard ER60 calibration procedures were used as documented for previous cruises (the relevant copper sphere was moved through all quadrants of each transducer, see cruise reports for JR245 or JR260). In addition the sphere was held on-axis for extra periods of time to enable calibration variables to be determined in Echoview.

A CTD (Event 68) was undertaken on the morning of the calibration. Temperature and salinity were averaged from the surface to 30 m (depth of the calibration sphere) and were 1.16 °C and 33.8 PSU resulting in a speed of sound constant of 1457 m/s (Kongsberg software calculation).

Each transducer was calibrated at the settings used throughout the cruise. Parameters from the ER60 lobes calibration were NOT updated onto the ER60 software (Table 5 - ER60 Calibration settings), in addition an Echoview calculation of the calibration was calculated (Table 6 - Echoview calibration).

Table 5 - ER60 Calibration settings

Date (dd/mm/yyyy)	05/12/2012	05/12/2012	05/12/2012
Location	Stromness	Stromness	Stromness
Time (GMT)	11:45	12:30	13:00
Frequency (kHz)	38	120	200
GPT serial no	009072033fa5	00907203422d	9072033191
Comments	EA600 on	EA600 on	EA600 on
Water temperature (°C)	1.16	1.16	1.16

Salinity (PSU)	33.82	33.82	33.82
Sound velocity (m/s)	1465	1462	1462
Absorption coeff (dB/km)	10.072	28.156	41.245
Ping rate (sec^{-1})	1	1	1
Transmit Power (W)	2000	500	300
Pulse length (ms)	1.024	1.024	1.024
Bandwidth (kHz)	2.43	3.03	3.09
Sample Interval (m)	0.186	0.186	0.186
Original gain (dB)	25.51	22.15	23.61
Original Sa correction (dB)	-0.52	-0.41	-0.22
Theoretical TS of sphere (dB)	-33.80	-40.40	-44.85
New gain (dB)	25.71	22.17	23.63
New Sa correction (dB)	-0.51	-0.42	-0.24

Table 6 - Echoview calibration

Parameter	38kHz	120 kHz	200 kHz
Alpha (dB/km)	10.366	27.08	40.73
Theoretical TS (dB)	-33.80	-40.4	-44.85
TS gain	25.54	22.25	23.40
Sa correction	-0.47	-0.72	-0.27

3.3 Data coverage

3.3.1 Acoustic transects

The WCB was run in a west to east direction starting at the Southern end. Weather conditions were good for the first three transects. The fourth transect was undertaken in worsening conditions. A large iceberg existed at the northern end of the third which caused a detour to the start of transect 3.1, and the transect was resumed as per normal after the second XBT.

Table 7 - Transect times, directions and speeds.

Transect	Date	Start time (GMT)	End time (GMT)	Comments
WCB1.1	01/12/2012	09:01	13:44	
WCB1.2	01/12/2012	14:57	19:17	
WCB2.1	02/12/2012	09:00	13:46	
WCB2.2	02/12/2012	14:54	19:17	
WCB3.1	03/12/2012	09:00	13:43	Transect diverted between 1st two waypoints
WCB3.2	03/12/2012	15:00	19:19	
WCB4.1	04/12/2012	09:30	14:09	
WCB4.2	04/12/2012	14:49	19:24	

3.3.2 Problems encountered

Interference from other acoustic instruments was at a minimum with respect to the other scientific instruments, although the Doppler logger was run throughout the cruise causing noise in the 120 kHz data whenever the water depth was less than 250 m. During opportunistic swathing the multibeam system caused interference in the EK60, this was accepted.

3.4 Deployment of the ES853 Echo Sounder

3.4.1 Introduction

The ES853 echo sounder is a custom designed instrument manufactured by Imagenex óCʎƎdzǋŜ c). The unit has an acoustic frequency of 120 Hz, sampling to a range of 100 m with 0.5 m bin intervals and is pressure rated to a depth of 1000 m. The onboard transducer has a beam angle of 10° beam angle. The hardware amplifier has a configurable 20 or 40 dB gain option. The echo sounder can be deployed to log to internal memory or to an attached MS Windows based computer using the manufacturer's supplied software. When logging to internal memory, the echo sounder records data to its 2 GB built-in solid state memory card. Depending on the deployment configuration, the unit pings at different rates. When attached to a computer the echo sounder will ping as fast as it is capable, approximately 2 Hz. When set to stand-alone mode and logging to memory, the ping rate is 1 Hz. When in glider mode, a mode used when mounted onboard an iRobot Seaglider, data is logged to memory and the ping rate is 0.25 Hz. The ES853 has a Source Level of 211.1 dB re 1 µPa @ 1m and a Receiver Response of -178.2 dB re 1V/µPa. Four individual ES853 units were used during the cruise and had the following serial numbers 5379, 5706, 5707 and 5708. Unit 5379 was previously deployed during JR260, where it became non-responsive. It has since been refurbished by Imagenex and a time stamp function has been integrated. The latter three units are new from Imagenex but built to the same specification as the refurbished 5379 unit.

Figure 6 - ES853 echo sounder with serial cable connection.

3.4.2 Deployment

The echo sounder was deployed on three different platforms; on board the RMT 8 cross, on an inflatable platform and integrated into Seaglider 565. The Seaglider is capable of powering the ES853 using its own internal batteries and operation of ES853 is performed by the internal systems of the glider. The ES853 deployments on the cross and inflatable platform were operated by the same configuration, consisting of a battery pack (with rechargeable NiMH batteries giving a nominal 24V), a power cable with breakout serial interface and the ES853. Changing the mode of the echo sounder or live logging of data on a PC was done through a connection with the serial interface (Figure 7). A 50m extension cable was used repeatedly when the system was exposed or on the back deck, pre deployment. Serial communication with the echo sounder was achieved using the Imagenex software. Upon deployment, the serial connection was established and the mode of the echo sounder changed from *Normal Mode* (which does not log to the ES853 memory) to *Stand Alone*, which samples at a rate of 1 Hz and logs internally. Bench tests showed that the activity of the echo sounder could be monitored by tuning a wideband radio to 120.5 MHz AM or 480.100 MHz WFM where an intermittent buzz, corresponding with the unit's pinging, could be heard.

Logged data was periodically downloaded by USB connection with a PC, where the echo sounder's internal memory is mounted as a removable drive requiring no drivers or additional software beyond a modern operating system.

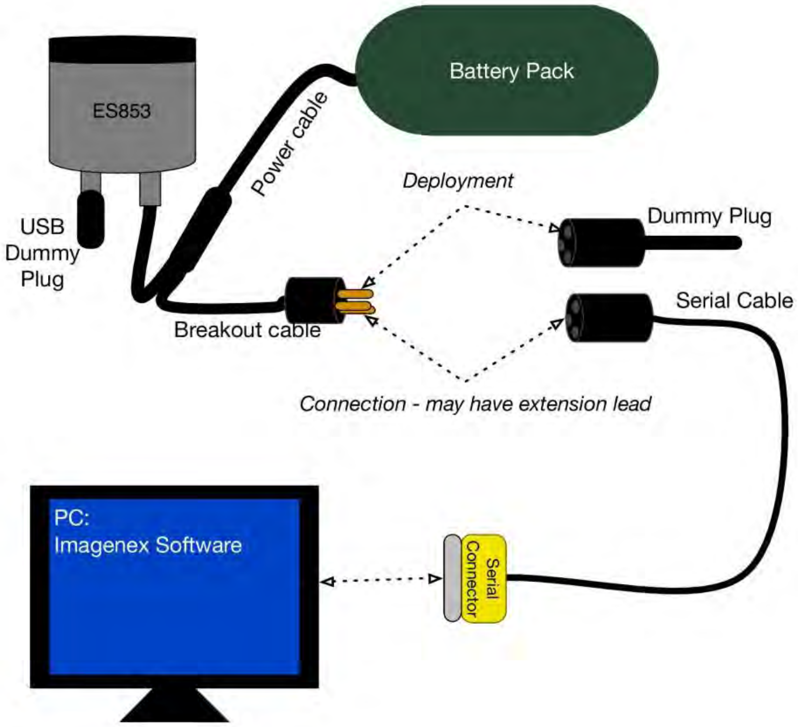

Figure 7. The deployment configuration of the ES853 system with cables, battery and computer connection.

3.4.3 ES853 mounted on the RMT cross

The echo sounder system was mounted on the RMT cross during towed net deployments. The battery pack was strapped inside the frame, above the electronics bottle. The cable was strapped in place around the frame and the echo sounder was mounted on a bracket in a position normally occupied by the RMT altimeter. The altimeter was repositioned at the rear of the cross. The echo sounder's transducer was positioned at approximately 45 ° to the crosses orientation, such that it would be facing downwards during towing (Figure 8).

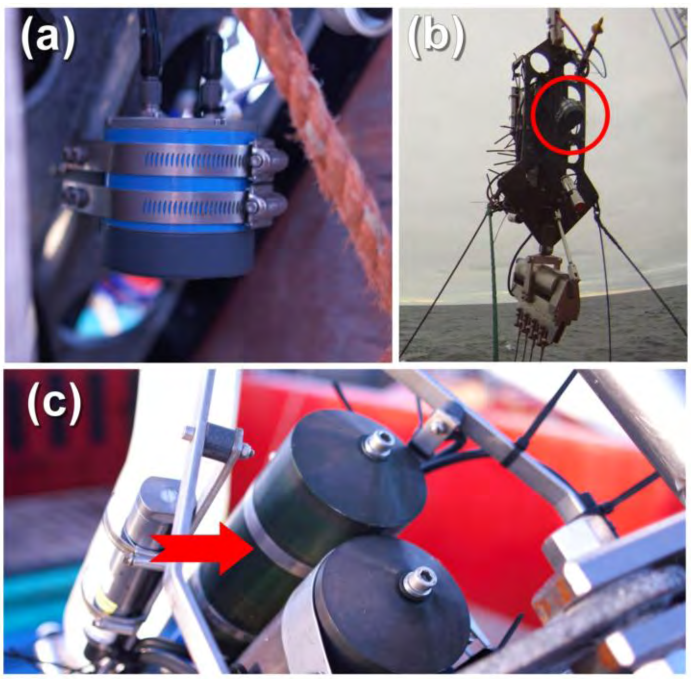

Figure 8. (a) The echo sounder is shown mounted beneath the RMT cross. (b) The echo sounder's position (circled) is visible during net deployment and recovery. (c) The battery pack (highlighted) is shown strapped above the RMT electronics bottle.

A consequence of the revision of the ES853 hardware is that the echo sounder does not create new files each time it is set to stand alone mode. Instead it appends a single file unless it receives a serial command to generate a new file. There is currently no available method of sending this serial command using the Imagenex software, thus data were recorded in the appending fashion. This required the splitting of the file into distinct events, achieved by searching for gaps in the time series. A Matlab function, *makeuniqueecho.m,* was written for this purpose. In order to position the cross in space so that the acoustic data could be compared with the ship-based EK60, data were downloaded from the JCR's SCS data system. The SCS data were then used to calculate an approximate position of the RMT cross, making use of the net monitor stream, particularly the values for winch out, cross depth, cross pitch and roll as well as the ship's position information. To automate the process, a Matlab function, *aligndwnm.m*, was written. This function included a call to the *get_scs_data.m*, which is a new and provisional function written to download SCS data streams for particular periods directly to Matlab. The process of processing all RMT deployed ES853 files in a directory was automated with the script *processes853dwnm.m*.

Unit 5379 was deployed on the RMT 8 cross during Events 10, 11, 12, 22, 23, 24, 34, 35, 36, 48 and 49. The performance of the unit was noted as disappointing after the first download, where no targets could be seen. It was after Event 49 that one of the pins was found to have corroded on the serial bulkhead in the echo sounder. The associated cable was deemed to be unusable due to the blockages in the female connections. Unit 5708 was subsequently mounted on the cross but only saw deployment once, during Event 65.

On comparing the data collected by echo sounder 5379 with recorded net monitor data, it is apparent that for nearly all deployments resulted in the loss of function of the unit as soon as or very shortly after the cross went in the water, occasionally restarting once the cross was back on deck. Only two events with this echo sounder contain useable in-water data; Events 35 and 48. The former was interrupted 4 minutes into the deployment, though targets are visible during that time. The latter was unusual in that it was interrupted just as the cross was recovered and contains data for the entire deployment. Once the echo sounder was exchanged for unit 5708, deployment went as it should. Data recorded by 5708 and coordinated with the Downwire Net monitor data is shown in Figure 9. A cursory view shows that the seabed is visible, as is a well consolidated krill swarm. It is suggested that the data also shows the avoidance behaviour of krill as they escape the net, though this assertion will need careful consideration. A change in the target strength as swarm reaches depth may be consistent with a change of orientation.

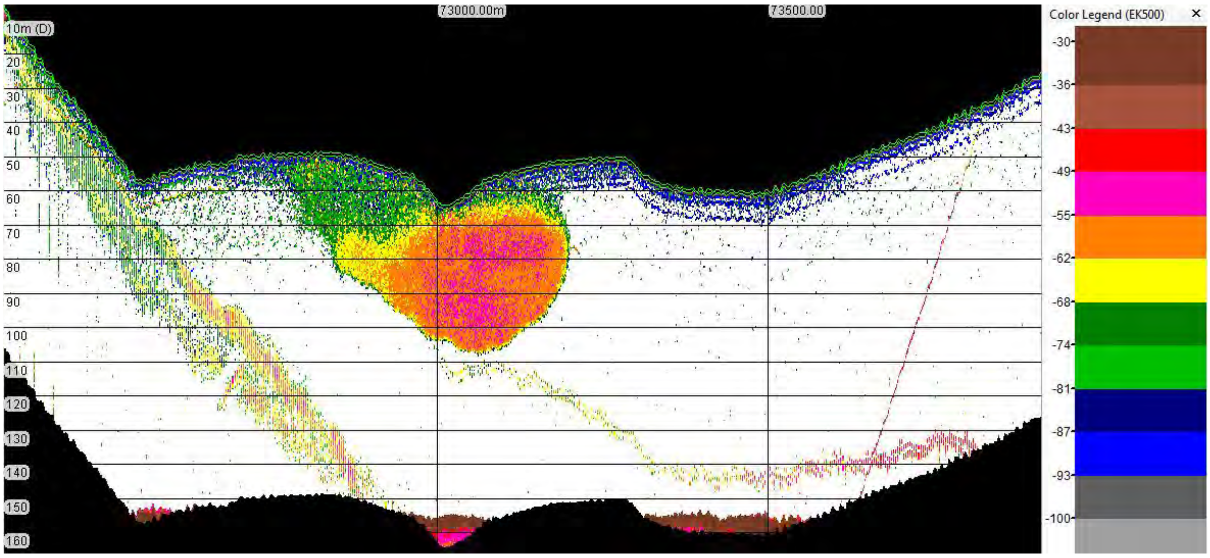

Figure 9. Example of data collected by ES853 5708 during event 65 and coordinated with the Downwire Net monitor date. The seabed and a krill swarm are visible.

3.4.4 ES853 Calibration in Stromness

An assembly consisting of an large inflatable ring, cross supports and a downright pole was constructed such that the echo sounder could be positioned facing down while the platform was floating level on the surface of the water. The battery pack was kept dry on one of the cross supports. Fishing reels were attached at three of ends of the cross supports. The echo sounder was connected to a laptop in the wetlab by a 50 m serial cable. A tungsten carbide sphere was then lowered to varying depths using the fishing reels. The platform and its deploymnet is shown in Figure 10.

Initially unit 5708 was deployed on the platform. Lowering the sphere was hampered by knots in the reels and maintaining the sphere in the beam axis was made next to impossible given the wind and currents. The sphere was lowered to only 30 metres below the surface. The data returned to the laptop seemed spurious and while the seabed and target were apparent, the values seemed incorrect. At approximately -82 dB, the backround acoustic data was about 10 dB higher than a similar exercise during JR260.Strange patterns of interference were also observed in the data. Unit 5707 was substituted but the values remained largely unchanged. As conditions deteriorated, it became harder and harder for the team operating the platform to keep it steady.

The source of the interference was examined and it was discovered that removing the AC power supply from the laptop resulted in a significant improvement in the quality of the data. The banding pattern disappeared and the values for the background acoustic level fell into line with what is expected. Unfortunately, it was too late to continue the calibration and so it was called off. All data was logged, though it is anticipated that it will not be useable for calibration. The discovery of the laptop interfering with data logging is a useful result and will inform future calibration attempts.

Figure 10. Deployment of the inflatible platform, suspending the echo sounder in the water.

3.4.5 ES853 mounted on Seaglider SG565

Figure 11. ES853 unit 5706 integrated into the ogive fairing of Seaglider 565

ES853 unit 5706 is reserved for use on the Seaglider. While the Seaglider was not deployed during JR280, it underwent simulated dive tests to ensure proper communications and control. Unit 5706 was fitted to the Seaglider prior to these tests (Figure 11) and the command given to log with each simulated dive. On the 2nd of December, 2012, 5 simulated dives were performed, with no points of concern noted. The echo sounder appeared to ping throughout. The Seaglider provided power and serial communication to the ES853, with no direct interaction between the pilot and the echo sounder, thus it was important to ensure that the echo sounder was logging, that new files were being created and that the timing of these files was correct. The ES853 files are logged to the ES853 memory and not stored internally in the Seaglider, so they were downloaded once the Seaglider was being dismantled for travel.

All ten expected files were present (one each for ascent and descent for each of five simulated dives). All files are correctly time stamped, with the descent start times occurring just after the initiation of the dive, which is expected. The integration of the ES853 with the Seaglider is, from these tests, in good order with the creation of files and timestamps operating as normal. The integrated unit, 5706, has not yet been calibrated but it is hoped that this can be performed at a later date when the other units are also calibrated.

4. Deployment Gear

Peter Enderlein & Anna Totterdell

4.1 Down Wire Net Monitor (DWNM)

The RMT8 DWNM was used on the 'Biological Wire'. As the termination was two years old a new electrical and mechanical termination was done. Prior to use, it was load tested to 3 tonne. The RMT25 DWNM was set up on the 17.4 mm wire. A new mechanical and electrical termination was made and prior to use was load tested to 4 tonne.

The DWNM system was set up on the RMT8 and RMT25 cross with the various sensors. These all worked well except for the altimeter. The system was tested with the spare altimeter, with spare cables and with changing the angle the altimeter was pointing, but there was no success. Only the spare Altimeter gave some useful reading, but not at all reliable. As a result of this the net could not be used very close to the sea floor.

At one point there was loss of communications between the RMT8 DWNM and the surface control. To quickly solve this we replaced the DWNM on the cross with the spare unit 4 and it then worked successfully.

4.2 RMT 8 net

The RMT8 was successfully deployed 14 times for target fishing and oblique hauls. It worked very well. There were a few occasions when the cod ends had been pulled in that the clips fastening it together had come undone, however never to the extent that the cod ends came completely unattached. It is thought that this happens if they get caught on the net whilst pulling them back onto the ship. On one of the bigger krill hauls the cod ends got tangled together whilst they were being pulled onto the ship, this meant they both had to be pulled on together, there were a few small rips on the older net and these have been fixed. This happened again, but it was found that by lowering the cod ends back down into the water they untangled themselves.

4.3 RMT 25 net

We used the RMT25 net once close to South Georgia for a test deployment using two new nets. It worked well and seemed quite manageable for use in future. The new nets are quite a bit heavier than the old ones. It was obvious that the whole net cannot be lifted out of the water by hand but ropes attached to the cod ends were used to recover these first, followed by pulling in the remaining net afterwards. This is only possible with 4 people pulling hard and any catch in the cod ends will make them too heavy to pull them in by hand.

When the RMT25 will be used as a standard gear item on a cruise, the **gilson winch wire** (or similar) should be rigged and then the net-handler should pull up the net only to the point when they can reach the 4 ropes (two on each cod end) and link them to the wire, so the cod ends and net can be pulled on board by the winch.

The current ropes on the cod ends have to be replaced with new ones. These need to be spliced in with plastic thimbles on the cod end side and a further splice with plastic thimbles on the top end side with quick release shackles or similar fitted.

5. Moorings

Peter Enderlein, Anna Totterdell & Sophie Fielding

5.1 General

During JR280 the WCB shallow water mooring and the P2 deep sediment trap moorings were successfully recovered and redeployed. Also the new Signy mooring off Inaccessible Islands was successfully deployed. The P3 deep sediment trap mooring was successfully recovered, but could not be redeployed because of weather conditions (a large swell at the time) and the lack of cruise time left to wait for the swell to calm down to a suitable deployment condition.

5.2 Signy mooring of Inaccessible Islands

The Signy mooring was deployed on 28.11.2012 at 12:28 in 688 m water depth at location: 60.57537 S and 46.51749 W.

Because of ice in the vicinity, the mooring was deployed weight first, ship heading into the approaching ice. The 500 m of mooring rope was preloaded onto the new mooring winch in two sections, one 300 m section and one 200 m section. This should site the buoy at a depth of ~150 m, sheltered by surrounding shallower topography at the ~700m site. At the end of the deployment, the main buoy was lifted with the Gilson winch and was released with a toggle. As the weight of the mooring was too much to pull the toggle by hand, the new mooring winch was used to pull the toggle free.

5.2.1 Equipment list and settings

Iridium satellite beacon: No: 12091770

RDI ADCP: No: 16698

Settings:
- No of bins: 30
- Bin size: 8
- Pings per sample: 10
- Interval in min: 15
- Deployment duration: 550 days
- Expected water depth: 200 m

SBE CTD: No: 37 SMP 63270-8049

Settings: Interval in sec: 900

Releases:

Release 1:	Sn: 1357	ARM: 092C	Release: 0955	Diagnostics: 0949
Release 2:	Sn: 1358	ARM: 092D	Release: 0955	Diagnostics: 0949

Signey mooring (700 m water depth)

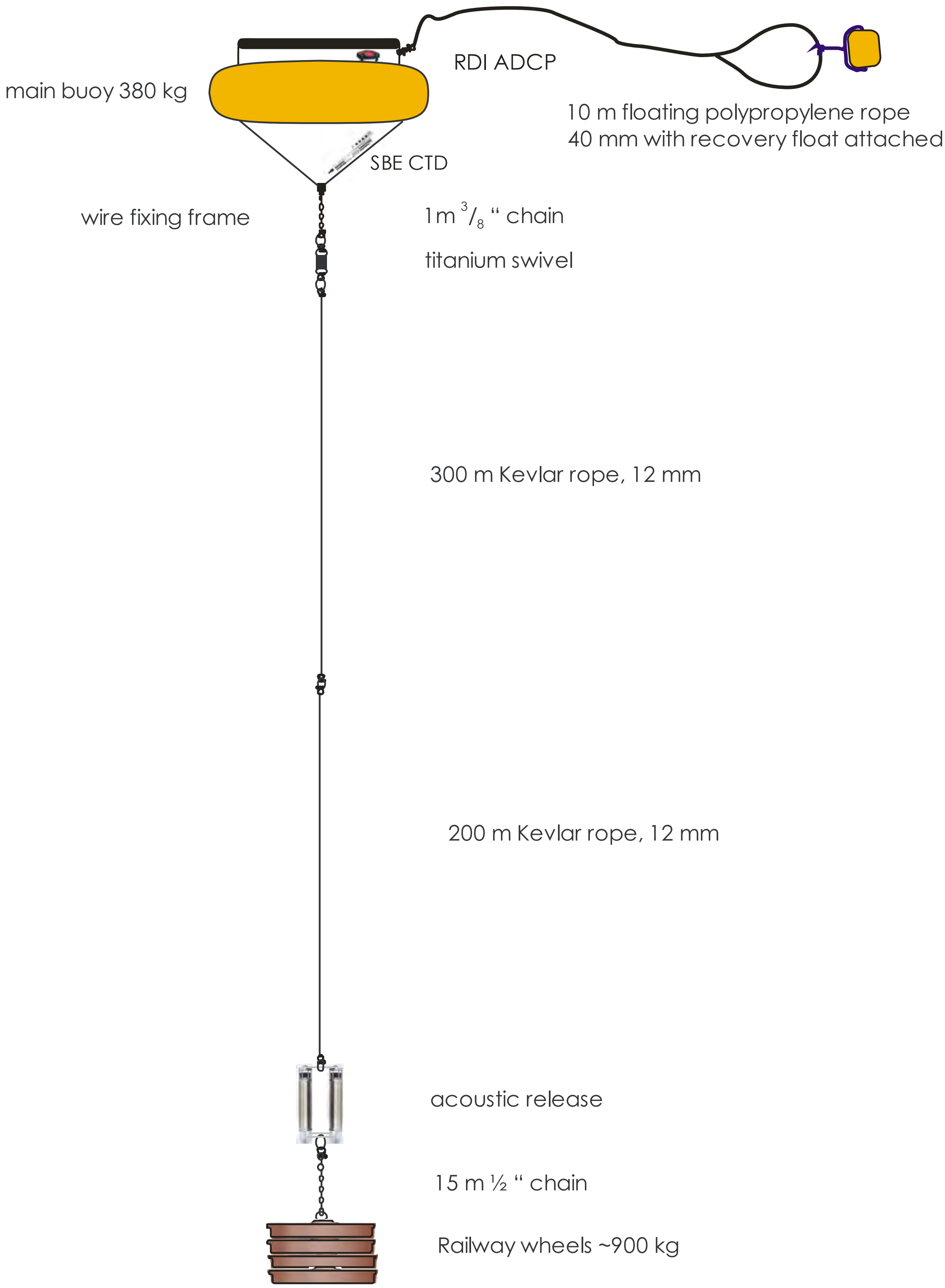

Figure 12 - Signy Mooring Configuration

5.3 3200m sediment trap mooring @ P2

5.3.1 Recovery

The P2 mooring was recovered on the 29th November 2012. The mooring did not release until the second time when both releases were fired and popped up after a few minutes on the port side behind the ship. The recovery went well with no problems. The trimsim buoy on the floating rope was lost as its rope had parted, probably due to rubbing on the floating rope. There were a few goose barnacles growing on the main buoy and ADCP. A sample of the barnacles was taken and stored in ethanol. For the recovery the new mooring winch was used very successfully by bringing the mooring winch rope right to midships to connect to the floating recovery rope. Once the main buoy was recovered a 12mm Dyneema rope was used to stopper off the main mooring rope. Once shackled over to the mooring winch rope the mooring rope was then fully spooled onto the mooring winch by keeping the linking shackles and eyes to one side, with not overlaying any rope over the shackles to minimise the risk of damage to the rope. This worked very well and the speed of the mooring winch increased the speed of recovery remarkably.

5.3.2 Performance of Instruments

The CTD data show that the instrument apparently spent most of the time just below the surface indicating that either the rope had stretched beyond calculation or that the mooring was not deployed at the right water depth.

The ADCP was unsuccessful with only one day of data recorded. When the housing was opened the housing was under internal pressure and after further investigation the battery was found to be fully discharged. It is most likely that the broken battery was responsible for the ADCP stopping after one day. The reason why the battery broke so early in the deployment is unclear, as this was a brand new instrument with a brand new battery from the manufacturer.

The sediment trap rotations worked according to the timetable set for the P2 sediment trap with 13 planned rotations between deployment and recovery. On recovery, 6 of the 21 sample bottles fitted to the sediment trap were lost, 4 of which belonged to the bottles that potentially contained sediment. The cause for the loss of bottles might have been a mixture of the sudden necessary acceleration of the ship during recovery and material failure due to the age of the bottles. All existing bottle contents were transferred to glass bottles for storage at +4°C for analysis in Cambridge and the used sediment trap bottles were discarded. A new set of bottles has been purchased this year and all bottles have been replaced for re-deployment.

The current meter worked well throughout the deployment.

5.3.3 Redeployment

The mooring was redeployed on 8th December 2012 with the former P3 equipment. A new position was chosen because of the near surfacing of the previous deployment. The chosen position is 55° 14.83S, 41° 16.08W of about 3350m water depth.

The deployment started at 12:53 GMT with the buoy first again. After the deployment of all the equipment the weight was finally released at 14:31 at a depth of **3383m** at **55.24915S and 41.27434W**

Again the mooring was pinged after the deployment to determine its position by triangulation. The ship moved from its position approx. 1 nm first N and then again 1 nm E. The positions, water depth, acoustic distance where:

Table 8 – P2 Mooring Triangulation Values

Position	Time	Triangulation		Latitude	Longitude
P1	16:15	Depth	3413	-55.25146	-41.28258
		Ping distance	3603		
P2	16:55	Depth	3393	-55.23906	-41.28316
		Ping distance	3860		
P3	17:11	Depth	3366	-55.24033	-41.25559
		Ping distance	3586		

This gave the following triangulation, with a relative position of **55° 15.0462 S and 41° 15.7888 W** where we believe the 3700m mooring is sitting:

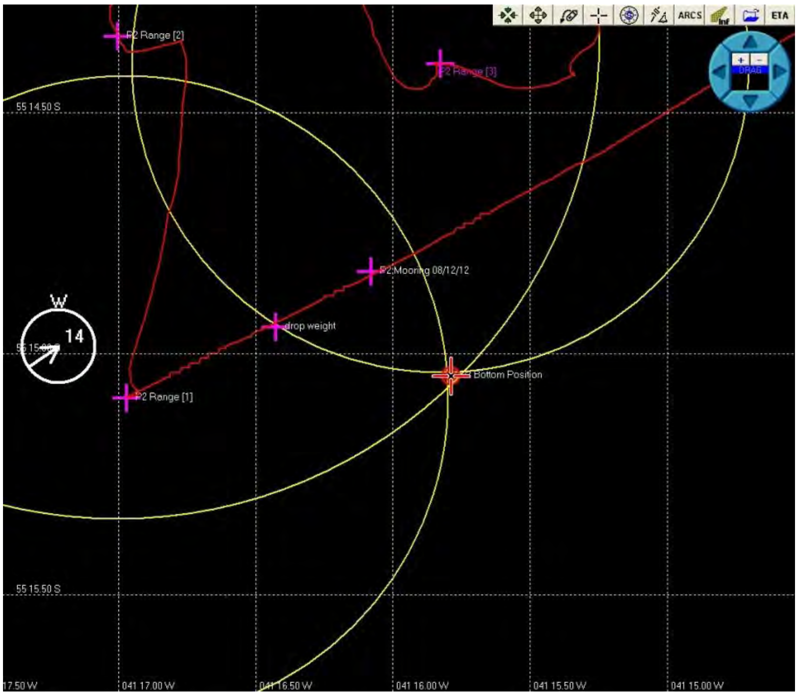

Figure 13 - P2 Triangulated Position

5.3.4 Mooring Settings and Work carried out

NOVATEC beacon: U07-029, Ch A, 154.585 MHz

Acoustic Releases:

<u>Codes</u>:

Release No: 290

On FR1 FR2 : B637

Release: **B639**

Diagnostic: B640

Pinger: B636 + B694

On new deck unit:

Option 1. RXTX settings

Option 1. Immediate Transmit

RT6XX

Transmit type: command only

Code command: B639 (release), B640 (diagnostic)

Enter

FTO=mono 8kHz

Ranging Distance

Enter

Release No: 1022

ARM, Ranging: 1890

Release code: **1890 + 1855**

Release + Pinger: ARM + 1856

Pinger on: ARM + 1847

Pinger of: ARM + 1848

Diagnostic: ARM + 1849

Acoustic releases: 290 + 1022

- new batteries
- tested

Irmasat beacon 12098770

- new batteries
- tested

NOVATEC Combo beacon: U07-029

- new batteries
- tested

CTD 37 SMP 43742: 4852 on main buoy

- data downloaded
- new batteries
- set-up instrument for re-deployment
    - set real time clock to PC clock (p. 28)
    - check instruments is ok and clock is set properly by using “DS”command (p. 27)
    - set-up instrument for “Autonomous Sampling” following the instructions on page 24
    - samplenum=0 automatically makes entire memory available for recording
    - sample interval: 900 sec
    - starttime=10122012

CTD 37 SMP 43742: 4855 at estimated 500 m

- data downloaded
- new batteries

- set-up instrument for re-deployment
    - set real time clock to PC clock (p. 28)
    - check instruments is ok and clock is set properly by using "DS"command (p. 27)
    - set-up instrument for "Autonomous Sampling" following the instructions on page 24
    - samplenum=0 automatically makes entire memory available for recording
    - sample interval: 900 sec
    - starttime=10122012

ADCP WHS300 – I – UG26: 7522

- data downloaded
- new batteries
- one O-ring replaced- it was noticed that there are no spare O-rings of the smaller size
- set-up instrument for re-deployment
    - erase data (p.16 WinSC)
    - start WinSC for set up instrument
    - set-up instrument
        - Number of bins: 30 (1-128)
        - Bin size (m): 8 (0.2-16)
        - Pings per Ensemble: 10
        - Interval: 15 min
        - Duration: 550 days
        - Transducer depth: 200 m
    - save deployment settings in prepared folder
    - set up ADCP real time clock to PC clock
    - don't verify the compass (needless on a ship)
    - run pre-deployment tests to check instrument

Sediment trap: ***Parflux*** *No: ML11966-01*

- new batteries (14x C – Cells + 1x 9V Block battery)
    - do not remove both batteries at the same time!

- **Always disconnect the cable on the Sediment trap first, before unplugging the Computer end!!**

Parflux sediment trap deployment settings (21 cups)

PS3 Sediment Trap Deployment

Schedule Verification

Event 1 of 22 = 12-15-12
Event 2 of 22 = 01-01-13
Event 3 of 22 = 01-15-13
Event 4 of 22 = 02-01-13
Event 5 of 22 = 02-15-13
Event 6 of 22 = 03-01-13
Event 7 of 22 = 04-01-13

Event 8 of 22 = 05-01-13
Event 9 of 22 = 06-01-13
Event 10 of 22 = 07-01-13
Event 11 of 22 = 08-01-13
Event 12 of 22 = 09-01-13
Event 13 of 22 = 10-01-13
Event 14 of 22 = 11-01-13
Event 15 of 22 = 12-01-13
Event 16 of 22 = 12-15-13
Event 17 of 22 = 01-01-14
Event 18 of 22 = 01-15-14
Event 19 of 22 = 02-01-14
Event 20 of 22 = 02-15-14
Event 21 of 22 = 03-01-14
Event 22 of 22 = 04-01-14

Table 9 - P2 Sediment trap event verifications

Current meter: Aquadopp No A2L - 1793 at estimated 2000 m water depth

- data downloaded
- new batteries
    - The current meter batteries (lithium) are extremely expensive and those batteries deployed during last season will be returned to the UK with the view to finding a local manufacturer.

Aquadopp current meter deployment settings:

==

Deployment : P2J280

Current time : 07/12/2012 16:22:22

Start at : 10/12/2012 00:00:01

Comment:

Deployed on Jr280 at P2

Measurement interval (s) : 900

Average interval (s) : 60

Blanking distance (m) : 0.37

Diagnostics interval(min) : N/A

Diagnostics samples : N/A

Measurement load (%) : 4

Power level : HIGH

Compass upd. rate (s) : 900

Coordinate System : ENU

Speed of sound (m/s) : MEASURED

Salinity (ppt) : 34

File wrapping : OFF

\---

Assumed duration (days) : 550.0

Battery utilization (%) : 243.0

Battery level (V) : 10.5

Recorder size (MB) : 89

Recorder free space (MB) : 89.000

Memory required (MB) : 2.1

Vertical vel. prec (cm/s) : 1.4

Horizon. vel. prec (cm/s) : 0.9

\---

Aquadopp Version 1.28

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5.3.5 Mooring Configuration Diagram

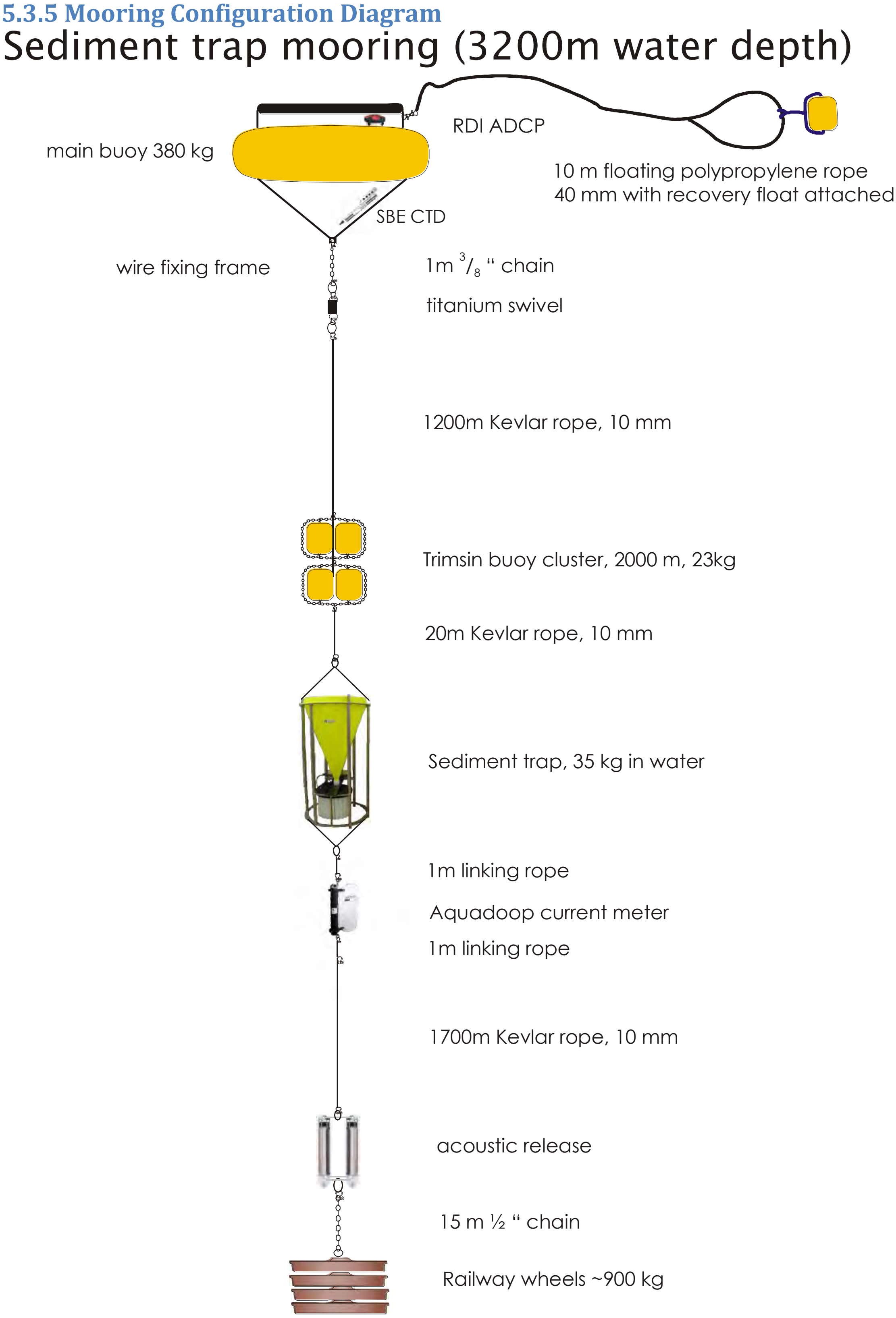

Figure 14 - P2 Mooring Configuration

5.4 3700m sediment trap mooring @ P3

5.4.1 Recovery

The recovery took place on 30th November 2012. The acoustic releases were very temperamental when talking to the deck unit. The release was fired but no response. However shortly after this the buoy popped up to the starboard side in front of the ship. The mooring was hooked mid ships and recovered as under the P2 mooring recovery described.

5.4.2 Performance

The CTD on the main buoy recorded depths for 60-120m and recorded data until the 14th June. The CTD on the rope showed depths between 370-440m and recorded data until the 7th July.

The ADCP worked well during the whole time of the deployment.

The sediment trap rotations worked according to the timetable set for the P3 sediment trap with 13 planned rotations between deployment and recovery. On recovery 2 of the 21 sample bottles fitted to the sediment trap were lost. However, both bottles were part of the set (bottles 9-10) and exposed to sedimentation so two samples were lost. All existing bottle contents were transferred to glass bottles for storage at +4°C for analysis in Cambridge and the used sediment trap bottles were discarded. A new set of bottles will be fitted to the sediment trap on re-deployment later in the season.

The current meter worked fine during the deployment.

5.4.3 Redeployment

The mooring could not be redeployed, as the swell on the morning of the 07th of December was too large to deploy the mooring, in particular there was concern that the sediment trap would be damaged during the deployment. As no cruise time was left the only option with the given circumstances was not to deploy the mooring.

5.4.4 Work carried out

All equipment was maintained and is now on the P2 mooring (see above). The P2 equipment was also maintained and is now waiting for deployment at P3. Please see below current status.

NOVATEC beacon: R09, Ch B, 159.48 MHz

Acoustic Releases:

Codes:

Release No: 93 release code: **0484 + 0455**

Release No: 573 release code: **15E1 + 1555**

Acoustic releases: 93 + 573

- new batteries
- tested
- still connected

Irmasat beacon 13901110

- did not work, taken back to Cambridge for investigation

NOVATEC Combo beacon: R09-020

- new batteries
- tested
- batteries taped

CTD 37 SMP 29579: 2462 on main buoy

- data downloaded
- new batteries
- batteries removed and stored in CTD box

ADCP WHS300 : 15548

- data downloaded
- new batteries
- batteries disconnected inside instrument

Sediment trap: Parflux No: ML11966-02

- no batteries replaced (14x C – Cells + 1x 9V Block battery)

Current meter: Aquadopp No A2L - 1792

- data downloaded
- new batteries
- batteries disconnected inside instrument

Hardware where abouts:

- main buoy: on pallet, stored in FIPASS
- ADCP: in Pelican case, stored in Container
- CTD: in wooden box, stored in Container
- Combo beacon: in mooring crate
- Iridium beacon: going back to CB for investigation
- sediment trap: on pallet, stored in FIPASS
- current meter: in mooring crate
- releases: separated, in wooden box, stored in Container
- chain: in old barrel, stored in Container
- weights: in wooden box, stored in FIPASS

5.4.5 P3 Mooring Configuration Diagram

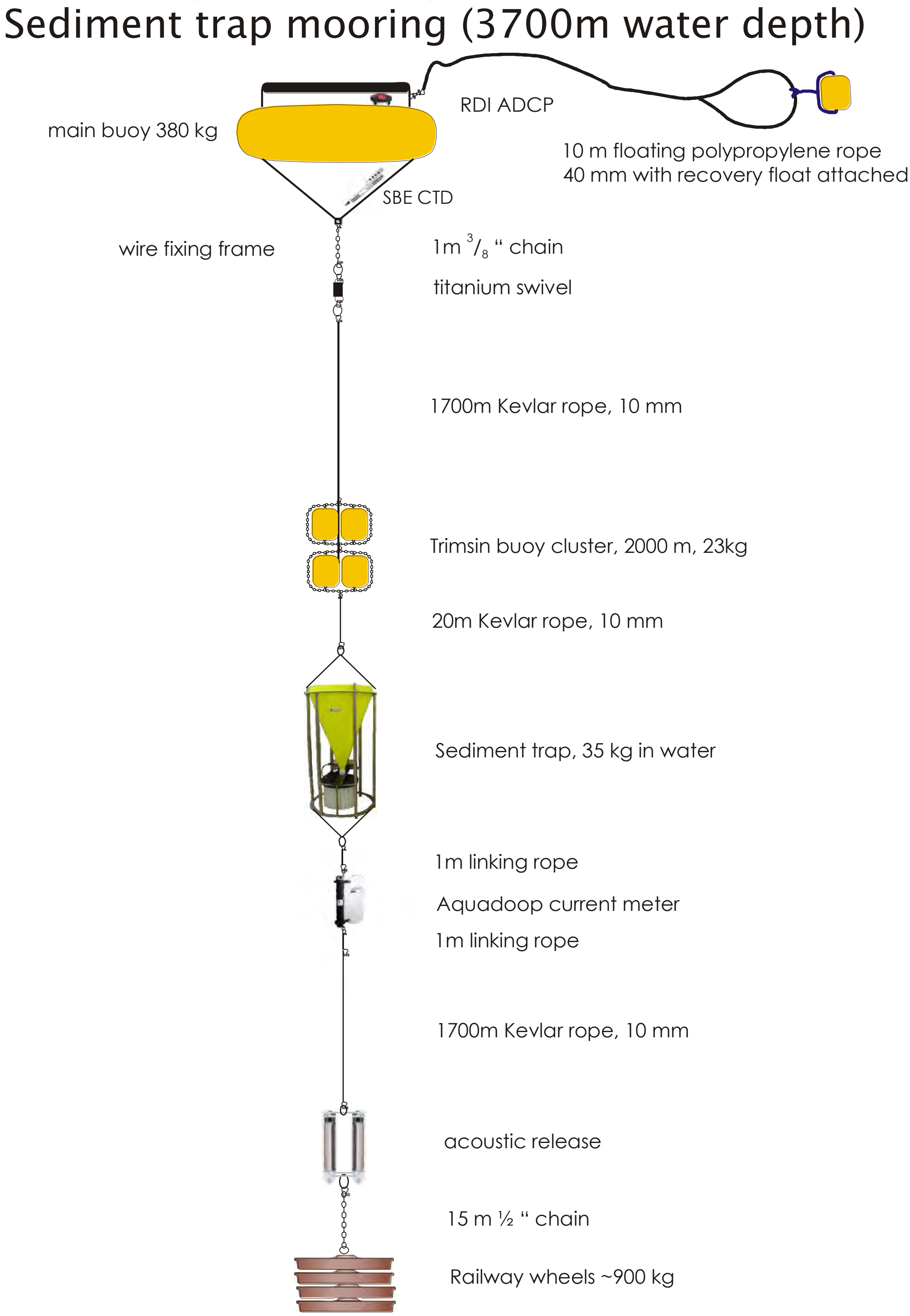

Figure 15 - P3 Mooring Configuration

5.5 shallow water WCB mooring

5.5.1 Recovery and redeployment

The western core box mooring was successfully recovered on 3rd December. Before it was released it was located on the EA600 12kHz with a pulse length of 4 milli-seconds. This was to see the signal from the sonar bell, which was apparent above the acoustic releases.

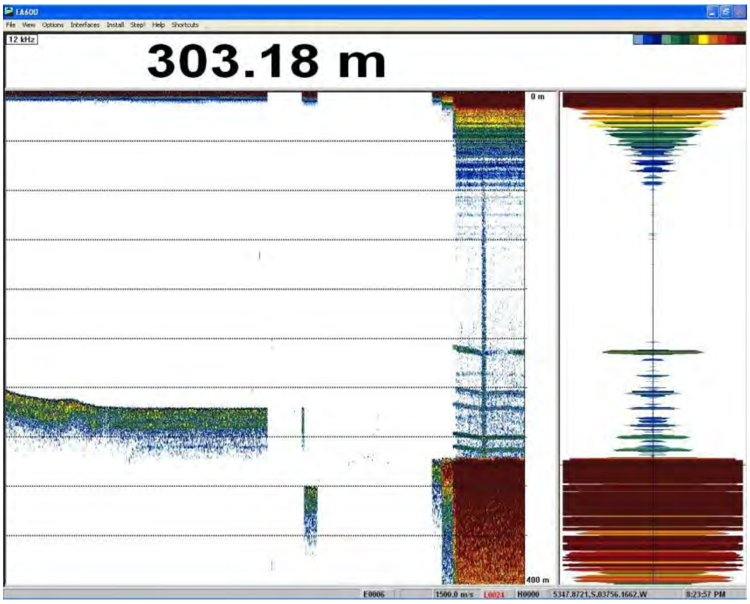

Figure 16 - Shallow WCB sonar bell echo trace

It was redeployed on the 6th December, this was in a different arrangement to the original mooring; instead of the trimsim arrangement of ropes there was one 50m long rope between the releases and the main buoy. A single trimsim buoy was attached to the main buoy via a 10m floating rope. The sonar bell was not redeployed. The WCB anchor was released at 53°47.88S and 37°56.06W

5.5.2 Performance

The CTD and ADCP worked fine with a large data set. The CTD collected data until September. The water column profiler did not perform well with no proper data. There were about a dozen large files showing data from 0-50m, these are thought to be from the test deployments prior to deployment last year. These are followed by a large number of files, but of small file size. These files were ranging 0-200m and it appears as if the files had been created but no proper data recorded. There was no physical damage to the instrument which had been seen in previous deployments.

It was decided that the WCP on this mooring would be replaced with the new WCP in the titanium housing for the next deployment.

5.5.3 Work carried out

NOVATEC beacon R09-021: Ch. C.: **160.725 MHz**

Acoustic Releases:

Code shallow water mooring:

release:No: 572 release code: **15E0 + 1555**

release:No: 1218 release code: **0895 + 0855**

work on mooring:

Acoustic release 572 & 1218

- new batteries
- tested

NOVATEC Combo beacon: R09-021

- new batteries
- tested

Irmasat beacon 12094770

- new batteries
- tested

Sonar Bell

- this was taken off to be returned to supplier, it showed on the echo sounder prior to recovery as per description above

WCP

- data downloaded
- got new WCP from factory, Serial: AZFP-55004
- the new ASL hardware in the old titanium housing
- New deployment file: wcp_05122012_deployfile.mfawcpl

CTD 37 SMP 43742: 2463

- data downloaded
- new batteries
- 1 screw of Conductivity cell guard missing

Get new CTD, so this one can go for repairs

Get new screw: part NO:30859

- set-up instrument for re-deployment
  - set real time clock to PC clock (p. 28)
  - check instruments is ok and clock is set properly by using "DS"command (p. 27)

- set-up instrument for "Autonomous Sampling" following the instructions on page 24
- samplenum=0 automatically makes entire memory available for recording
- sample interval: 900 sec

ADCP WHS300 – I – UG26: 2967 – replace with unit 17275

- data downloaded
- taken off for maintenance as plastic housing was showing deformation
- this was replaced with a brand new instrument, ADCP 17275

- set-up instrument for deployment
    - start WinSC for set up instrument
    - set-up instrument
        - Number of bins: 30 (1-128)
        - Bin size (m): 8 (0.2-16)
        - Pings per Ensemble: 10
        - Interval: 15 min
        - Duration: 550 days
        - Transducer depth: 200 m
    - save deployment settings in prepared folder
    - set up ADCP real time clock to PC clock
    - don't verify the compass (needless on a ship)
    - run pre-deployment tests to check instrument

5.5.4 Shallow WCB Mooring Configuration Diagram

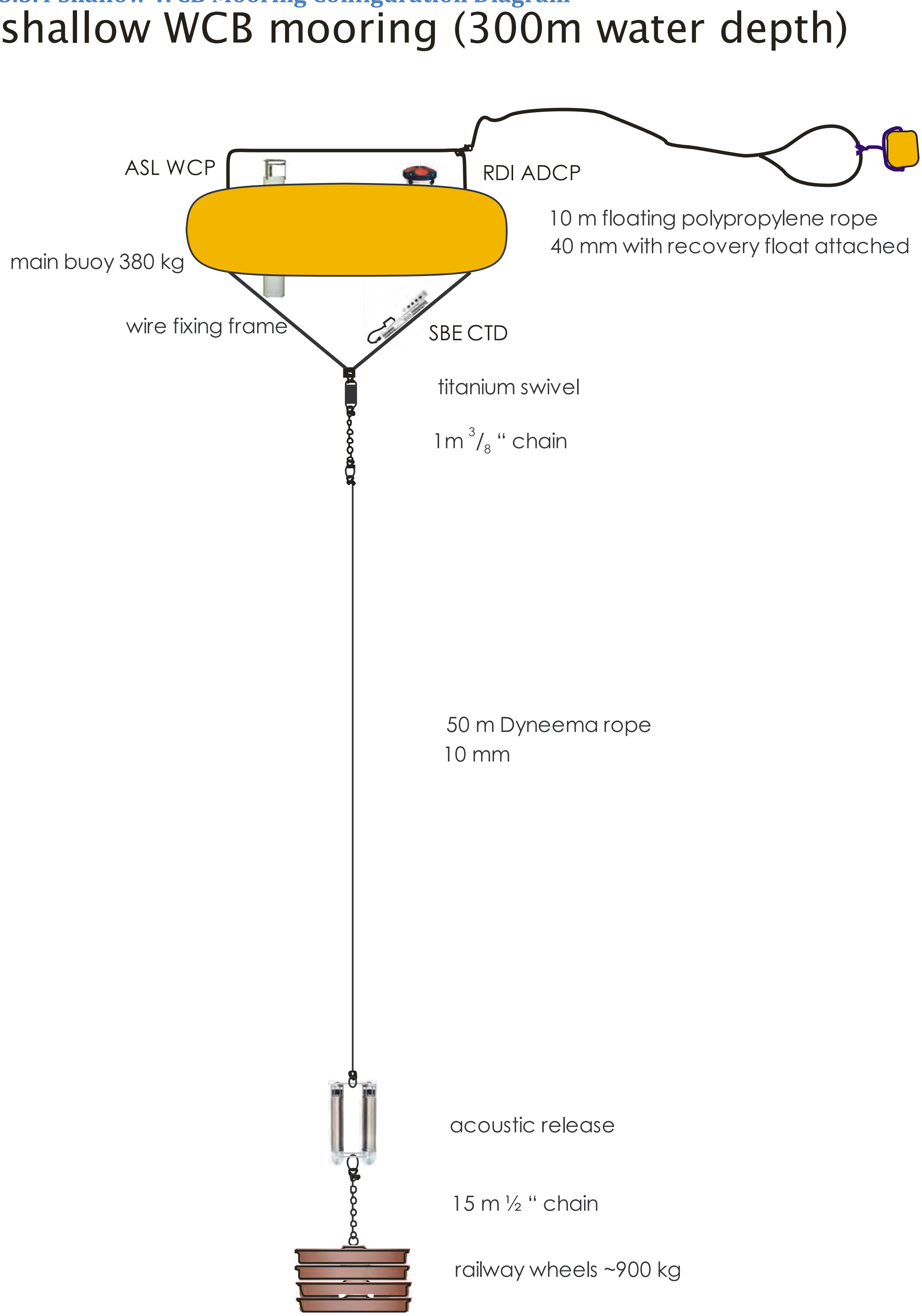

Figure 17 - Shallow WCB Mooring Configuration

6. Western Core Box

Jon Watkins, Sophie Fielding, Peter Enderlein, Anna Totterdell, Gabriele Stowasser, Ryan Saunders, Damien Guihen, David Connor, Louise Biddle, Ines Heisterkemp, Arjun Chennu

6.1 Narrative

The Western Core Box (WCB) survey was run in the normal west to east direction. Transect 1.1 was started at the southern end at 06:00 (L) on 01/12/2012. The sea was reasonable and there was little dropout. XBTs were run at the start and end of the first transect of the day and at three points equidistant along the transect. The speed for deploying the XBTs was 6 knots and the transects were run at 10 knots. At the end of the transect 1.2 the ship relocated to station 1.2S to undertake the station CTD followed by the oblique RMT8 haul between surface and 200 m. Prior to the station based sampling (RMT8 and CTD) at the offshore station 1.2N, target fishing for krill was carried out successfully at the shelf break.

The second pair of transects (2.1 and 2.2) were initially blocked by a large iceberg which required moving the northern start point of transect 2.1 ~1 nautical mile to the west. However the iceberg had moved sufficiently to be able to complete the second transect without deviating from the planned track line. After completing a deep CTD and oblique RMT8 net haul at station 2.2N we target fished a large krill swarm out in deep water (>3000 m) before relocating to station 2.2S to undertake the station-based sampling.

The third day was foggy and overcast with a moderate swell and the transect pair 3.1 and 3.2 with associated XBTs was completed without problem. At the end of the second transect we moved back up the transect ~5 nautical miles to the position of the WCB shallow mooring. The mooring was recovered and a mooring site CTD completed before steaming to station 3.2S to undertake a station CTD and oblique RMT8 haul. Target fishing took place near to the shallow 3.2S station. However by the time we arrived at station 3.2N weather conditions had deteriorated sufficiently that we were only able to complete the 1000 m CTD cast.

The final day of the core box survey took place in a bigger swell than the previous 3 days but the transect pair 4.1 and 4.2 were completed without problem. As this is the last transect pair and there is no station-based sampling on transect 4.2, XBTs were taken on both transects 4.1 and 4.2. At the completion of the second transect we returned to station 4.2N to undertake the station-based RMT8 that was not completed the previous day. An early evening target fishing session caught large krill with many moults. After this the ship proceeded to Stromness to carry out the acoustic calibration.

Table 10 - Western core box events and station listing

Station	Event No.	Start	Finish
XBTs			
WCB 1.1	15	01/12/2012 09:07	
WCB 1.1	16	01/12/2012 10:12	
WCB 1.1	17	01/12/2012 11:20	
WCB 1.1	18	01/12/2012 12:30	

WCB 1.1	19	01/12/2012 13:39	
WCB 2.1	27	02/12/2012 09:00	
WCB 2.1	28	02/12/2012 10:11	
WCB 2.1	29	02/12/2012 11:20	
WCB 2.1	30	02/12/2012 12:32	
WCB 2.1	31	02/12/2012 13:40	
WCB 3.1	39	03/12/2012 09:00	
WCB 3.1	40	03/12/2012 10:08	
WCB 3.1	41	03/12/2012 11:15	
WCB 3.1	42	03/12/2012 12:25	
WCB 3.1	43	03/12/2012 13:37	
WCB 4.1	53	04/12/2012 09:36	
WCB 4.1	55	04/12/2012 10:47	
WCB 4.1	56	04/12/2012 11:54	
WCB 4.1	57	04/12/2012 13:03	
WCB 4.1	58	04/12/2012 14:08	
WCB 4.2	59	04/12/2012 14:51	
WCB 4.2	61	04/12/2012 15:58	
WCB 4.2	62	04/12/2012 17:07	
WCB 4.2	63	04/12/2012 18:16	
WCB 4.2	64	04/12/2012 19:29	
CTDs			
Station W1.2S	21	01/12/2012 20:27	01/12/2012 20:57
Station W1.2N	25	02/12/2012 05:26	02/12/2012 06:19
Station W2.2N	33	02/12/2012 20:34	02/12/2012 21:26
Station W2.2S	37	03/12/2012 06:00	03/12/2012 06:23
Station W3.2S	47	03/12/2012 23:09	03/12/2012 23:28
Station W3.2N	50	04/12/2012 07:06	04/12/2012 07:58
RMT			
Station W1.2S	22	01/12/2012 21:11	01/12/2012 22:24
Station W1.2N	24	02/12/2012 03:08	02/12/2012 04:24
Station W2.2N	34	02/12/2012 21:39	02/12/2012 22:50
Station W2.2S	36	03/12/2012 03:50	03/12/2012 05:01
Station W3.2S	48	03/12/2012 23:43	04/12/2012 00:48
Station W3.2N	65	04/12/2012 21:35	04/12/2012 22:54

7. Nets

7.1 RMT8 fishing

Two sorts of net hauls were undertaken: stratified hauls from the surface to 200 m to the surface, and target hauls. Target hauls were undertaken in the normal fashion. Acoustic targets were detected during steaming downwind at 6 – 10 knots and then the ship undertook either a Williamson or Stevenson turn to return upwind fishing over the ships track. Stratified hauls were undertaken at the 6 WCB standard repeat sites, W1.2S, W1.2N, W2.2S, W2.2N, W3.2S, W3.2N.

Table 11 - RMT8 hauls

Event No	Date	In water (GMT)	On deck (GMT)	Comment	Krill
8	30/11/2012	18:10	18:26	Test	
9	30/11/2012	18:41	18:55	Test	
10	01/12/2012	02:18	02:50	Target	Yes
11	01/12/2012	04:03	04:28	Net not opened no target	
12	01/12/2012	04:59	05:30	Net not opened no target	
22	01/12/2012	21:11	22:22	Oblique haul (W1.2S)	
23	02/12/2012	00:14	00:36	Target	Yes
24	02/12/2012	03:12	04:19	Oblique haul (W1.2N)	
34	02/12/2012	21:41	22:46	Oblique haul (W2.2N)	
35	02/12/2012	23:42	00:01	Target	Yes
36	03/12/2012	03:50	04:57	Oblique haul (W2.2S)	
48	03/12/2012	23:49	00:40	Oblique haul (W3.2S)	
49	04/12/2012	02:52	03:20	Target	
65	04/12/2012	21:58	22:50	Oblique haul (W3.2N)	
66	05/12/2012	01:36	01:46	Target	Yes

7.2 Krill Length Frequency

7.2.1 Introduction

Antarctic krill (*Euphausia superba*) were sampled to determine the variation in the structure of the population around South Georgia and to provide parameters required in the target strength model for krill biomass estimation.

7.2.2 Methods

Krill samples were taken from RMT8 samples where there were sufficient numbers of krill to select 100 decent state specimens for length frequency, maturity and krill shape photographs. Krill were laid out on blue plastic boards (in pre-drilled grooves) and photographed using a Nikon DX3 with two flash guns on a stand (Figure 19). The same krill were then measured for length and staged. Krill total length was measured, using the standard BAS measurement from the anterior edge of the eye to the tip of the telson, with measurements rounded down to the nearest millimetre (Morris et al. 1988). Maturity stage was assessed using the scale of Makarov and Denys with the nomenclature described by Morris et al. (1988).

7.2.3 Data

Krill length frequency data were input into a spreadsheet on the L drive "JR280_krill_length_frequencies.xls". The Net event numbers from which krill were measured and whether they were photographed is identified in Table 11 with the mean length of those events.

Table 12 - Krill length frequency mean length per station

Event Number_Net Number	Photo	Mean Length (mm)
23_1	Y	52.42
23_2	Y	50.53
35_1	Y	50.89
37_1	Y	49.06
48_1	Y	47.01
48_2	Y	42.87
65_1	Y	50.82
65_2	y	50.31

The krill length frequency pdf for the whole cruise are shown in Figure 18 - Krill length. A total of 39.29 m of krill were measured.

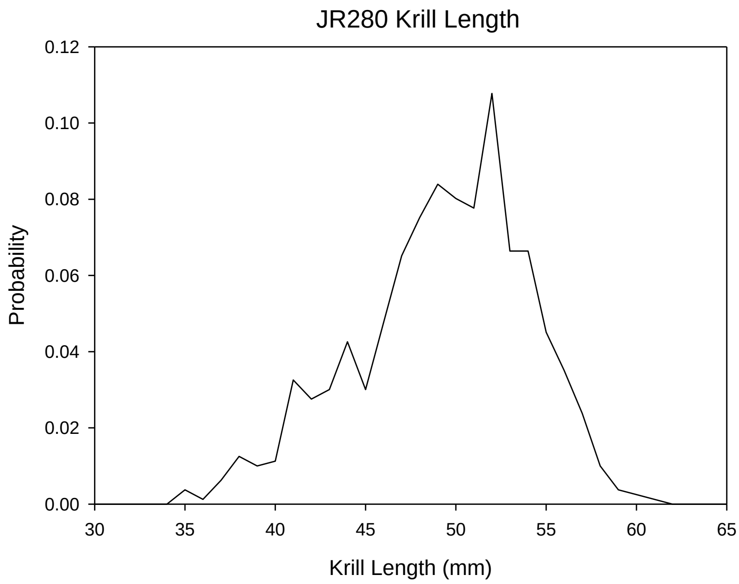

Figure 18 - Krill length

7.3 Photography of krill samples

Each krill sample that was used as part of the length frequency sampling was photographed both dorsally and laterally. The photographs were taken for use in the development of a computerised approach to calculating the shape of krill to better inform a krill target strength model.

Krill were arranged on plastic boards in five rows of four, with the exception of Event 48, Net 1, where five rows of five were possible. The boards were a medium to dark blue colour, intended to optimize the contrast with the krill bodies. Five grooves were machine-melted into the boards. Melting was preferable to cutting as it reduced the scattering of light from rough edges.

A Nikon D3X with an attach Nikon 24 -85 mm lens was mounted level, above the board such that the board was almost filling the field of view (Figure 19. (a) Krill photography setup with magnetically mounted flash guns, camera stand and krill board. (b) Two magnetically mounted flash guns were positioned low, either side of the board (Figure 199b), approximately 1 m apart and connected to the camera. The camera was set in Manual mode with an aperture of F22 and a shutter speed of 1/30 and ISO of 200.

Due to a problem with the main camera battery charger, a replacement was used for Event 23. The replacement camera was a Canon 5D Mark III with a fixed focal length 50 mm lens. The Canon was set with an aperture of F16, and ISO of 50 and a shutter speed of 1/200.

The photos were downloaded directly from the camera, catalogued and renamed to include the event number, view, board and net number. A list of the photographs and details of the associated event number, date etc. is included in Table 13 - Krill photography log.

An example of the photographed krill is shown in Figure 20.

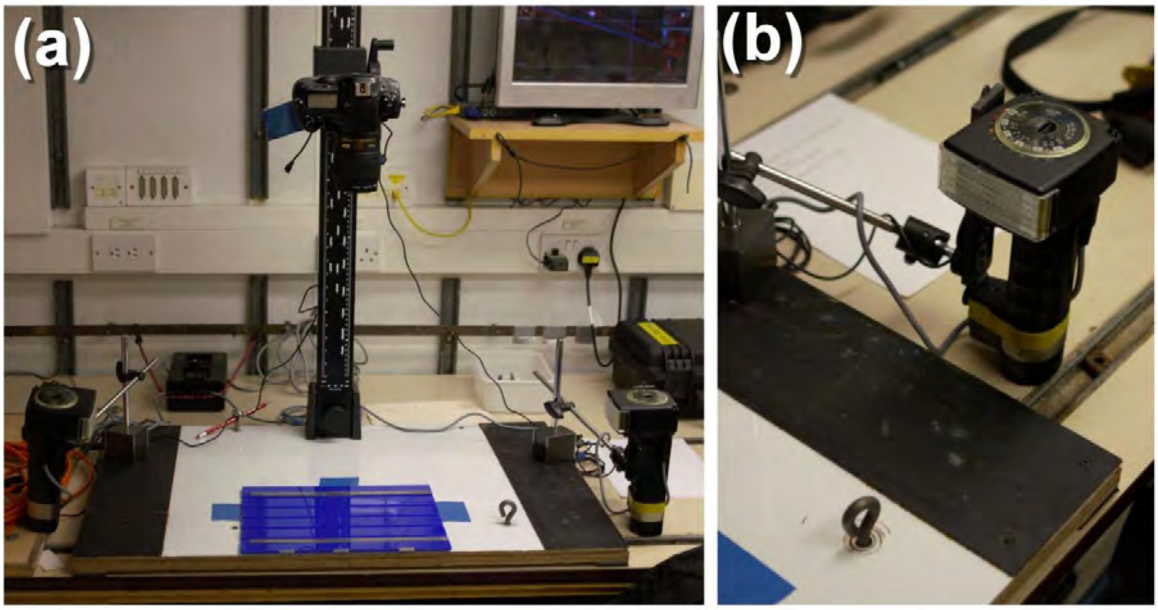

Figure 19. (a) Krill photography setup with magnetically mounted flash guns, camera stand and krill board. (b) Two magnetically mounted flash guns were positioned low, either side of the board.

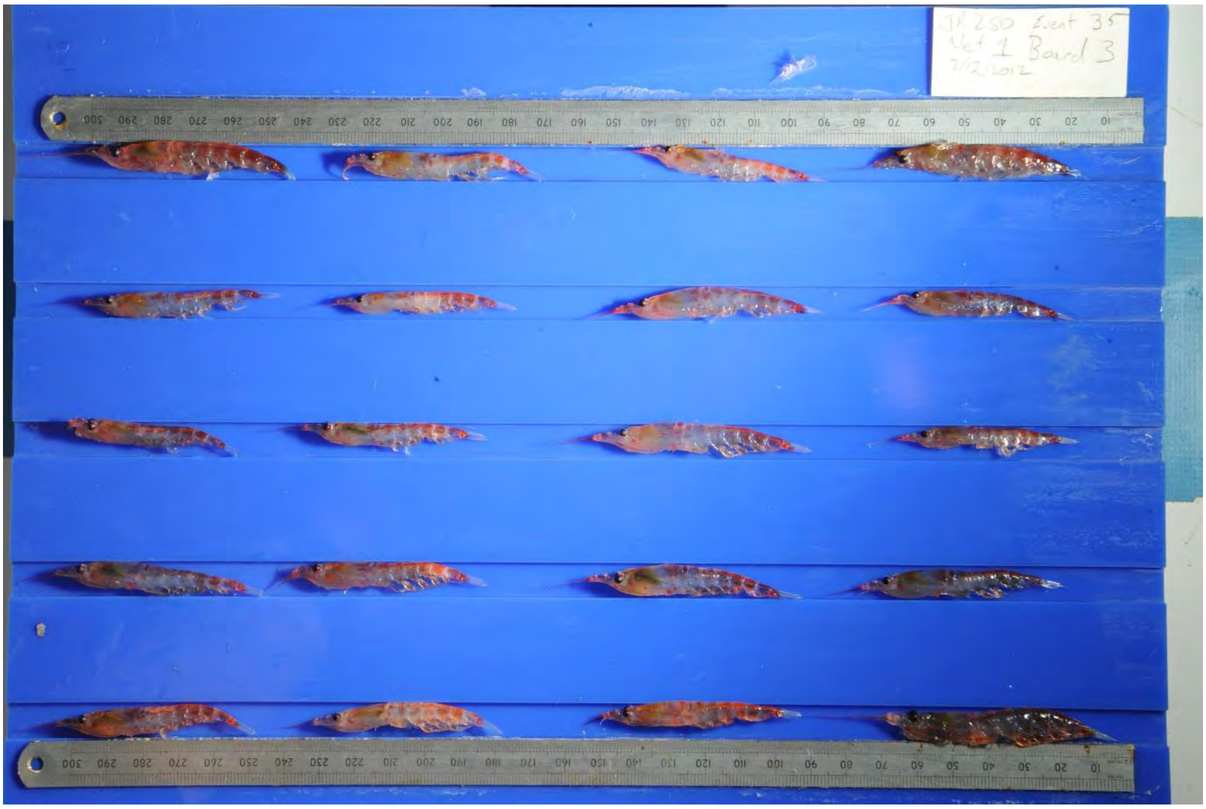

Figure 20. Example of krill photographed for morphometric studies

Table 13 - Krill photography log

Date	Event	Filename	Net	Board	View	Camera	Lens
02/12/2012	23	Event_23_Net_2_Board_1_Dorsal.JPG	2	1	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_1_Lateral.JPG	2	1	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_2_Dorsal.JPG	2	2	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_2_Lateral.JPG	2	2	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_3_Dorsal.JPG	2	3	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_3_Lateral.JPG	2	3	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_4_Dorsal.JPG	2	4	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_4_Lateral.JPG	2	4	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_5_Dorsal.JPG	2	5	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_2_Board_5_Lateral.JPG	2	5	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_1_Dorsal.JPG	1	1	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_1_Lateral.JPG	1	1	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_2_Dorsal.JPG	1	2	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_2_Lateral.JPG	1	2	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_3_Dorsal.JPG	1	3	Dorsal	Canon 5d	Canon 50mm

02/12/2012	23	Event_23_Net_1_Board_3_Lateral.JPG	1	3	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_4_Dorsal.JPG	1	4	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_4_Lateral.JPG	1	4	Lateral	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_5_Dorsal.JPG	1	5	Dorsal	Canon 5d	Canon 50mm
02/12/2012	23	Event_23_Net_1_Board_5_Lateral.JPG	1	5	Lateral	Canon 5d	Canon 50mm
02/12/2012	35	Event_35_Net_1_Board_1_Dorsal.JPG	1	1	Dorsal	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_1_Lateral.JPG	1	1	Lateral	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_2_Dorsal.JPG	1	2	Dorsal	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_2_Lateral.JPG	1	2	Lateral	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_3_Dorsal.JPG	1	3	Dorsal	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_3_Lateral.JPG	1	3	Lateral	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_4_Dorsal.JPG	1	4	Dorsal	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_4_Lateral.JPG	1	4	Lateral	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_5_Dorsal.JPG	1	5	Dorsal	Nikon D3x	Nikon 24-85mm
02/12/2012	35	Event_35_Net_1_Board_5_Lateral.JPG	1	5	Lateral	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_1_Dorsal.JPG	1	1	Dorsal	Nikon D3x	Nikon 24-85mm

03/12/2012	37	Event_37_Net_1_Board_1_Lateral.JPG	1	1	Lateral	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_2_Dorsal.JPG	1	2	Dorsal	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_2_Lateral.JPG	1	2	Lateral	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_3_Dorsal.JPG	1	3	Dorsal	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_3_Lateral.JPG	1	3	Lateral	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_4_Dorsal.JPG	1	4	Dorsal	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_4_Lateral.JPG	1	4	Lateral	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_5_Dorsal.JPG	1	5	Dorsal	Nikon D3x	Nikon 24-85mm
03/12/2012	37	Event_37_Net_1_Board_5_Lateral.JPG	1	5	Lateral	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_2_Board_1_Dorsal.JPG	2	1	Dorsal	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_2_Board_1_Lateral.JPG	2	1	Lateral	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_2_Board_2_Dorsal.JPG	2	2	Dorsal	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_2_Board_2_Lateral.JPG	2	2	Lateral	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_2_Board_3_Dorsal.JPG	2	3	Dorsal	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_2_Board_3_Lateral.JPG	2	3	Lateral	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_2_Board_4_Dorsal.JPG	2	4	Dorsal	Nikon D3x	Nikon 24-85mm

04/12/2012	48	Event_48_Net_2_Board_4_Lateral.JPG	2	4	Lateral	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_1_Board_1_Dorsal.JPG	1	1	Dorsal	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_1_Board_1_Lateral.JPG	1	1	Lateral	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_1_Board_2_Dorsal.JPG	1	2	Dorsal	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_1_Board_2_Lateral.JPG	1	2	Lateral	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_1_Board_3_Dorsal.JPG	1	3	Dorsal	Nikon D3x	Nikon 24-85mm
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04/12/2012	48	Event_48_Net_1_Board_4_Dorsal.JPG	1	4	Dorsal	Nikon D3x	Nikon 24-85mm
04/12/2012	48	Event_48_Net_1_Board_4_Lateral.JPG	1	4	Lateral	Nikon D3x	Nikon 24-85mm
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05/12/2012	65	Event_65_Net_1_Board_1_Lateral.JPG	1	1	Lateral	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_1_Board_2_Dorsal.JPG	1	2	Dorsal	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_1_Board_2_Lateral.JPG	1	2	Lateral	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_1_Board_3_Dorsal.JPG	1	3	Dorsal	Nikon D3x	Nikon 24-85mm

05/12/2012	65	Event_65_Net_1_Board_3_Lateral.JPG	1	3	Lateral	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_1_Board_4_Dorsal.JPG	1	4	Dorsal	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_1_Board_4_Lateral.JPG	1	4	Lateral	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_1_Board_5_Dorsal.JPG	1	5	Dorsal	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_1_Board_5_Lateral.JPG	1	5	Lateral	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_2_Board_1_Dorsal.JPG	2	1	Dorsal	Nikon D3x	Nikon 24-85mm
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05/12/2012	65	Event_65_Net_2_Board_2_Lateral.JPG	2	2	Lateral	Nikon D3x	Nikon 24-85mm
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05/12/2012	65	Event_65_Net_2_Board_3_Dorsal.JPG	2	3	Dorsal	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_2_Board_3_Lateral.JPG	2	3	Lateral	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_2_Board_4_Dorsal.JPG	2	4	Dorsal	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_2_Board_4_Lateral.JPG	2	4	Lateral	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_2_Board_5_Dorsal.JPG	2	5	Dorsal	Nikon D3x	Nikon 24-85mm
05/12/2012	65	Event_65_Net_2_Board_5_Lateral.JPG	2	5	Lateral	Nikon D3x	Nikon 24-85mm

7.4 Krill weigh bridge

The weight and density of krill was measured during JR280 using the new krill weigh bridge designed and built by Sevi Afanasyev. Krill were kept in the cold room and used when weather conditions permitted. Prior to each set of weight measurements the krill weigh bridge was set up and left connected to the battery for a minimum of an hour with the reference weight and an 80g calibration weight to establish the baseline measurements made by the load cells. After each measurement the krill was put into a single eppendorf tube and frozen at -80 °C.

Measurement protocol: The process requires an accurate measurement (on land) of the reference weight, the density bottle (and lid) and the volume of water the bottle can hold. The following constants are required before use (with weights measured on land):

W_{rw} Weight of the reference weight (g) = 80 g

W_b Weight of empty bottle and lid (hereafter just referred to as bottle) (g) = 31.694 g

V_b Volume of bottle (ml) = 49.972 ml

Step by step procedure

1. Fill bottle to brim with water and weigh (W_1)

2. Remove ~2ml of water using a syringe and weigh (W_2)

3. Add krill to bottle and weigh (W_3)

4. Fill bottle to brim with water (same water and temperature as during 1) and weigh (W_4)

Specific gravity of the water (σ_w) used is calculated as:

$$\sigma_w = \frac{(W_1 - W_b)}{V_b}$$

Weight of krill (W_k) is calculated as:

$$W_k = W_3 - W_2$$

Weight of liquid (W_l) added is calculated as:

$$W_l = W_4 - W_k - W_b$$

Volume of liquid (V_l) in bottle is calculated as:

$$V_l = \frac{W_l}{\sigma_w}$$

Volume of krill (V_k) is calculated as:

$$V_k = V_b - V_l$$

Specific gravity of krill (σ_k) is calculated as:

$$\sigma_k = \frac{W_k}{V_k}$$

Table 14 Krill weights contains all the measurements of krill weight and density contrast (g), the actual measurements recorded from the krill weigh bridge are contained within the file JR280 Krill weights.xls. The relationship between krill length and weight and density contrast are given in Figure 21 and Figure 22.

Table 14 - Krill weights

Krill id	Krill Length (mm)	Krill stage	Correction	Krill wt (g)	Krill g
1	55	FA2	0.06	1.44	1.01408
2	53	FA2	0.06	1.11	1.01835
3	50	FA1	0.06	0.81	1.0125
4	57	FA2	0.06	1.63	1.05161
5	52	FA2	0.06	0.99	1.02062
6	50	FA1	0.06	1.04	1.0297
7	51	FA2	0.06	1.06	1.00952
8	52	FA2	0.06	1.07	1.03883
9	51	FA2	0.06	0.98	1.02083
10	52	FA2	0.06	1.06	1.01923
11	52	FA2	0.06	1.07	1.03883
12	51	FA2	0.06	0.98	1.02083
13	52	FA2	0.06	1.06	1.01923
14	49	FA2	0.06	0.93	1.00541
15	44	FA1	0	0.65	0.95588
16	48	FA1	0	0.82	1.01235
17	57	MA2	0	1.74	1.01754
18	48	MA1	0	0.87	0.98864
19	43	MS2	0	0.57	1.00885
20	43	MS2	0	0.61	0.976
21	46	FA1	0	0.69	1
22	51	MA1	0	1.13	1.01802
23	41	MS2	0.03	0.51	0.95327
24	43	MS2	0.03	0.59	0.98333
25	52	MA2	0.03	1.27	1.01195
26	50	MA2	0.03	0.97	1.03191
27	43	MS2	0.03	0.59	1.01724
28	44	FA1	0.03	0.6	0.98361
29	49	FA2	0.03	0.91	1.02247
30	52	FA2	0.03	1.12	1.00901

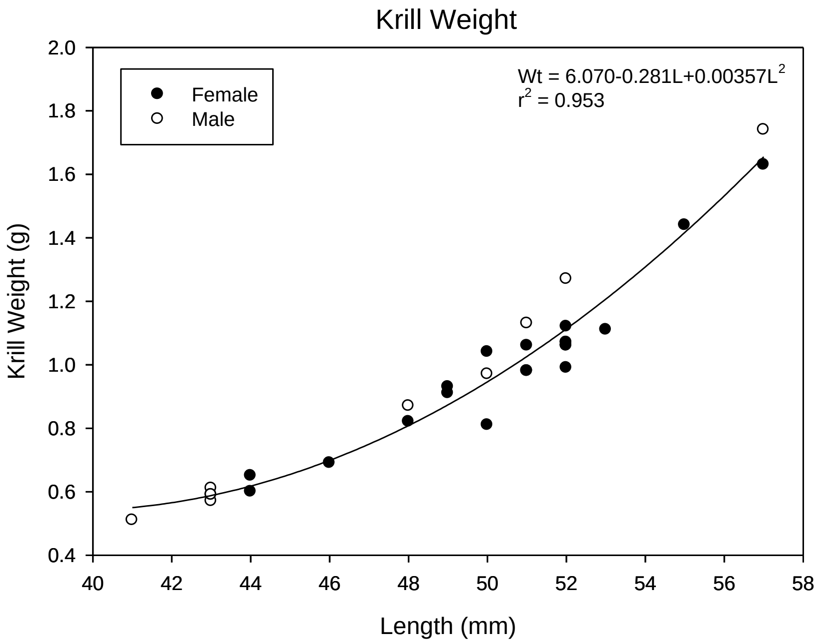


Figure 21 - Krill Weight

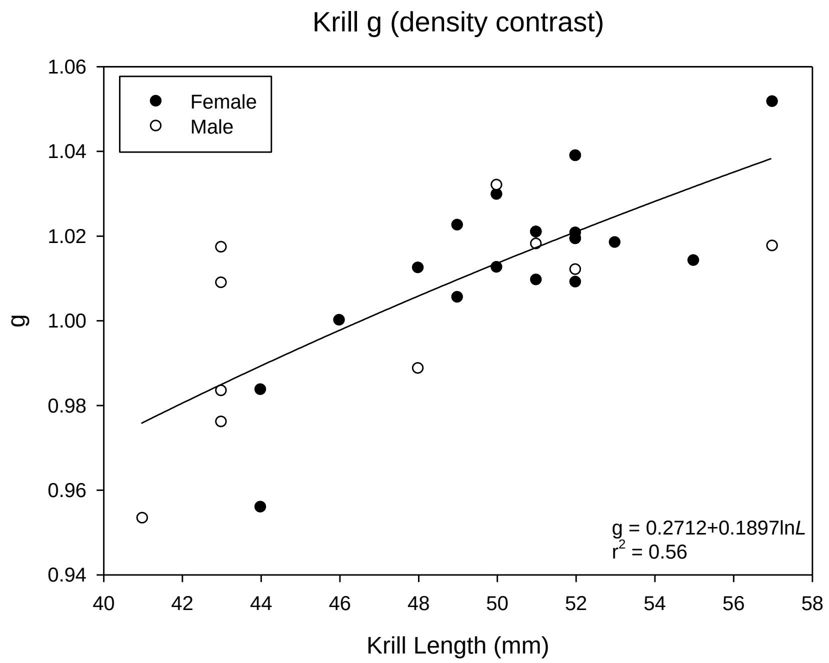


Figure 22 - The relationship between krill length and weight, and krill length and density contrast.

7.5 Macrozooplankton

Gabriele Stowasser, Sophie Fielding, Ryan Saunders, Jon Watkins, Peter Enderlein, Anna Totterdell, Ines Heisterkamp, Arjun Chennu, Damien O'Gaoithin and Will Goodall-Copestake

7.5.1 Gear

The RMT8 was used to characterise the macrozooplankton community in the Western Corebox in 200m oblique trawls and target trawls (Table 15 – RMT net events). Target trawls were undertaken on krill swarms identified from the EK60. In oblique trawls net 1 was opened at the surface and the net deployed to 200m (where water depth was sufficient) before closing and net 2 opened at 200m depth and closed at the surface. The choice of deployment type depended on the task. Target hauls were made to supply Ines Heisterkamp and Arjun Chennu (Max Planck Institute, Bremen) with *Euphausia superba* (Antarctic krill) for live incubations and the WCB team with krill for length frequency measurements and preservation for different projects in Cambridge. Oblique trawls were only undertaken at the Western Core Box stations. One net catch was worked up and the other preserved to be analysed in the laboratory in Cambridge. Of some catches only a subsample was preserved due to the size of the catch.

7.5.2 Catch sorting and processing

7.5.2.1 Oblique hauls

For the oblique hauls the total catch of one net was sorted and quantified. Numbers caught and total weight was obtained for each species. For some groups specific identification was not possible and identification will be verified through re-examination in the laboratory. All material collected in the second net was preserved in formalin. Specimens of squid species were collected for a Masters project on cephalopod feeding ecology and distribution in the Scotia Sea and preserved at -80°C. Specimens of the amphipod *Themisto gaudichaudii* were collected for collaborators and preserved in 96% Ethanol for genetic analysis. All myctophid fish specimen caught were kept and frozen at -20°C for educational purposes. All data were recorded in an Excel database.

7.5.2.2 Targeted hauls

The catch of targeted hauls was sorted and quantified. Where live *E. superba* were caught samples were taken for live incubations and subsamples were frozen at -80°C and preserved in 96% Ethanol for various genetic studies. In hauls where sufficient numbers of *E. superba* were caught, length-frequency data was collected (see chapter on krill length frequency). Krill total length was measured on 100 fresh krill, using the standard BAS measurement from the anterior edge of the eye to the tip of the telson, with measurements rounded down to the nearest mm (Morris et al. 1988). Maturity stage was assessed using the scale of Makarov and Denys with the nomenclature described by Morris et al. (1988).

Table 15 - RMT8 hauls

Event No	Date	In water (GMT)	On deck (GMT)	Comment	Krill
8	30/11/2012	18:10	18:26	Test	
9	30/11/2012	18:41	18:55	Test	
10	01/12/2012	02:18	02:50	Target	Yes
11	01/12/2012	04:03	04:28	Net not opened no target	
12	01/12/2012	04:59	05:30	Net not opened no target	

22	01/12/2012	21:11	22:22	Oblique haul (W1.2S)	
23	02/12/2012	00:14	00:36	Target	Yes
24	02/12/2012	03:12	04:19	Oblique haul (W1.2N)	
34	02/12/2012	21:41	22:46	Oblique haul (W2.2N)	
35	02/12/2012	23:42	00:01	Target	Yes
36	03/12/2012	03:50	04:57	Oblique haul (W2.2S)	
48	03/12/2012	23:49	00:40	Oblique haul (W3.2S)	
49	04/12/2012	02:52	03:20	Target	
65	04/12/2012	21:58	22:50	Oblique haul (W3.2N)	
66	05/12/2012	01:36	01:46	Target	Yes

Table 16 - Location and numbers of invertebrate species sampled in the Western Core Box area during cruise JR280

Project	Species	Event*	Number sampled	Storage
Feeding ecology	*Slosarczykovia circumantarctica*	10	15	-80°C
	Squid ident.	24	5	-80°C
	Squid ident.	65	4	-80°C
Genetics	*Euphausia superba*	23	100	Ethanol
	Euphausia superba	23	100	-80°C
	Euphausia superba	35	100	Ethanol
	Euphausia superba	35	100	-80°C
	Euphausia superba	48	100	Ethanol
	Euphausia superba	48	100	-80°C
	Euphausia superba	66	100	-80°C
	Themisto gaudichaudii	24	26	Ethanol
	Themisto gaudichaudii	65	14	Ethanol
Educational	*Electrona antarctica*	10	3	-20°C
	Electrona antarctica	24	14	-20°C
	Electrona carlsbergi	10	1	-20°C
	Gymnoscopelus braueri	24	19	-20°C
	Gymnoscopelus nicholsi	24	2	-20°C
	Krefftichthys anderssoni	24	4	-20°C
	Krefftichthys anderssoni	34	8	-20°C

7.5.3 Genetic study

A further aim during this cruise was to sample *E. superba* for evolutionary genetics research projects based at BAS Cambridge, where DNA will be extracted from the krill and multiple genetic loci PCR amplified and sequenced. The resulting sequence information will be used to start building a multi-gene molecular phylogeny of krill, the aim of which is to resolve the contradictions and weakly resolved nodes that occur in krill molecular phylogenies produced to date. When large sample sizes are available, DNA sequence information will be used for population-genetic historical demography analysis. These analyses generate historical trajectories of krill population size through time that can be compared with existing trajectories for *E. superba* and with paleo-environmental data (e.g. climate change inference) so that we can build up a picture of how krill communities (as opposed to just single species) may have changed in response to glacial-timescale climate change. Several sample sets of 100 *E. superba* were collected from sites within the WCB to test for possible differences in population structure within the same year of recruitment and to compare to samples taken at the same positions in previous years (positions and numbers see Table 16).

7.6 Nitrous oxide emission from krill

Ines Heisterkamp and Arjun Chennu
(Max Planck Institute for Marine Microbiology, Bremen, Germany)

7.6.1 Background and objective

Nitrous oxide (N_2O) is an important atmospheric trace gas that significantly contributes to global warming and to the destruction of the stratospheric ozone layer. To date, the biogenic N_2O sources remain poorly quantified in the global N_2O budget. Natural N_2O production mainly originates from microbial nitrification and denitrification in soils and oceans. High N_2O emission rates have been reported for earthworms and several freshwater and coastal marine invertebrates. The N_2O production associated with these invertebrates has been attributed to incomplete denitrification in the gut of the animals. The gut microenvironment of N_2O -emitting animals is characterized by anoxia and the availability of nitrate and labile organic carbon sources, and thus stimulates the denitrification activity of ingested microorganisms. The ecological relevance of N_2O emission from invertebrates is given if N_2O is emitted by highly abundant species living in nitrate-rich environments. The overall goal of this project was therefore to investigate the N_2O emission potential of the Antarctic krill *Euphausia superba*. Our main objectives were to investigate 1) *in situ* N_2O emission rates of freshly collected krill, 2) N_2O production and total denitrification rates of dissected krill guts, 3) N_2O saturation levels in the ambient water, and 4) the (micro-)environment and microbial community in the krill gut and water column.

7.6.2 Sampling and measurements

7.6.2.1 Incubation experiments with live krill

7.6.2.1.1 *in situ* N_2O emission rates

Krill was supplied by the RMT 8 hauls event no. 10 and 23 (Table 17). Immediately after the catch was brought on board, krill individuals of good physiological condition were incubated in 500 ml gas-tight glass bottles filled with 400 ml of 0.2 µm-filtered seawater for 4 h at 4°C. Krill individuals were photographed to record their length and gut filling state before adding them to the incubation vials (Figure 23 - Monitoring gut filling state before incubation). Bottles were placed on a shaker during incubation to ensure equilibrated distribution of N_2O between water and gas phase (Figure 24 - Experimental set-up in the cold room). Gas samples were taken from the headspace of the incubation bottles in regular time intervals and transferred to gas-tight 3 ml glass vials. N_2O concentrations in the glass vials will be analysed by gas chromatography at the MPI in Bremen. Water samples for nutrient analysis were taken before and after the incubation, filtered and frozen at -20°C.

Figure 23 - Monitoring gut filling state before incubation


Figure 24 - Experimental set-up in the cold room

Table 17 - RMT8 hauls that supplied krill for experiments.

Event No	Date	In water (GMT)	On deck (GMT)	Comment
10	01/12/2012	02:18	02:50	Target
23	02/12/2012	00:14	00:36	Target
35	02/12/2012	23:42	00:01	Target
66	05/12/2012	01:36	01:46	Target

Krill from all catches were kept in a flow-through tank in the cold room (4°C) until 9.12.2012.

7.6.2.1.2 Stable isotope experiments

The RMT 8 target haul event 10 supplied live krill for the first stable isotope experiment (Table 17 - RMT8 hauls that supplied krill for experiments.). The second experiment was set up with krill that were kept in the flow-through tank in the cold room. Krill individuals of good physiological condition were incubated in 500 ml gas-tight glass bottles filled with 400 ml of 0.2 µm-filtered artificial seawater amended with $^{15}NO_3^-$. Incubation bottles were placed on a shaker in the cold room (4°C)and gas samples were taken in regular time intervals over 4 h and transferred to gas-tight 3 ml glass vials. Gas samples will be analysed for the concentration of $^{45}N_2O$ and $^{46}N_2O$ on a mass spectrometer at the MPI in Bremen. The guts of the incubated krill individuals were dissected after the incubation for analysis of $^{14}NO_3^-$ and $^{15}NO_3^-$. Water samples were taken, filtered and stored at -20°C for nutrient analysis.

7.6.2.2 Incubation experiments with krill guts

Krill guts were dissected from freshly caught krill (event 23, 35 and 66) or from krill that were kept in the flow-through tank in the cold room. Dissected guts were incubated in 6 ml gas-tight glass vials filled with 1 ml of 0.2 µm-filtered artificial seawater. Four different incubation assays were set up to investigate the potential N_2O production by nitrification and denitrification and measure the total denitrification rate of the gut:

a) artificial seawater with 25 µM nitrate under anoxic conditions

b) artificial seawater with 25 µM nitrate under anoxic conditions with 10% acetylene

c) artificial seawater with 25 µM ammonium under oxic conditions

d) artificial seawater with 25 µM ammonium and 100 µM allylthiourea under oxic conditions

To adjust experimental conditions, the seawater and headspace of the incubation vials were purged with pressurised air or nitrogen gas before starting incubations. Incubation vials were put on a shaker for 4 h at 4°C and gas samples were taken in regular time intervals and filled into 3 ml glass vials for later analysis of the N_2O concentration at the MPI in Bremen.

7.6.2.3 Microsensor measurements

We used microsensors to measure oxygen and pH in the stomach and gut of krill (Figure 26). The microsensor set-up comprised a pico-ampere meter for oxygen measurements, a milli-volt meter for pH measurements, a motor-controlled micromanipulator for exact positioning of the microsensors, a data-acquisition device and computer to record the signal of the sensor and to position the motor.

The tip diameters of the sensors were 10 to 60 µm. The sensors were calibrated before, during, and after the measurements. Oxygen microsensors were calibrated in seawater at 0 and 100% air-saturation by purging with nitrogen gas and synthetic air, respectively. The pH sensors were calibrated in standard solutions of pH 7.0 and 9.0. Freshly dissected guts were fixed on an agarose bottom in a flow-cell, which was continuously flushed with 0.2 µm-filtered seawater that was cooled to *in situ* temperature (Figure 25). Aided by a dissection microscope, the microsensor tip was positioned at the middle of the gut diameter and point measurements were recorded along the complete gut length in 0.25 to 0.5 cm steps.

Figure 26 - O2 microsensor

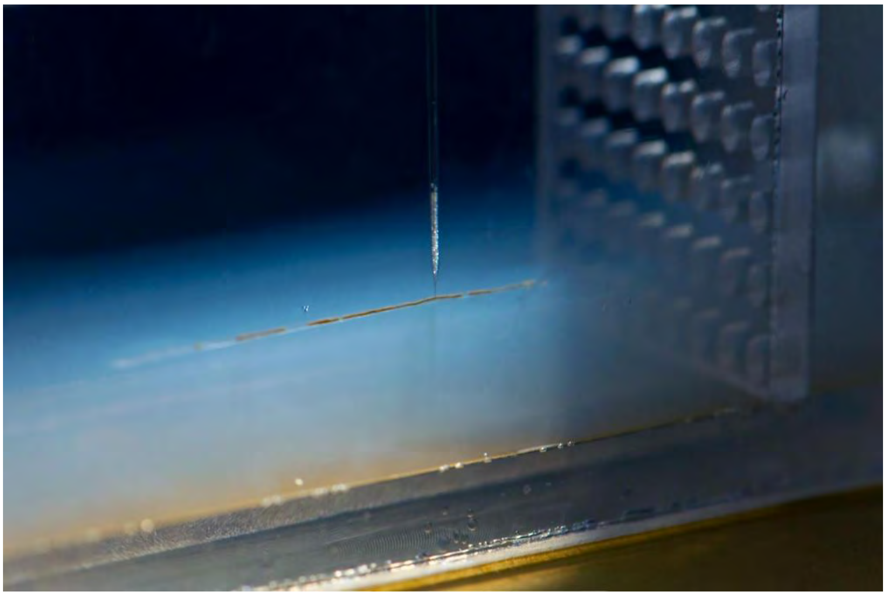


Figure 25 - Microsensor measurements inside the dissected krill gut placed in a flow-cell

7.6.2.4 Water samples for dissolved N_2O concentration and nutrient analysis

Water samples were taken from CTD casts at the stations of the Western Core Box transects before and after target fishing (Table 18). Niskin bottles were fired at six to seven depths in which krill typically occurs and some deeper reference sites. Samples were drawn bubble-free from Niskin bottles, filled into gas-tight glass vials that contained mercuric chloride to stop biological activity. Samples will be analysed on the gas chromatograph at the MPI in Bremen for N_2O concentration. For nutrient analysis, water samples were filtered (0.2 µm) and frozen at -20°C.

Table 18- CTD casts sampled for N2O and nutrient analysis.

Event No	Date	Bottle number	Depths
21	01/12/2012	1-12	200, 100, 50, 25, 10, surface
25	02/12/2012	1-12	200, 100, 50, 25, 10, surface
33	02/12/2012	1-14	1000, 500, 200, 100, 50, 25, surface
37	03/12/2012	1-12	200, 100, 50, 25, 10, surface
47	03/12/2012	1-12	125, 100, 50, 25, 10, surface
50	04/12/2012	1-12	1000, 500, 200, 100, 50, 25
67	05/12/2012	1-12	150, 100, 75, 50, 25, surface

7.6.2.5 Water and krill tissue samples for molecular analysis

Guts were dissected from freshly sampled krill and frozen at -80°C for DNA/RNA extraction or fixed in formaldehyde for fluorescence in situ hybridization. Water samples from different depths were filtered on a 0.2 µm GTTP filter and either frozen at -80°C or fixed with formaldehyde.

8. Opportunistic swath bathymetry

The EM122 was turned on for periods of transit from South Georgia to Signy and the return, and from the P2 mooring location to Stanley following advice and transects provided by Gwen Buys (BAS). The EM122 was interfaced with EA600 through the SSU, with EM122 as master and EA600 as passive slave. The folder name was JR280_a for all opportunistic swath data and the setup followed the protocol as outlined in the recommend settings. A second folder JR280_b was setup with fine scale gridding to examine the Signy mooring location bathymetry.

Table 19 - Swath Line Log

Locations	Start time	End time	Comments
South Georgia to Signy	22/11/12 14:47	24/11/12 15:25	Bad weather caused bad data particularly on 22/11
Signy to South Georgia	28/11/12 18:33	29/11/12 20:33	
South Georgia to Stanley	08/12/12 19:21	10/12/12 22:00	Bad weather caused bad data on 09/12 interesting feature was EM122 unable to maintain dynamic dual mode

9. JR280 Argos tag validation

9.1 Motivation

The seaglider is an unmanned underwater vehicle, collecting oceanographic data in a specified region through buoyancy control and movement of ballast. The lack of onboard propellers means that it is possible for the glider to be pushed off course by a stronger current, potentially widening the search area when it is to be recovered. Further, the GPS system on the glider is dependent on the battery being operational – if there is an electrical failure, the glider will go into recovery mode, but would be unable to transmit its position. In order to narrow the search area, and to act as a secondary location device, an Argos tag can be fitted to the glider. This report studies the accuracy of the location provided through the Argos satellites in comparison to the shipboard GPS system.

9.2 Set-Up

An Argos tag was placed on the stern of the forecastle deck, and programmed to transmit every 90 seconds for the first 10 minutes it was on, then every 2 minutes, with wet/dry sensor enabled. The shipboard GPS system is the Seatex GGA, which provides latitude, longitude and altitude every second throughout the cruise, and the Seatex VTG provides the GPS velocity of the ship. The timestamp was taken from the Argos tag location data and used to select the GPS data for the same time, producing .csv files. The Argos tag data was then also split into "transit" and "Bird Island" time periods, approximating to data gathered whilst travelling >10 knots and data gathered whilst mostly stationary around Bird Island off of South Georgia. The accuracy of the Argos tag location was decided through the direct distance between the Argos tag location and the shipboard GPS position, using an alteration of *LatLonDist2.m*, included in the *argos_validation.m* script:

> **argos_validation.m**: Extracts data required from .csv files, runs LatLonDist2 to get the distance between the ship GPS position and the Argos position and produces four plots illustrating the quality and accuracy of the data.
>
> **statistical_argos.m**: Calculates standard deviation, median and mean of distances between Argos position and ship GPS, as well as 63rd percentile errors (to compare to CLS accuracy estimates).

Iterations of both of these scripts for Bird Island data only and transit data only

9.3 Argos Tag Performance

The Argos tag location errors were found to be greater than the CLS location class accuracy estimates provided with the tag, but similar to other studies of this error (*Brown, JR255 cruise report*) when comparing 63rd percentile errors (see table 20). The only location class error that fell within the expected bounds was for LC-1 at Bird Island (1282 m), with the lowest error associated with the LC-3 locations at Bird Island (444 m). Whilst in transit and moving at 10 knots (approximately 5 ms^{-1}) the errors increased massively, with the smallest error found in LC-2 rather than LC-3.

Table 20 - 63rd percentile errors for the three groups of data in this study, compared to the CLS estimate.

	LC-3	LC-2	LC-1	LC-0	LC-A	LC-B
CLS Location Class accuracy	**<250m**	**250m-500m**	**500m-1500m**	**>1500m**	**Not quoted**	**Not quoted**
All Data	1032m	1120m	2101m	5643m	2483m	8450m
Bird Island Data	444m	645m	1282m	3635m	1851m	3220m
Transit Data	2414m	1818m	2526m	5977m	3457m	14563m

It seems unlikely that this error is solely due to the speed of the ship, which is insignificant compared to the speed of the Argos satellite (~484 kms-1).

9.4 Argos Tag Times

A histogram of the times that messages were received was also produced (figure 27). This provided an interesting result, illustrating the times of day when more satellites pass overhead in the Scotia Sea area. There is a significant “low” at around 3pm (GMT) each day, with the most messages received between 10pm and 6am – during the hours of darkness. The CFS Argos manual states that the Argos satellites pass the same locations on the Earth’s surface at approximately the same time each day, so this could potentially shift by small amounts throughout the year. But it is still a useful result, as it could provide a basis for programming the Argos tag to transmit only in the hours when satellites are passing and in daylight (i.e. 6am to 12pm, and 6pm to 10pm), extending its battery life.

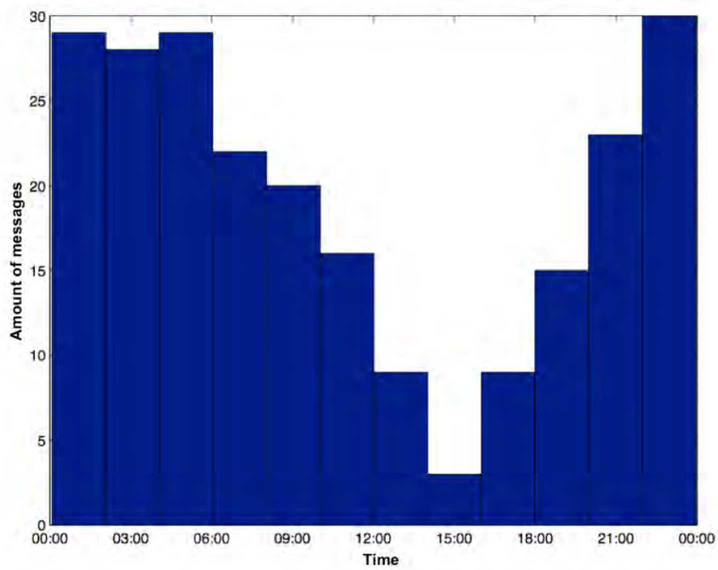


Figure 27 - Histogram of the times that messages were received by Argos satellites

9.5 Argos Tag Error Bias

When the longitudinal error distance was plotted against the latitudinal error, a clear bias was visible for the "all data" group, and a slight bias – in a different direction – for the "Bird Island data" group (figure 28). The bias for all of the data appears to be in the direction that the ship had travelled from, again suggesting that the movement of the ship is what is propagating the errors. Whilst stationary at Bird Island, however, the bias was in the NE-SW direction. The source of this bias is a topic for further research, as it could be associated with the Argos satellites' elliptical radius of error, caused by the direction of the satellite track.

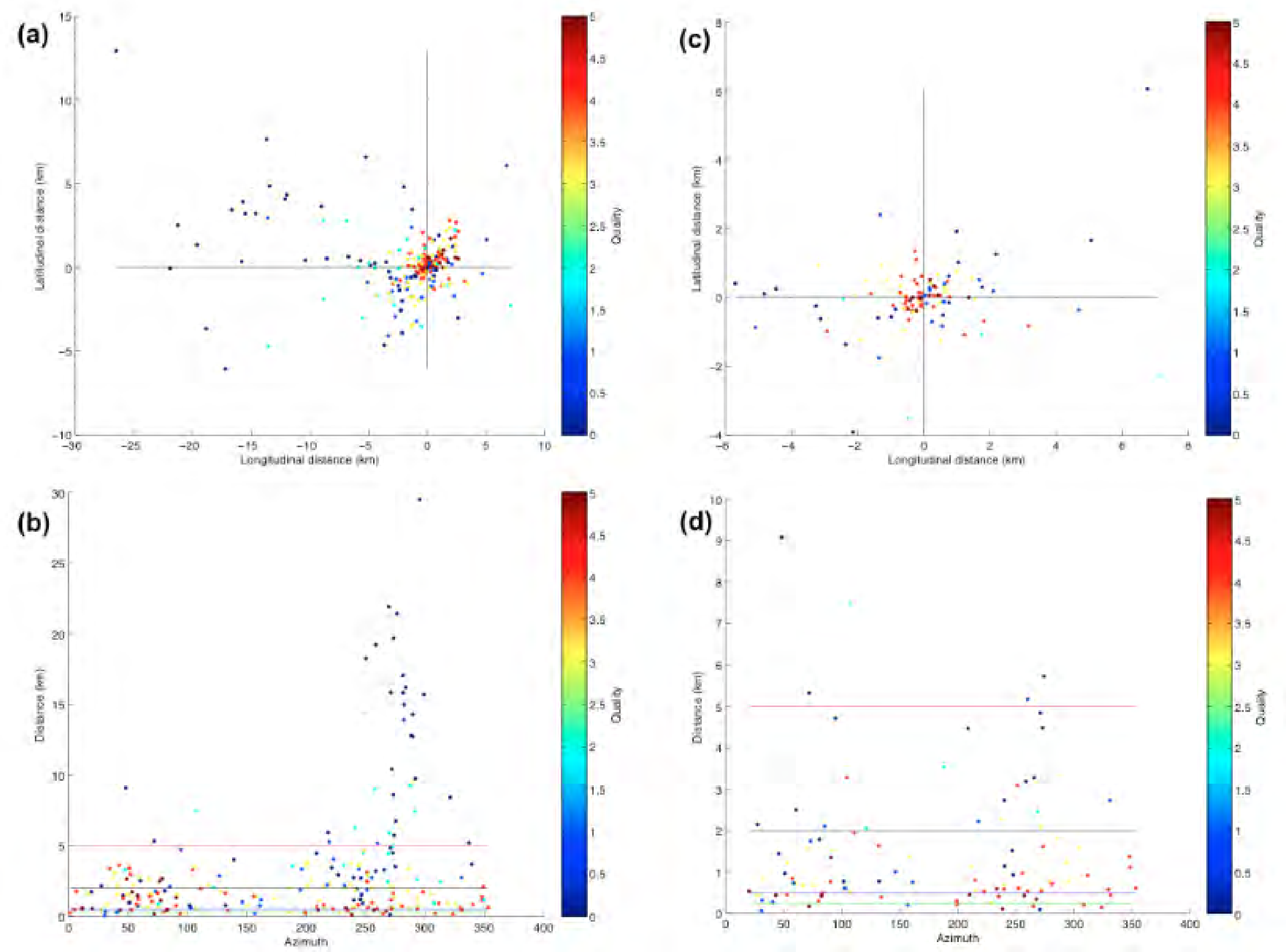


Figure 28 - Plots a-b for "All Data" and c-d for "Bird Island Data". Illustrating the bias to the NW for whilst the ship is moving, and the skew of NE-SW for stationary. The LC-B is 0, LC-A is 1, then LC-0 is 2 etc for quality values.

10. AME Report

Please see Appendix H for the AME instrument report and relevant instrument calibration sheets.

11. ICT Report

11.1 Cruise Details & Setup

ICT engineer : **Peter Lens**
Captain : **Jerry Burgan**

Sailed from Stanley to Stanley

Logging start - 14 Nov 2012 @ 13:22 UTC

SCS ACQ version : 4.5.1.1063
SIS version : 3.8.3 Build 89
SIS PU parameters and Users settings saved in /work folder on backups.

11.2 Recommendations

Replace batteries in both SCS and ESX rack units in summer 2013
Radio room UPS failed : replace APC Smart-UPS 1000 2U rack, confirm with MPEG
indent for i7 to replace JRUH (UIC)

11.3 Cruise Log

Pcdl 22:45, 4 December 2012 (UTC)
Furuno-GLL showed as red on the monitor screen, this was traced to a failed raw2compress process.
Ran raw2compress.pl raw2compess.xml on jrlb as scs and this fixed the problem.
At 22:30:06 Net monitor raw stream stopped coming in. Problem was USB to serial devices or drivers on netmon PC. In future logging to both local and SCS.
Pcdl 09:00, 25 November 2012 (UTC)
Working cargo at Signy
Pcdl 11:52, 20 November 2012 (UTC)
Working cargo at KEP for 2 days
Pcdl 06:00, 17 November 2012 (UTC)
Base relief at Bird Island - site visit document available from pcdl
Pcdl 19:12, 15 November 2012 (UTC)
Replace EA600 KVM sender PSU
Pcdl 13:23, 14 November 2012 (UTC)
ACQ started
jrub and jrld certificates expired so problems mounting jrlb data areas - fixed by JPRO remotely
Galleon NTP server in "unsynchronised" state -> power cycled -> Tardis on SCS jumped -7 seconds

12. Data Management Report

12.1 Cruise Summary

Cruise: JR280 & BI/KEP/Signy Relief

Leg: 2012-11-14 - ICT report and summary

PSO - Jon Watkins

12.2 Cruise Projects

JR280 - Western Core Box - Moorings, acoustic Transects, XBT, CTD, and fishing

Base Relief - General data logging

(A detailed summary of these projects can be found in the JR280 cruise report)

12.3 Mapping and Data Requests During Cruise

12.3.1 Signy Mooring - Inaccessible Trench

A request for available bathymetry near 60.57426 S, 46.51906 W was made to determine the most suitable drop point for the Signy mooring.

Gwen Buys prepared the appropriate imagery and sent it overnight. The image is stored in the cruise work directory under data_management/02a - signy_inaccessible_trench_mooring

12.3.2 Western Core Box - Glider Test Area

A proposed point for a glider test was made for 37° 43.13'S, 53° 28.97'W. Using the SGBD2008 dataset, under guidance from Gwen Buys, the appropraite printout was made showing bathymetry for the area around the target zone.

The output files and source ArcMap files are stored in the cruise work directory under data_management\02b - WCB_glider_target_area

12.3.3 P2 Mooring Site

A proposed point for the P2 mooring was 55.2085S 41.11047W. Using the SGBD2008 dataset, under guidance from Gwen Buys, the appropraite printout was made showing bathymetry for the area around the target zone.

The output files and source ArcMap files are stored in the cruise work directory under data_management\02c - p2_mooring_deployment

Previous location: 55.2085 S 41.11047 W New location: 55° 14.83 S 41° 16.08 W

12.4 ARGOS Positioning Tag Validation

The seagliders and other instruments use ARGOS tags to establish a position. The argos tag determines it's position using a satellite network and reports back to the tag owner an approximate position. For details about how the ARGOS tag validation is done and how positioning and accuracy is calculated see section 9 for the analysis. The matlab code for this an actual plotting and processing is described in section 9. This section deals with the preparation of data for the argos positions, running the matlab scripts from a linux task scheduler (CRON)and various automation steps.

12.4.1 Software
For this cruise a small set of python scripts was written that would read in the argos emails, grab a timestamp from the position, grab ship data and save both the ship position information and the ARGOS position information in a file format that is easy to read into matlab. The matlab scripts written by Louise Biddle are then called from the script which generate a series of plots.

12.4.2 Data Preparation
The argos positions are returned as an email in a specific format. The python cron job is looking in a specific directory for new email files. When they show up the system then parses the emails and saves a list of ARGOS times and positions.

The script then takes those argos positions and calculates the ships position and speed for that timestamp. The script also dumps a 30 second interval of ships GPS positions into a separate file.

With these three files (ARGOS positions, Ship positions that map to argos times, and general ship track) the python script then calls argos_validation.m to generate the plots of position and speed.

The python script called by the cronjob is get_all_data.py. The code for this project is stored in the [JR280 data directory]/work/argos_validation/utils/

12.5 SCS

12.5.1 SCS/perl/Apache/SCS/Constants.pm
The parameter

$SCS_MINSEC

is a listing of seconds for us in templates and arrays. The value 51 was repeated twice and no 52 was listed.

12.5.2 Download.pm
The JSON portion of Download.pm has been overhauled to allow some restful GET requests. This allows for easier integration into languages that make it difficult to make POST requests.

12.6 DPS

12.6.1 DPS/Display/TimeGraph.pm
Due to bad/null result in Raw/Compress file TimeGraph.pm was not handling NaN situations gracefully. I haven't identified which in-built perl module was causing the string 'NaN' to be returned as a value but this is apparently somewhat common with perl math and a test was added to check for this. In the method update() a check is done for invalid values and an additional check for NaN as a string has been added.

In method update():

```
if($val eq "NaN") {

  return;

}

if($val eq "nan") {
```

```
  return;
}
```

12.6.2 Utils/monitor.pl

The rebuilt SCS Monitor PC was not allowing the creation of TK graphs. When calling create display a blank screen would show. The bug was tracked down to needing an environment variable set for the path to the DPS utils directory.

DPSBINPATH=U:/DPS/dps/utils/

12.7 Eventlog

12.7.1 Database Restoration

The eventlog history had been overwritten by a correction to the database. During JR271 while correcting cols field in the eventlog table an UPDATE command must have been used without a WHERE or LIMIT clause as all logs prior to JR271 lognum=327 were all set to the same value.

seatex-gga:seatex-gga-lat:Lat,seatex-gga:seatex-gga-lon:Lon,ea600:ea600-depth:Depth (m),oceanlogger:oceanlogger-sstemp:Sea Surface Temp,oceanlogger:oceanlogger-salinity:Salinity,Built In:String:Max Depth,Built In:String:Fate

Pete Lens restored the raw MySQL data directory from around this time and the appropriate data was extracted and restored.

The only remaining data that needs verification is lognum 326 and 327 as they are currently the same value but might need to be different. This can be checked against the cruise report in the future.

12.7.2 Archive Script

Currently the eventlog is backed up using the standard ship backup facilities but this doesn't link the eventlog backup/checkpoint against the cruise directory for storage in cambridge. For the ease of backup and for the ability for the eventlog data to be included as part of a leg/cruise checkpoint a new script has been written and placed in the Evenlog utils directory. The script is named archive.pl.

This script generates a mysqldump of eventlog once a day and places it in /data/cruise/jcr/current/web/eventlog/. If the backup has changed from day-to-day then it is not saved to disk. This means that there will be a backup copy of eventlog data for every day that the data may have changed. This also allows for more easy restoration of data in the case of a simple accidental mistake while managing the database during the cruise.

See /data/web/webapps/eventlog/current/utils/Archive.pl for more about the script.

The script requires one parameter, the eventlog database XML config file.

12.8 JCR SCS Monitoring Development

12.8.1 JCR SCS Development VM

To aid in the development of software for the JCR a virtual machine was created that runs a copy of the JCR web software.

The packages installed are:

- SCS
    - raw2compress
    - command line utilites
    - apache web app /scs/
- DPS
- JCR Intranet
- Eventlog / Bridgelog / Noonpos
- XBT / SVP
- Perl – matched to ship version
- PHP / MySQL

The development VM also matches the /data/ structure of the JCR network. This includes /data/cruise, /data/web/, /data/web/webapps, /packages/*

This allows the testing of code and changes to the system without breaking anything.

12.8.2 Integrated Portal

A trial of a system that provides basic access to ship information was undertaken on this cruise. The portal brings together SCS, eventlog and mapping information to provide in cabin access to position and instrumentation.

The portal was demoed with four top level sections:

- Current Status – Details on cruise: latest map, most recent events, current ship travel target
- SCS Status & Graphs – An HTML5 replication of the perl DPS monitoring utilities for the SCS. This allows access to live SCS graphs from any HTML5 enabled device such as PCs, tablets and phones.
- Interactive Cruise Map – A real-time plot of the ship's track using data from the Antarctic Digital Database, South Georgia GIS, Polar Data Centre, Arctic Portal, and Digital Earth mapping.
- Eventlog – A read-only version of the eventlog system so those without logins can view the ships status.

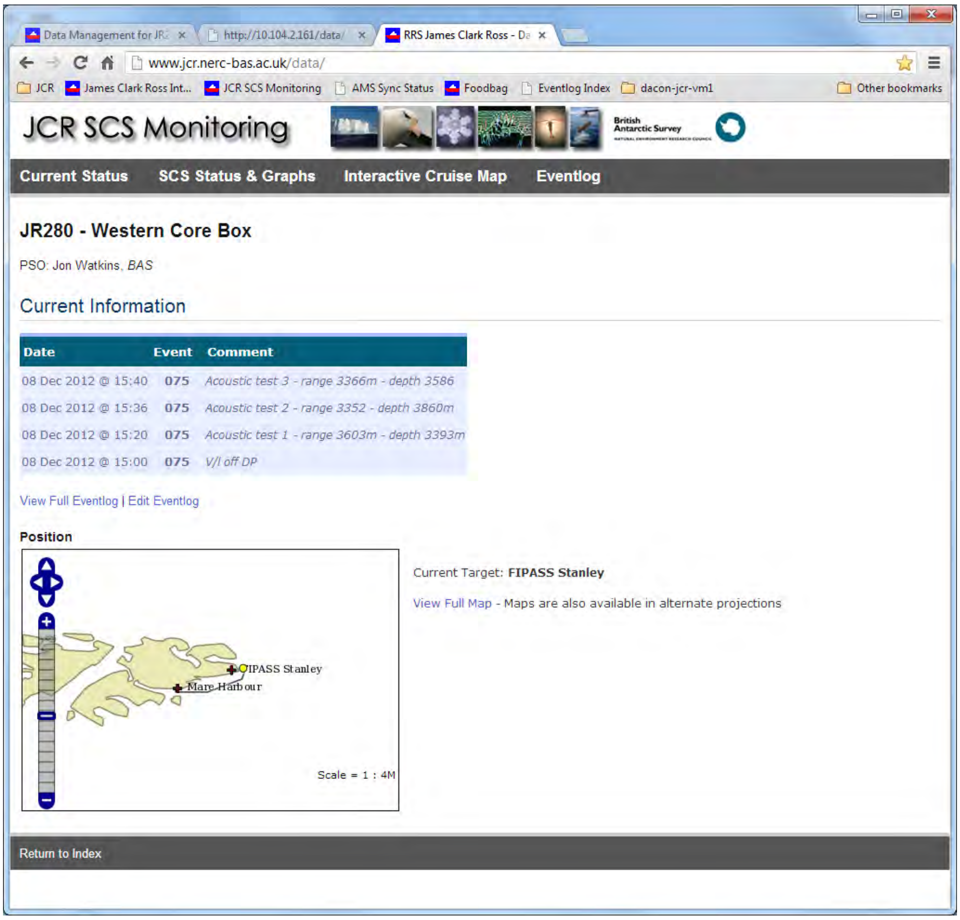


Figure 29 - JCR Data monitoring portal home page

12.8.3 SCS Status Graphs

The SCS Status Graphs were first tested on JR245. The JR245 data cruise report has details about the javascript functionality of the system. On this cruise the only modifications were integrating it into the code for a wider data portal. This allows it to share functions and configuration with the eventlog and mapping display.

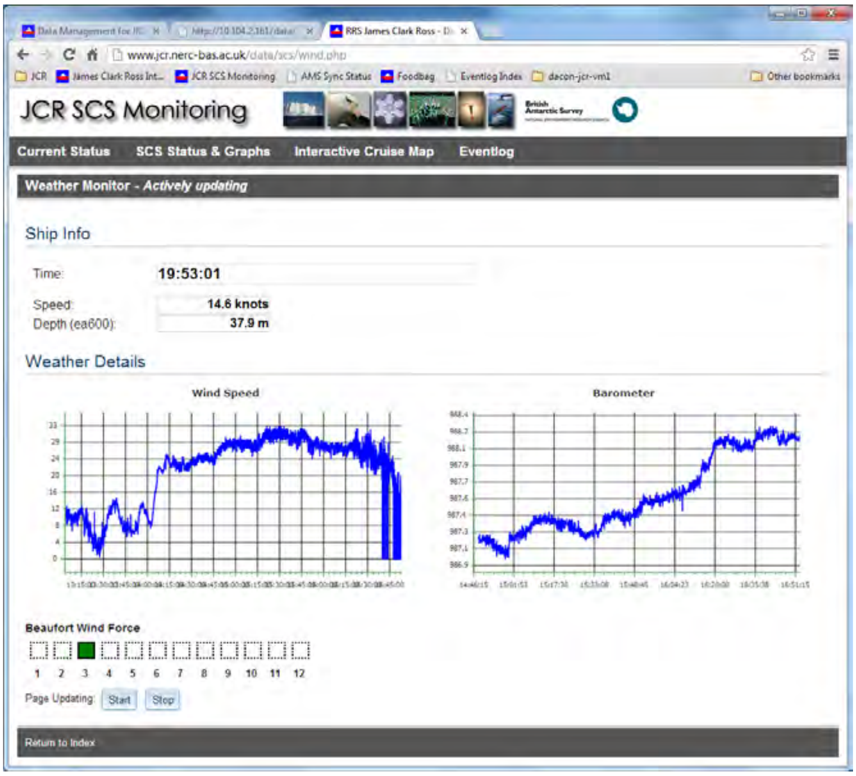


Figure 30 - Weather display panels

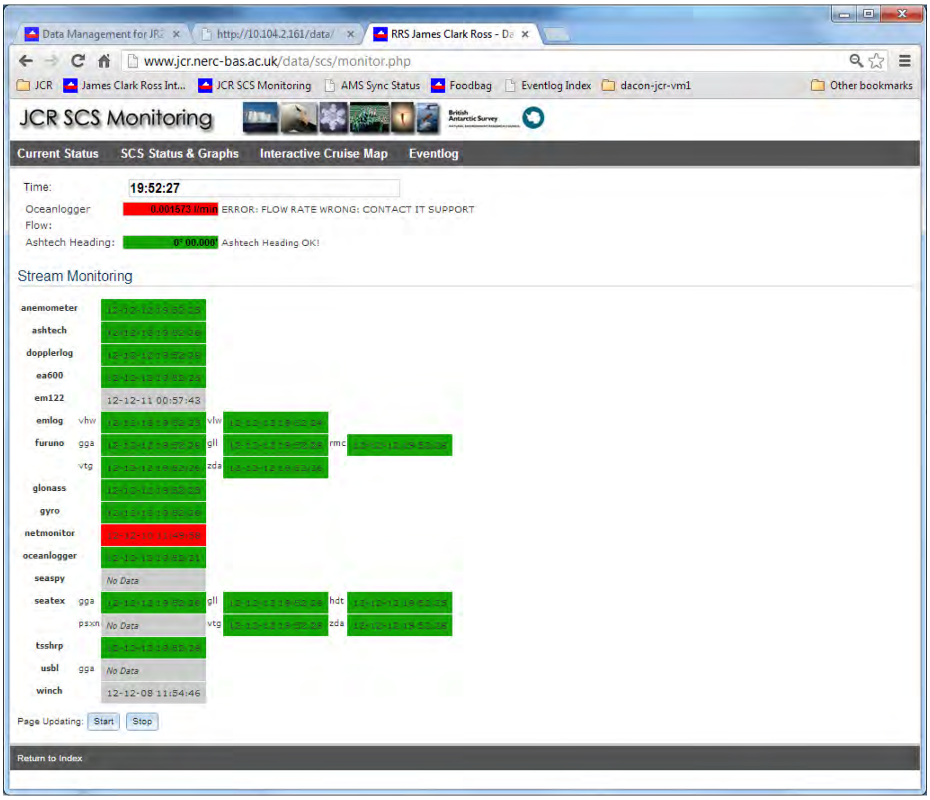


Figure 31 - SCS status display

Tweaks were made to the LineChart widget to allow the use of fixed access plots. A CTD/winch page was made which allows you to see the status of the winching system. Interest has been expressed from the crew to display these plots from cabins and waiting areas to allow them to see when to return.

The display pages have been tested on various PC, Andorid and iOS devices and they work well.

12.8.4 Mapping Application

A simple mapping page was setup to display the ships track during the cruise. The system is based on OpenGeoSuite and uses Geoserver as a backend. Information is read directly from the SCS using the web api and a postgres database caches the points and lines.

Background imagery and data is provided from:

- Antarctic Digital Database
- South Georgia GIS
- Arctic Portal
- Polar Data Centre
- Digital Earth (digitalearth.org)

The system allows you to view the map in a variety of projections depending on the most appropriate operating area.

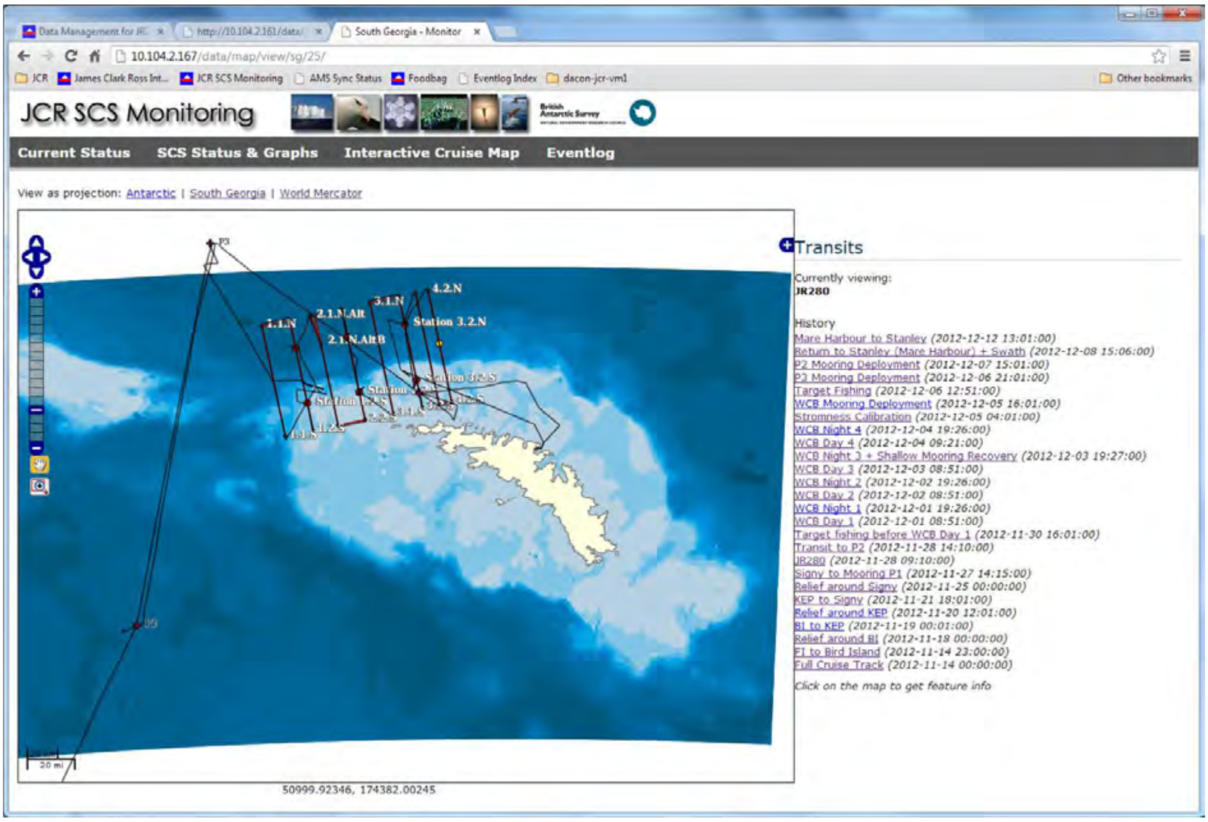


Figure 32 - Mapping display of Western Core Box in South Georgia Lambert Conformic projection (EPSG:19854)

Using the built-in functionality of geoserver a small table was made to split the cruise up into legs. These legs allow you to view portions of the cruise history.

Waypoints and interesting features were added using geoservers built in support for PostGIS and ArcGIS.

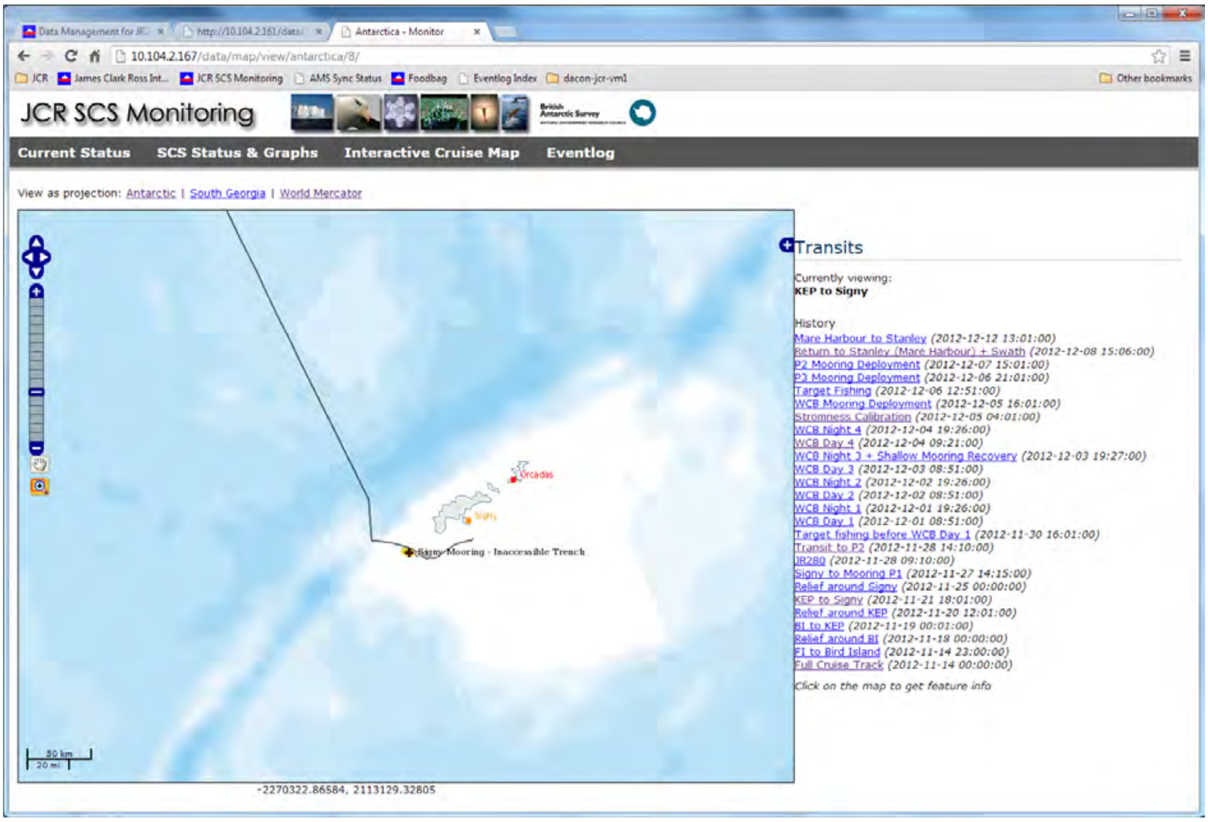


Figure 33 - Signy relief in Antarctic Polar Stereographic

The use of geoserver means that for any technically competent computer manager or data manger , cruise specific details can be added such as waypoints, stations, proposed cruise tracks, or any kind of geographical layer supported by Geoserver.

12.8.5 Recommendations

There is potential in developing this code into a full cruise information system. The work would tie in with work the PDC is doing to prepare the onboard eventlog system to match the system used by BODC.

The potential uses for an easy-to-access resource for cruise information range from allowing easier information dissemination to team members to simply provide access to display information from cabins and common areas.

The system used on this cruise has been very simple and not much work has gone in to developing the features as it was just meant to be a proof of concept. A proper system should be designed in conjunction with ICT, PDC and MAGIC and allow for a flexible system that will cope with many cruises.

I'd also recommend that in setting up a permenant mapping server that we split off the web serving functions from JRLB and make a dedicated web server for the ship. The SCS web software only needs access to the Compress stream of SCS data system and moving the web functions off would allow JRLB to only have to deal with data collection and distrubtion through NFS links.

12.8.6 Development VMs

Copies of the development virtual machines have been left under: /data/web/webapps/scs-monitor/dev-vm/

- [CentOS 64-bit - Yum Repo Mirror - Downloaded] - This is a plain CentOS 6.3 installation with the OpenGeoSuite repo set-up locally and downloaded.
- [CentOS 64-bit - Yum Repo Mirror - Installed] - This is the above VM after running the OpenGeo installation package
- [JCR Map Server VM] - This is the final copy of the Map Server VM before the end of the cruise. It has the cruise track, events, waypoints and transit legs of JR280 loaded.
- [JCR SCS Dev VM] – Development installation of many jrlb functions.

Access, password and download information is available on the JCR Wiki or BAS Redmine project.

Appendix A: CTD Log

Time	Event No	Lat	Lon	Depth	Cable Out	Bottle	Pressure (CTD)	Temp (CTD)	Salinity (CTD)	Action	Comment	User
28/11/2012 09:34	1	-60.5552	-46.53771	715.81	-3		-0.86			CTD in Water	Data acquisition was not enabled. No data was collected on this CTD apart from the screenshots of the seabird software. This screenshots are included in the CTD data directory.	pstar
28/11/2012 09:49	1	-60.55852	-46.53767	583.68	556					CTD at bottom	altimeter: 20m	pstar
28/11/2012 10:04	1	-60.5552	-46.53771	715.81	-3		-0.86			CTD back on deck	All bottles were fired.	pstar
28/11/2012 12:53	3	-60.58397	-46.50086	774.3	-1		-0.87			CTD at surface		dacon
28/11/2012 12:53	3	-60.58397	-46.50086	774.3	-1		737.2			CTD at bottom		dacon
28/11/2012 12:53	3	-60.58397	-46.50086	774.3	-1		-0.86			CTD in water		dacon
28/11/2012 13:25	3	-60.58299	-46.50745	11.9	10	1	12.1	-1.61	33.88	Bottle fired	Bottle test	dacon
28/11/2012 13:26	3	-60.58304	-46.50755		10	2				Bottle fired		dacon
28/11/2012 13:26	3	-60.58312	-46.50769		10	3				Bottle fired		dacon
28/11/2012 13:26	3	-60.58317	-46.50778		10	4				Bottle fired		dacon
28/11/2012 13:27	3	-60.58327	-46.50795		10	5				Bottle fired		dacon
28/11/2012 13:27	3	-60.58334	-46.50805		10	6				Bottle fired		dacon
28/11/2012 13:27	3	-60.58337	-46.5081		10	7				Bottle fired		dacon
28/11/2012 13:27	3	-60.58338	-46.50812		10	8				Bottle fired		dacon
28/11/2012 13:27	3	-60.58341	-46.50815		10	9				Bottle fired		dacon
29/11/2012 23:01	5	-55.20593	-41.10434	3170.45	0		-0.8			CTD in water		dacon
29/11/2012 23:29	5	-53.7298	-48.52873	4718.39	5		1541.91			CTD at bottom		dacon
29/11/2012 23:56	5	-55.20597	-41.10439	3170.33	44		-0.79			CTD at surface		dacon
30/11/2012 16:01	7	-52.80759	-40.12204	3787.9	-6		0.41			CTD in water		dacon
30/11/2012 16:30	7	-	-	3787.6	1459		1522.31			CTD at		dacon

		52.80762	40.12209							bottom		
30/11/2012 16:32	7	-52.8076	-40.12209	150.3	1500	1	1522	1.17	34.69	Bottle fired	Tests for SBE35	dacon
30/11/2012 16:32	7	-52.8076	-40.12207	150.3	1500	2	1522	1.17	34.69	Bottle fired		dacon
30/11/2012 16:58	7	-52.80763	-40.12212	20.15	16	3	20.01	2.28	33.8	Bottle fired		dacon
30/11/2012 16:58	7	-52.80763	-40.12213	20.15	16	4	20.01	2.28	33.8	Bottle fired		dacon
30/11/2012 16:59	7	-52.80762	-40.1221	3790.68	9		-0.62			CTD at surface		dacon
01/12/2012 20:27	21	-53.8462	-39.14393	291.4	-5					CTD in water		dacon
01/12/2012 20:36	21	-53.84616	-39.14392	290.63	270		278.38			CTD at bottom		dacon
01/12/2012 20:40	21	-53.84617	-39.14392		200	1				Bottle fired	200m	dacon
01/12/2012 20:40	21	-53.84616	-39.14392		200	2				Bottle fired	200m	dacon
01/12/2012 20:44	21	-53.84615	-39.1439	101.7	100	3	102.6	1.06	33.94	Bottle fired	100m	dacon
01/12/2012 20:44	21	-53.84615	-39.14387	101.7	100	4	102.6	1.06	33.94	Bottle fired	100m	dacon
01/12/2012 20:46	21	-53.84616	-39.14391	51.3	50	5	52.02	1.68	33.85	Bottle fired	50m	dacon
01/12/2012 20:47	21	-53.84614	-39.1439	51.3	50	6	52.02	1.68	33.85	Bottle fired	50m	dacon
01/12/2012 20:49	21	-53.84615	-39.14391	26.6	25	7	27.12	1.79	33.853	Bottle fired	25m	dacon
01/12/2012 20:50	21	-53.84615	-39.14388	26.6	25	8	27.12	1.79	33.853	Bottle fired	25m	dacon
01/12/2012 20:52	21	-53.84615	-39.14391	10.7	9	9	10.9	1.92	33.854	Bottle fired	10m	dacon
01/12/2012 20:54	21	-53.84617	-39.14392	10.25	8	10	10.16	1.92	33.854	Bottle fired	10m	dacon
01/12/2012 20:55	21	-53.84615	-39.14391	2.4	1	11	2.15	1.92	33.85	Bottle fired	surface	dacon
01/12/2012 20:56	21	-53.84615	-39.1439		1	12				Bottle fired	surface	dacon
01/12/2012 20:56	21	-53.84615	-39.14389	290.86	1					CTD at surface		dacon
02/12/2012 05:22	25	-53.49308	-39.25072	3148.61	-3					CTD in water		dacon
02/12/2012 05:44	25	-53.49315	-39.251	3148.87	984		1012.5			CTD at bottom		dacon
02/12/2012 06:00	25	-53.4931	-39.25103	202	200	1	204	1.46	34.22	Bottle fired	200m	dacon

02/12/2012 06:01	25	-53.49309	-39.25104	202	200	2	204	1.46	34.22	Bottle fired	200m	dacon
02/12/2012 06:04	25	-53.4931	-39.25101	100	98	3	101	0.76	33.94	Bottle fired	100m	dacon
02/12/2012 06:04	25	-53.49311	-39.25102	100	98	4	101	0.76	33.94	Bottle fired	100m	dacon
02/12/2012 06:07	25	-53.49311	-39.25102	50.6	48	5	51.5	1.47	33.89	Bottle fired	50m	dacon
02/12/2012 06:07	25	-53.4931	-39.251	50.6	48	6	51.5	1.47	33.89	Bottle fired	50m	dacon
02/12/2012 06:09	25	-53.4931	-39.251	26	23	7	25.8	1.71	33.89	Bottle fired	25m	dacon
02/12/2012 06:10	25	-53.49309	-39.25099	26	23	8	25.8	1.71	33.89	Bottle fired	25m	dacon
02/12/2012 06:12	25	-53.49309	-39.25101	10.7	8	9	11.2	1.73	33.89	Bottle fired	10m	dacon
02/12/2012 06:13	25	-53.4931	-39.25098	10.7	8	10	11.2	1.73	33.89	Bottle fired	10m	dacon
02/12/2012 06:15	25	-53.49309	-39.25098	1.4	-1	11	1.3	1.74	33.89	Bottle fired	surface	dacon
02/12/2012 06:15	25	-53.49308	-39.25098	1.4	-1	12	1.3	1.74	33.89	Bottle fired	surface	dacon
02/12/2012 06:17	25	-53.49309	-39.251	3148.91	-4					CTD at surface		dacon
02/12/2012 20:34	33	-53.43202	-38.69571	3497.27	-3					CTD in water		dacon
02/12/2012 20:55	33	-53.43204	-38.69583	3497.22	981		1010.5			CTD at bottom		dacon
02/12/2012 20:56	33	-53.43205	-38.69594	999.1	1000	1	1010.5	1.54	34.67	Bottle fired	1000m	dacon
02/12/2012 20:57	33	-53.43204	-38.69598	999.1	1000	2	1010.5	1.54	34.67	Bottle fired	1000m	dacon
02/12/2012 21:07	33	-53.43205	-38.69664	501	501	3	506.4	1.9	34.57	Bottle fired	500m	dacon
02/12/2012 21:07	33	-53.43205	-38.6967	501	501	4	506.4	1.9	34.57	Bottle fired	500m	dacon
02/12/2012 21:13	33	-53.43206	-38.69739	201.4	200	5	203.4	1.87	34.36	Bottle fired	200m	dacon
02/12/2012 21:14	33	-53.43206	-38.69745	201.4	200	6	203.4	1.87	34.36	Bottle fired	200m	dacon
02/12/2012 21:17	33	-53.43205	-38.69771	101.7	100	7	102.7	0.49	33.98	Bottle fired	100m	dacon
02/12/2012 21:17	33	-53.43205	-38.69775	101.7	100	8	102.7	0.49	33.98	Bottle fired	100m	dacon
02/12/2012 21:19	33	-53.43205	-38.69792	51.4	50	9	51.9	0.96	33.93	Bottle fired	50m	dacon
02/12/2012 21:20	33	-53.43205	-38.69799	51.4	50	10	51.9	0.96	33.93	Bottle fired	50m	dacon

02/12/2012 21:22	33	-53.43205	-38.69822	25.3	23	11	25.7	1.56	33.88	Bottle fired	25m	dacon
02/12/2012 21:23	33	-53.43205	-38.6983	25.3	23	12	25.7	1.56	33.88	Bottle fired	25m	dacon
02/12/2012 21:24	33	-53.43206	-38.69845	1.58	0	13	2.3	1.57	33.88	Bottle fired	surface	dacon
02/12/2012 21:25	33	-53.43205	-38.69849	1.58	0	14	2.3	1.57	33.88	Bottle fired	surface	dacon
02/12/2012 21:25	33	-53.43205	-38.69853	3499.88	-1					CTD at surface		dacon
03/12/2012 05:56	37	-53.7851	-38.58416	207.4	-4					CTD in water		dacon
03/12/2012 06:05	37	-53.78507	-38.58416	208.41	195		198			CTD at bottom		dacon
03/12/2012 06:06	37	-53.78507	-38.58415	196.5	195	1	198	1.22	34.18	Bottle fired	200m	dacon
03/12/2012 06:06	37	-53.78506	-38.58417	196.5	195	2	198	1.22	34.18	Bottle fired	200m	dacon
03/12/2012 06:09	37	-53.78506	-38.58416	101.9	100	3	102.5	0.71	33.99	Bottle fired	100m	dacon
03/12/2012 06:09	37	-53.78506	-38.58417	101.9	100	4	102.5	0.71	33.99	Bottle fired	100m	dacon
03/12/2012 06:11	37	-53.78506	-38.58416	51.9	50	5	52.9	1.15	33.89	Bottle fired	50m	dacon
03/12/2012 06:12	37	-53.78506	-38.58417	51.9	50	6	52.9	1.15	33.89	Bottle fired	50m	dacon
03/12/2012 06:14	37	-53.78506	-38.58416	27.1	25	7	27.4	1.81	33.87	Bottle fired	25m	dacon
03/12/2012 06:14	37	-53.78507	-38.58417	27.1	25	8	27.4	1.81	33.87	Bottle fired	25m	dacon
03/12/2012 06:15	37	-53.78505	-38.58418	12.2	10	9	11.9	1.87	33.87	Bottle fired	10m	dacon
03/12/2012 06:16	37	-53.78506	-38.58418	12.2	10	10	11.9	1.87	33.87	Bottle fired	10m	dacon
03/12/2012 06:18	37	-53.78506	-38.58416	2.4	0	11	2.3	1.87	33.87	Bottle fired	surface	dacon
03/12/2012 06:19	37	-53.78506	-38.58416	2.4	0	12	2.3	1.87	33.87	Bottle fired	surface	dacon
03/12/2012 06:20	37	-53.78505	-38.58418	208.26	-4					CTD at surface		dacon
03/12/2012 21:56	46	-53.79519	-37.94034	315.31	5					CTD in water		dacon
03/12/2012 22:06	46	-53.79516	-37.94035	315.08	300		303.36			CTD at bottom		dacon
03/12/2012 22:10	46	-53.79516	-37.94035		200	1				Bottle fired		dacon
03/12/2012 22:10	46	-53.79515	-37.94036		200	2				Bottle fired		dacon

03/12/2012 22:13	46	-53.79516	-37.94037		100	3				Bottle fired		dacon
03/12/2012 22:14	46	-53.79516	-37.94038		100	4				Bottle fired		dacon
03/12/2012 22:16	46	-53.79517	-37.94036	317.12	-3					CTD at surface		dacon
03/12/2012 23:09	47	-53.7142	-37.96598	133.88	-3					CTD in water		dacon
03/12/2012 23:15	47	-53.7142	-37.96595	134.81	84					CTD at bottom		dacon
03/12/2012 23:16	47	-53.7142	-37.96598	126.3	125	1	126.5	0.8	34.035	Bottle fired	125m	dacon
03/12/2012 23:17	47	-53.71421	-37.96599	126.3	125	2	126.5	0.8	34.035	Bottle fired	125m	dacon
03/12/2012 23:18	47	-53.71422	-37.96599	101.9	100	3	102.7	0.76	34.01	Bottle fired	100m	dacon
03/12/2012 23:19	47	-53.71422	-37.96598	101.9	100	4	102.7	0.76	34.01	Bottle fired	100m	dacon
03/12/2012 23:21	47	-53.71421	-37.96596	52.25	50	5	51.4	1.15	33.89	Bottle fired	50m	dacon
03/12/2012 23:22	47	-53.71421	-37.96598	52.25	50	6	51.4	1.15	33.89	Bottle fired	50m	dacon
03/12/2012 23:23	47	-53.71421	-37.96599	26.4	25	7	26.6	1.81	33.85	Bottle fired	25m	dacon
03/12/2012 23:23	47	-53.71421	-37.96598	26.4	25	8	26.6	1.81	33.85	Bottle fired	25m	dacon
03/12/2012 23:25	47	-53.71421	-37.96598	11.8	10	9	11.6	1.93	33.85	Bottle fired	10m	dacon
03/12/2012 23:25	47	-53.71421	-37.96598	11.8	10	10	11.6	1.93	33.85	Bottle fired	10m	dacon
03/12/2012 23:26	47	-53.71422	-37.96598	1.5	0	11	1.5	1.95	33.85	Bottle fired	surface	dacon
03/12/2012 23:27	47	-53.71422	-37.96599	1.5	0	12	1.5	1.95	33.85	Bottle fired	surface	dacon
03/12/2012 23:28	47	-53.71422	-37.96598	135.08	-5					CTD at surface		dacon
04/12/2012 07:05	50	-53.35955	-38.08425	2657.21	-5					CTD in water		dacon
04/12/2012 07:27	50	-53.35955	-38.08424	2657.42	986		1006.6			CTD at bottom		dacon
04/12/2012 07:28	50	-53.35955	-38.08426	995	1000	1	1006.6	1.73	34.69	Bottle fired	1000m	dacon
04/12/2012 07:29	50	-53.35954	-38.08425	995	1000	2	1006.6	1.73	34.69	Bottle fired	1000m	dacon
04/12/2012 07:39	50	-53.35951	-38.08425	499.2	500	3	503.1	2.2	34.61	Bottle fired	500m	dacon
04/12/2012 07:39	50	-53.35954	-38.08426	499.2	500	4	503.1	2.2	34.61	Bottle fired	500m	dacon

04/12/2012 07:46	50	-53.35952	-38.08423	200	200	5	201.7	1.85	34.3	Bottle fired	200m	dacon
04/12/2012 07:46	50	-53.35952	-38.08423	200	200	6	201.7	1.85	34.3	Bottle fired	200m	dacon
04/12/2012 07:49	50	-53.35952	-38.08427	102.5	100	7	103.6	0.65	33.95	Bottle fired	100m	dacon
04/12/2012 07:49	50	-53.35951	-38.08428	102.5	100	8	103.6	0.65	33.95	Bottle fired	100m	dacon
04/12/2012 07:51	50	-53.35949	-38.08423	52.8	50	9	53.2	1.22	33.92	Bottle fired	50m	dacon
04/12/2012 07:52	50	-53.3595	-38.08424	52.8	50	10	53.2	1.22	33.92	Bottle fired	50m	dacon
04/12/2012 07:54	50	-53.35948	-38.08421	28.2	25	11	28.4	1.64	33.88	Bottle fired	25m	dacon
04/12/2012 07:55	50	-53.35951	-38.08424	28.2	25	12	28.4	1.64	33.88	Bottle fired	25m	dacon
04/12/2012 07:58	50	-53.35947	-38.08438	2657.14	-3					CTD at surface		dacon
05/12/2012 02:20	67	-53.66658	-38.08686	158.58	-6					CTD in water		dacon
05/12/2012 02:27	67	-53.66657	-38.08686	158.48	139		154.2			CTD at bottom		dacon
05/12/2012 02:28	67	-53.66656	-38.08684	152.1	150	1	154.2	0.89	34.07	Bottle fired	150m	dacon
05/12/2012 02:28	67	-53.66657	-38.08685	152.1	150	2	154.2	0.89	34.07	Bottle fired	150m	dacon
05/12/2012 02:30	67	-53.66658	-38.08688	102.5	100	3	103.6	0.77	34.01	Bottle fired	100m	dacon
05/12/2012 02:31	67	-53.66657	-38.08686	102.5	100	4	103.6	0.77	34.01	Bottle fired	100m	dacon
05/12/2012 02:32	67	-53.66657	-38.08688	78.5	75	5	78.2	0.75	33.95	Bottle fired	75m	dacon
05/12/2012 02:33	67	-53.66658	-38.08688	78.5	75	6	78.2	0.75	33.95	Bottle fired	75m	dacon
05/12/2012 02:34	67	-53.66657	-38.08687	52.9	50	7	54.1	1.4	33.87	Bottle fired	50m	dacon
05/12/2012 02:35	67	-53.66657	-38.08687	52.9	50	8	54.1	1.4	33.87	Bottle fired	50m	dacon
05/12/2012 02:36	67	-53.66657	-38.08687	28.1	25	9	28.3	1.89	33.84	Bottle fired	25m	dacon
05/12/2012 02:36	67	-53.66657	-38.08686	28.1	25	10	28.3	1.89	33.84	Bottle fired	25m	dacon
05/12/2012 02:38	67	-53.66656	-38.08685	4.5	2	11	4.6	1.93	33.84	Bottle fired	surface	dacon
05/12/2012 02:39	67	-53.66658	-38.08686	4.5	2	12	4.6	1.93	33.84	Bottle fired	surface	dacon
05/12/2012 02:40	67	-53.66656	-38.08686	158.67	-4					CTD at surface		dacon

05/12/2012 11:28	68	-54.15885	-36.69611	77.57	-1		-0.9			CTD in water		dacon
05/12/2012 11:35	68	-54.15884	-36.69648	75.26	50		50.85			CTD at bottom		dacon
05/12/2012 11:38	68	-54.15885	-36.69648	74.5	-2		-0.875			CTD at surface		dacon
06/12/2012 12:16	70	-53.79786	-37.94186	317.72	6		-0.82			CTD in water		dacon
06/12/2012 12:32	70	-53.79781	-37.94381	319.78	290		294.82			CTD at bottom		dacon
06/12/2012 12:39	70	-53.79779	-37.9438	320.19	-2		-0.85			CTD at surface		dacon
07/12/2012 11:12	73	-52.80908	-40.04988	3803.04	-1					CTD in water		dacon
07/12/2012 12:19	73	-52.80903	-40.04987	3797.2	3729		3806			CTD at bottom		dacon
07/12/2012 13:23	73	-52.80906	-40.04982	3803.2	-2					CTD at surface		dacon
08/12/2012 10:37	74	-55.20244	-41.05676	3185.71	-7		-0.97			CTD in water		dacon
08/12/2012 11:17	74	-55.20249	-41.04385	3197.61	2000		2022.03			CTD at bottom		dacon
08/12/2012 11:52	74	-55.20218	-41.03342	3182.56	-4		-0.98			CTD at surface		dacon

Appendix B: XBT Log

Time	Lat	Lon	Depth	Event No.	Station	File	Comment	User
04/12/2012 19:17	-53.15835	-37.82905	3351.87	64	4.2 XBT #5	T5_00031.EDF		dacon
04/12/2012 18:16	-53.32047	-37.77207	3007.09	63	4.2 XBT #4	T5_00030.EDF		dacon
04/12/2012 17:07	-53.49522	-37.71444	1912.69	62	4.2 XBT #3	T5_00029.EDF		dacon
04/12/2012 15:57	-53.67648	-37.65295	122.05	61	4.2 XBT #2	T5_00028.EDF		dacon
04/12/2012 14:49	-53.85306	-37.59368	114.06	59	4.2 XBT #1	T5_00027.EDF		dacon
04/12/2012 14:08	-53.87013	-37.72793	116.43	58	4.1 XBT #5	T5_00026.EDF		dacon
04/12/2012 13:02	-53.69438	-37.78644	112.77	57	4.1 XBT #4	T5_00025.EDF		dacon
04/12/2012 11:54	-53.51729	-37.84634	1361.79	56	4.1 XBT #3	T5_00024.EDF		dacon
04/12/2012 10:47	-53.34549	-37.90374	3473.37	55	4.1 XBT #2	T5_00022.EDF		dacon
04/12/2012 10:44	-53.3405	-37.90551	0	54	4.1 XBT #2	None	The XBT launched but the computer did not register that it had fired. It was a dud.	dacon
04/12/2012 09:36	-53.17395	-37.96093	3644.35	53	4.1 XBT #1	T5_00019.EDF	2nd XBT for this station.	dacon
04/12/2012 09:30	-53.16585	-37.96351	0	52	4.1 XBT #1	T5_00018.EDF	The profile showed a very warm spot at around 200-300m and it was decided to do a second XBT at this spot.	dacon
03/12/2012 13:36	-53.22068	-38.44904	3771.83	43	3.1 XBT #5	T5_00017.EDF		pstar
03/12/2012 12:25	-53.39637	-38.39175	2921.33	42	3.1 XBT #4	T5_00016.EDF		pstar
03/12/2012 11:15	-53.57336	-38.33507	2044.12	41	3.1 XBT #3	T5_00015.EDF		pstar
03/12/2012 10:07	-53.7495	-38.27674	219.11	40	3.1 XBT #2	T5_00014.EDF		pstar
03/12/2012 09:00	-53.9263	-38.22065	104.82	39	3.1 XBT #1	T5_00013.EDF		pstar
02/12/2012 13:40	-53.99448	-38.81825	197.49	31	2.1 XBT #5	T5_00012.EDF		pstar
02/12/2012 12:32	-53.8184	-38.87366	216.95	30	2.1 XBT #4	T5_00011.EDF		pstar
02/12/2012 11:20	-53.6417	-38.93064	3511.44	29	2.1 XBT #3	T5_00010.EDF		pstar
02/12/2012 10:11	-53.46491	-38.9834	2998.39	28	2.1 XBT #2	T5_00009.EDF		pstar
02/12/2012 09:00	-53.29351	-39.08447	3692.58	27	2.1 XBT #1	T5_00008.EDF		pstar
01/12/2012 13:39	-53.34672	-39.60256	0	19	1.1 XBT #5	T5_00007.EDF		pstar
01/12/2012 12:34	-53.5152	-39.55282	2727.52	18	1.1 XBT #4	T5_00006.EDF		pstar
01/12/2012 11:25	-53.69145	-39.5002	1938.54	17	1.1 XBT #3	T5_00005.EDF		pstar
01/12/2012 10:14	-53.87289	-39.44643	614.21	16	1.1 XBT #2	T5_00004.EDF		pstar
01/12/2012 09:09	-54.04114	-39.39617	433.64	15	1.1 XBT #1	T5_00003.EDF	2nd attempt at station. XBT fine.	pstar
01/12/2012 09:03	-54.05052	-39.39334	0	14	1.1 XBT #1	T5_00002.EDF	XBT gave erratic data from immediate deployment.	

Appendix C: EK60 Events Log

Time	Latitude	Longitude	Water Depth	Heading	Speed	Event	Comment	User
15/11/2012 12:24	-52.22718	-52.234	2477.54	101.48	11		Ek60 switched on to logging	ek60
17/11/2012 13:34	-54.01816	-38.05403	57.19	219.73	0.6		EK60 turned off logging during BI relief	ek60
21/11/2012 19:43	-54.12276	-36.46824	131.13	335.65	12.9		EK60 set logging on internal trigger opportunistic swath on, weather crummy	ek60
25/11/2012 11:17	-60.70239	-45.58104	32.09	303.08	0.3		Ek60 stopped logging during Signy relief	ek60
27/11/2012 19:07	-60.82692	-45.62795	316.42	265.19	6.1		Ek60 resumed logging. Opportunistic swath so EK60 on internal trigger	ek60
30/11/2012 12:23	-53.10456	-40.22738	3959.97	13.5	12.3		Changed speed of sound to local water (t = 3, S = 33.8) 1465	ek60
01/12/2012 09:01	-54.05465	-39.39203	427.09	347.45	5.5	Start of WCB1.1		ek60
01/12/2012 13:44	-53.33893	-39.60485	0	345.26	6.2	End of WCB1.1		ek60
01/12/2012 14:57	-53.31618	-39.30389	0	171.12	10.2	Start of WCB1.2		ek60
01/12/2012 19:17	-54.02292	-39.08926	216.38	170.04	10.2	End of WCB1.2		ek60
02/12/2012 09:00	-53.29214	-39.08494	3703.27	166.78	5.6	Start of WCB2.1		ek60
02/12/2012 13:46	-54.00339	-38.81385	0	84.25	7.1	End of WCB2.1		ek60
02/12/2012 14:54	-53.95957	-38.5274	152.26	347.75	10.1	Start of WCB2.2		ek60
02/12/2012 19:17	-53.25566	-38.75076	3800.3	351.29	10	End of WCB2.2		ek60
03/12/2012 09:00	-53.92667	-38.22052	105.6	351.05	6.1	Start of WCB3.1		ek60
03/12/2012	-	-38.45233	3772.96	350.75	5.9	End of		ek60

13:43	53.21073					WCB3.1		
03/12/2012 15:00	- 53.18601	-38.13892	3719.25	172.59	11	Start of WCB3.2		ek60
03/12/2012 19:19	- 53.88966	-37.90682	147.48	168.63	9.9	End of WCB3.2		ek60
04/12/2012 09:30	-53.1641	-37.96433	0	167.25	6	Start of WCB4.1		ek60
04/12/2012 14:09	- 53.87095	-37.72752	116.17	167.68	6.2	End of WCB4.1		ek60
04/12/2012 14:49	- 53.85336	-37.59364	113.5	350.2	6.1	Start of WCB4.2		ek60
04/12/2012 19:24	- 53.14753	-37.83238	3007.87	344.84	6.2	End of WCB4.2		ek60

Appendix D: EM122 Events Log

Time	Lat	Lon	Depth	Swath Depth	Sea Surface Temp	Wind speed	Settings or Info	Comment	User
22/11/2012 14:55	-55.7346	-40.336	3153.11	2986.83	0.36	21.8		Swath turned on	dacon
24/11/2012 16:00	-60.57	-46.4524	146.17	138.25	-1.87	15.5		Swath turned off	dacon
28/11/2012 18:33	-59.7501	-45.8477	2990.33	2946.99	-0.09	4.6	Swath logging on	JR280_a folder	ek60
29/11/2012 20:35	-55.216	-41.1198	3185.83	3110.22	0.76	7.5		Swath turned off	pstar
08/12/2012 19:21	-54.7773	-41.9179	0	3904.29	1.05	17.7	Swath logging on	JR280_a	ek60
09/12/2012 12:46	-53.8502	-46.6473	3593.04		3.28	27.2		Swath reboot to check on data quality.	bridge

Appendix E: RMT8 Events Log

Time	Latitude	Longitude	Wire Out	Net depth	Event	Action	Comment	User
30/11/2012 18:10	-52.93693	-40.05319	28	0.6	8	Net deployed	Test deployment	ek60
30/11/2012 18:14	-52.93702	-40.05915	67	0.6	8	Net 1 opened		ek60
30/11/2012 18:16	-52.93686	-40.06264	93	0.6	8	Net 1 closed		ek60
30/11/2012 18:17	-52.93685	-40.06349	93	0.6	8	Net 2 opened		ek60
30/11/2012 18:20	-52.93682	-40.06775	86	0.6	8	Net 2 closed		ek60
30/11/2012 18:26	-52.93667	-40.07673	-14	0.6	8	Net recovered		ek60
30/11/2012 18:41	-52.93689	-40.09867	-7	0.6	9	Net deployed	Test deployment	ek60
30/11/2012 18:44	-52.9371	-40.10333	51	0.6	9	Net 1 opened		ek60
30/11/2012 18:46	-52.9373	-40.1062	71	0.6	9	Net 1 closed		ek60
30/11/2012 18:47	-52.93733	-40.10766	73	0.6	9	Net 2 opened		ek60
30/11/2012 18:49	-52.93742	-40.11069	73	0.6	9	Net 2 closed		ek60
30/11/2012 18:55	-52.93788	-40.1199	-13	0.6	9	Net recovered		ek60
01/12/2012 02:18	-53.73479	-39.11734	-17	0.6	10	Net deployed		ek60
01/12/2012 02:25	-53.73291	-39.12767	80	0.6	10	Net 1 opened	Target haul	ek60
01/12/2012 02:35	-53.73016	-39.14096	74	0.6	10	Net 1 closed		ek60
01/12/2012 02:35	-53.73016	-39.14096	74	0.6	10	Net 2 opened		ek60

01/12/2012 02:45	-53.72717	-39.15339	47	0.6	10	Net 2 closed		ek60
01/12/2012 02:50	-53.72541	-39.15956	-8	0.6	10	Net recovered		ek60
01/12/2012 04:03	-53.75637	-38.98093	-15	0.6	11	Net deployed	Nets not opened target not found	ek60
01/12/2012 04:28	-53.75115	-39.01787	-25	0.6	11	Net recovered		ek60
01/12/2012 04:59	-53.75907	-38.97514	-15	0.6	12	Net deployed	Nets not opened. Target not found.	ek60
01/12/2012 05:30	-53.74852	-39.02091	-24	0.6	12	Net recovered		ek60
01/12/2012 21:11	-53.84592	-39.14683	-27	0	22	Net deployed	Oblique 0-200-0 W1.1	ek60
01/12/2012 21:16	-53.84557	-39.15352	26	0	22	Net 1 opened	20 m	ek60
01/12/2012 21:46	-53.84208	-39.19162	444	0	22	Net 1 closed	195 m	ek60
01/12/2012 21:46	-53.84202	-39.19214	447	0	22	Net 2 opened	203 m	ek60
01/12/2012 22:16	-53.83792	-39.22896	49	0	22	Net 2 closed	15 m	ek60
01/12/2012 22:22	-53.83716	-39.23654	-17	0	22	Net recovered		ek60
02/12/2012 00:14	-53.78955	-38.94498	-23	0.8	23	Net deployed	Target haul on 700 m target	ek60
02/12/2012 00:24	-53.78841	-38.95785	64	43.8	23	Net 1 opened		ek60
02/12/2012 00:27	-53.7879	-38.9613	56	30.4	23	Net 1 closed		ek60
02/12/2012 00:28	-53.78774	-38.96247	56	33.9	23	Net 2 opened		ek60
02/12/2012 00:36	-53.7863	-38.97332	-12	0.6	23	Net recovered		ek60
02/12/2012	-	-39.25739	484	195.3	24	Net deployed	Oblique 0-200-0	ek60

03:12	53.48992							
02/12/2012 03:14	-53.49981	-39.21684	17	11.8	24	Net 1 opened		ek60
02/12/2012 03:47	-53.48992	-39.25739	484	195.3	24	Net 1 closed		ek60
02/12/2012 03:48	-53.48958	-39.25868	500	203.1	24	Net 2 opened		ek60
02/12/2012 04:16	-53.48071	-39.29129	60	21	24	Net 2 closed		ek60
02/12/2012 04:19	-53.47969	-39.29487	7	2.2	24	Net recovered		ek60
02/12/2012 21:41	-53.42853	-38.69945	-13	0.6	34	Net deployed	Oblique 0-200-0	ek60
02/12/2012 21:44	-53.42586	-38.70026	32	24.7	34	Net 1 opened		ek60
02/12/2012 22:13	-53.40087	-38.70718	497	197.8	34	Net 1 closed		ek60
02/12/2012 22:14	-53.40004	-38.70747	499	202.1	34	Net 2 opened		ek60
02/12/2012 22:43	-53.37586	-38.71681	62	16.9	34	Net 2 closed		ek60
02/12/2012 22:46	-53.37327	-38.71803	-12	0.6	34	Net recovered		ek60
02/12/2012 23:42	-53.42751	-38.69819	98	76.6	35	Net deployed	Target fishing on 35-100 m	ek60
02/12/2012 23:49	-53.42751	-38.69819	98	76.6	35	Net 1 opened		ek60
02/12/2012 23:51	-53.42616	-38.69866	125	80.1	35	Net 1 closed		ek60
02/12/2012 23:52	-53.42549	-38.69895	134	83.3	35	Net 2 opened		ek60
02/12/2012 23:59	-53.42076	-38.70064	33	11	35	Net 2 closed		ek60
03/12/2012 00:01	-53.41939	-38.70104	-1	0.6	35	Net recovered		ek60

03/12/2012 03:50	-53.79616	-38.60471	-11	0.6	36	Net deployed	Oblique 0-200-0	ek60
03/12/2012 03:52	-53.79517	-38.60292	21	14.8	36	Net 1 opened		ek60
03/12/2012 04:24	-53.77887	-38.57183	445	175.5	36	Net 1 closed		ek60
03/12/2012 04:24	-53.77862	-38.57133	445	180	36	Net 2 opened		ek60
03/12/2012 04:54	-53.76362	-38.5436	35	9.2	36	Net 2 closed		ek60
03/12/2012 04:57	-53.76198	-38.54065		0.3	36	Net recovered		ek60
03/12/2012 23:49	-53.71928	-37.97422	0	0.3	48	Net deployed	Oblique 0-145-0	ek60
03/12/2012 23:50	-53.71995	-37.97478	10	6.7	48	Net 1 opened		ek60
04/12/2012 00:15	-53.73705	-37.98017	289	144	48	Net 1 closed		ek60
04/12/2012 00:15	-53.73738	-37.98028	291	145.4	48	Net 2 opened		ek60
04/12/2012 00:35	-53.75082	-37.98602	93	36	48	Net 2 closed	Net closed early due to going through large krill swarm	ek60
04/12/2012 00:40	-53.75435	-37.98765	19	12.6	48	Net recovered		ek60
04/12/2012 02:52	-53.72715	-37.96668	-14	0.3	49	Net deployed	Target 20-50 m	ek60
04/12/2012 03:04	-53.73425	-37.97381	37	22.3	49	Net 1 opened		ek60
04/12/2012 03:08	-53.73674	-37.97629	73	30.7	49	Net 1 closed		ek60
04/12/2012 03:12	-53.73953	-37.97849	73	45.4	49	Net 2 opened		ek60
04/12/2012 03:14	-53.74082	-37.97959	73	36	49	Net 2 closed		ek60
04/12/2012	-	-37.98216	-5	0.3	49	Net		ek60

03:20	53.74389					recovered		
04/12/2012 21:38	-53.35314	-38.12279	-11	0	65	Net deployed	Oblique 0-200-0	ek60
04/12/2012 21:45	-53.35145	-38.13346	24	0	65	Net 1 opened		ek60
04/12/2012 22:17	-53.34187	-38.18549	537	197	65	Net 2 opened		ek60
04/12/2012 22:47	-53.33298	-38.2342	77	0	65	Net 2 closed		ek60
04/12/2012 22:50	-53.33197	-38.23903	8	0	65	Net recovered		ek60
05/12/2012 01:36	-53.67958	-38.05923	-7	0.6	66	Net deployed	Target fishing 40-75 m	ek60
05/12/2012 01:40	-53.67771	-38.06359	84	52.4	66	Net 1 opened		ek60
05/12/2012 01:43	-53.6762	-38.06676	126	53	66	Net 1 closed		ek60
05/12/2012 01:43	-53.67593	-38.0673	137	56.7	66	Net 2 opened		ek60
05/12/2012 01:46	-53.67457	-38.06999	142	51.1	66	Net recovered		ek60

Appendix F: RMT25 Events Log

Time	Latitude	Longitude	Wire Out	Net depth	Event	Action	Comment	User
06/12/2012 18:40	-53.9646	-37.57947	20	-0.3	75	Net deployed		ek60
06/12/2012 18:43	- 53.96253	-37.58176	62	38.2	75	Net 1 opened		ek60
06/12/2012 18:44	- 53.96187	-37.58247	75	41.1	75	Net 1 closed	Max tension reached net shut early	ek60
06/12/2012 19:04	- 53.94852	-37.59635	55	37.1	75	Net 2 opened		ek60
06/12/2012 19:04	-53.9482	-37.59669	55	32.5	75	Net 2 closed		ek60

Appendix G: All Events Bridge Log

Time	Event	Lat	Lon	Comment
28/11/2012 09:22	1	-60.5642	-46.5368	Vessel on station in auto head DP, drifting with ice in open lead.
28/11/2012 09:31	1	-60.5627	-46.5357	CTD off the deck.
28/11/2012 09:34	1	-60.5621	-46.5352	CTD deployed.
28/11/2012 09:49	1	-60.5585	-46.5376	CTD at depth. Wire out 556m. Water depth 583m. Commenced recovery.
28/11/2012 10:04	1	-60.5554	-46.5376	CTD at the surface
28/11/2012 10:06	1	-60.5549	-46.5378	CTD on deck
28/11/2012 11:02	2	-60.5441	-46.5493	V/l off DP, repositioning to deeper water
28/11/2012 11:45	2	-60.5755	-46.5175	V/l on station in full auto position DP
28/11/2012 11:55	2	-60.5754	-46.5175	Mooring weight deployed
28/11/2012 12:04	2	-60.5754	-46.5179	Acoustic release deployed
28/11/2012 12:28	2	-60.5754	-46.5175	Buoy deployed, depth 688m
28/11/2012 12:30	2	-60.5747	-46.5184	V/l off DP moving clear of ice
28/11/2012 12:51	3	-60.5838	-46.5005	V/l on station in auto head DP, drifting with ice
28/11/2012 12:56	3	-60.5841	-46.5011	CTD off the deck
28/11/2012 12:57	3	-60.5843	-46.5014	CTD deployed
28/11/2012 13:13	3	-60.584	-46.505	CTD at depth. Wire out 732m. Water depth 745m. Commenced recovery.
28/11/2012 13:28	3	-60.5836	-46.5085	CTD at surface
28/11/2012 13:31	3	-60.5839	-46.5093	CTD on deck
28/11/2012 13:35	3	-60.5837	-46.5098	V/l off DP
29/11/2012 20:46	4	-55.2055	-41.1074	Vessel on station in full auto pos DP 500m downwind of mooring position.
29/11/2012 20:49	4	-55.2054	-41.1073	Hydrophone deployed. EA600 in passive.
29/11/2012 20:55	4	-55.2054	-41.1072	Buoy released. Hydrophone recovered to deck.
29/11/2012 21:07	4	-55.2054	-41.1073	Hydrophone redeployed.
29/11/2012 21:09	4	-55.2054	-41.1073	Release signal resent to Buoy. Hydrophone recovered to deck.
29/11/2012 21:12	4	-55.2054	-41.1073	Buoy on the surface.
29/11/2012 21:13	4	-55.2054	-41.1073	Vessel off DP and repositioning for Buoy recovery.
29/11/2012 21:23	4	-55.2015	-41.0895	Vesel set up in DP auto head.
29/11/2012 21:31	4	-55.2029	-41.0936	Buoy recovery line hooked. Vessel moviong ahead at 0.6kts
29/11/2012 21:34	4	-55.2029	-41.0934	Buoy at the stern.

29/11/2012 21:35	4	-55.203	-41.0936	Commenced recovery.
29/11/2012 21:38	4	-55.2031	-41.0939	Buoy on deck.
29/11/2012 22:06	4	-55.2049	-41.101	Trimsin Buoys on deck.
29/11/2012 22:12	4	-55.2048	-41.102	Sediment Trap and Current Meter on deck.
29/11/2012 22:39	4	-55.206	-41.1046	Acoustic release on deck. All gear clear. Vessel stopped on station for CTD.
29/11/2012 23:00	5	-55.2059	-41.1044	CTD off the deck.
29/11/2012 23:02	5	-55.2059	-41.1044	CTD deployed
29/11/2012 23:31	5	-55.206	-41.1044	CTD at depth. Wire out 1530m. Water depth 3173m. Commenced recovery.
29/11/2012 23:57	5	-55.206	-41.1044	CTD at surface
30/11/2012 00:00	5	-55.2059	-41.1043	CTD on deck
30/11/2012 00:16	5	-55.2064	-41.1056	V/l off DP
30/11/2012 14:00	6	-52.8106	-40.0938	V/l on station on DP, 600m downwind from P3 mooring
30/11/2012 14:05	6	-52.8105	-40.0963	Transducer deployed. EA600 passive
30/11/2012 14:18	6	-52.8105	-40.0964	Buoy released. Transducer recovered
30/11/2012 14:21	6	-52.8105	-40.0964	Buoy sighted on the surface
30/11/2012 14:36	6	-52.8071	-40.1051	Buoy recovery line hooked. V/l moving ahead 0.8knots
30/11/2012 14:38	6	-52.8071	-40.1057	Buoy at stern, commenced recovery
30/11/2012 14:40	6	-52.8071	-40.1064	Buoy on deck
30/11/2012 15:49	7	-52.8076	-40.1221	Mooring recovery complete - vessel stopped in DP
30/11/2012 16:01	7	-52.8076	-40.1221	CTD off the deck
30/11/2012 16:04	7	-52.8076	-40.1221	CTD deployed
30/11/2012 16:32	7	-52.8076	-40.1221	CTD at depth - cable 1500m - depth 3793m
30/11/2012 17:00	7	-52.8076	-40.1221	CTD at surface
30/11/2012 17:03	7	-52.8076	-40.1221	CTD on deck
30/11/2012 17:12		-52.8077	-40.1221	DP off moving for RMT
30/11/2012 18:07	8	-52.9369	-40.0488	Commence deplotment of RMT 8
30/11/2012 18:18	8	-52.9369	-40.0648	Commence hauling
30/11/2012 18:22	8	-52.9368	-40.071	Hauling for recovery
30/11/2012 18:29	8	-52.9365	-40.0807	Net onboard
30/11/2012 18:36	9	-52.9366	-40.0912	Commence deployment of RMT 08
30/11/2012 18:50	9	-52.9375	-40.1122	Hauling for recovery

30/11/2012 18:57	9	-52.9381	-40.1233	Net onboard
30/11/2012 19:05		-52.9388	-40.134	Remaining on course (head to wind) and speed (3kts) to test glider on the aft deck.
30/11/2012 19:38		-52.9427	-40.1833	Completed testing of glider. Aft deck and glider secure. Proceeding to next work site.
01/12/2012 02:16	10	-53.7352	-39.1148	Commenced deployment of RMT8
01/12/2012 02:22	10	-53.7338	-39.1234	Net fully deployed, wire out 104m
01/12/2012 02:29	10	-53.7319	-39.1329	Commenced recovery
01/12/2012 02:47	10	-53.7265	-39.1556	Hauling for recovery
01/12/2012 02:56	10	-53.7231	-39.1682	Net onboard
01/12/2012 03:22	11	-53.7318	-39.1065	Hauling for recovery
01/12/2012 03:58	11	-53.7576	-38.9723	Commence deplotment of RMT 8
01/12/2012 04:04	11	-53.7561	-38.9824	RMT 08 deployed
01/12/2012 04:33	11	-53.7499	-39.0254	RMT 8 recovered to deck
01/12/2012 05:00	12	-53.7588	-38.9764	RMT 08 deployed
01/12/2012 05:22	12	-53.7516	-39.0091	Hauling for recovery
01/12/2012 05:32	12	-53.7478	-39.0238	RMT 8 recovered to deck
01/12/2012 09:01	013 / 014	-54.0547	-39.392	Commenced transect 1.1 (south to north). Deployed XBT (ships speed 6kts)
01/12/2012 09:03	14	-54.0515	-39.3931	XBT Failed
01/12/2012 09:07	15	-54.0449	-39.3951	XBT Deployed (ships speed 6kts)
01/12/2012 09:09	15	-54.0416	-39.396	XBT OK. Increasing ships speed to 10kts.
01/12/2012 10:04	16	-53.893	-39.4403	Commenced slowing down to 6kts for XBT deployment.
01/12/2012 10:12	16	-53.8778	-39.4448	XBT Deployed (ships speed 6kts)
01/12/2012 10:14	16	-53.8746	-39.4459	XBT OK. Increasing ships speed to 10kts.
01/12/2012 11:15	17	-53.7101	-39.495	Commenced slowing down to 6kts for XBT deployment.
01/12/2012 11:20	17	-53.7003	-39.4976	XBT Deployed (ships speed 6kts)
01/12/2012 11:25	17	-53.6921	-39.5	XBT OK. Increasing ships speed to 10kts.
01/12/2012 12:23	18	-53.5365	-39.5464	Commenced slowing down to 6kts for XBT deployment.
01/12/2012 12:30	18	-53.5228	-39.5502	XBT Deployed (ships speed 6kts)
01/12/2012 12:35	18	-53.5145	-39.5529	XBT OK. Increasing ships speed to 10kts.
01/12/2012 13:32	19	-53.3607	-39.5985	Commenced slowing down to 6kts for XBT deployment.
01/12/2012 13:39	19	-53.3472	-39.6024	XBT Deployed (ships speed 6kts)
01/12/2012 13:44	019 / 013	-53.3389	-39.6049	XBT OK. Increasing ships speed to 10kts. End of transect 1.1

01/12/2012 14:57	20	-53.3162	-39.3039	Commence transec line 1.2 north to south
01/12/2012 19:17	20	-54.0229	-39.0893	Completed transect 1.2. Repositioning vessel to CTD station 51.2S
01/12/2012 20:22	21	-53.8464	-39.1438	Vessel stopped on station in full auto pos D.P.
01/12/2012 20:26	21	-53.8463	-39.1439	CTD off the deck.
01/12/2012 20:27	21	-53.8462	-39.1439	CTD deployed.
01/12/2012 20:37	21	-53.8462	-39.1439	CTD at depth 275m. Commenced recovery.
01/12/2012 20:57	21	-53.8462	-39.1439	CTD at the surface
01/12/2012 20:59	21	-53.8462	-39.1439	CTD on deck
01/12/2012 21:05	21	-53.8462	-39.1439	Midships gantry secure. Vessel off D.P. and moving off for RMT 8 fishing.
01/12/2012 21:11	22	-53.8459	-39.1468	Vessel at speed 2.5kts. Commenced net deployment.
01/12/2012 21:13	22	-53.8458	-39.1495	RMT 8 at the stern.
01/12/2012 21:47	22	-53.842	-39.1927	Veered to 447m. Commenced hauling.
01/12/2012 22:20	22	-53.8374	-39.2342	Net at the stern.
01/12/2012 22:24	22	-53.8369	-39.2391	Net on board. Bulwark door closed.
01/12/2012 22:28	22	-53.8363	-39.2442	Aft deck secure. Vessel proceeding to next work site for target fishing.
02/12/2012 00:18	23	-53.7892	-38.9503	RMT 8 deployed
02/12/2012 00:23	23	-53.7885	-38.9567	Commenced hauling
02/12/2012 00:30	23	-53.7874	-38.9652	Hauling for recovery
02/12/2012 00:41	23	-53.7853	-38.9798	Net onboard
02/12/2012 03:08	24	-53.5017	-39.2091	RMT 08 Oblique deployed
02/12/2012 03:49	24	-53.4893	-39.2599	RMT 08 at depth cable 515m - commence hauling
02/12/2012 04:10	24	-53.4826	-39.2844	Net at surface
02/12/2012 04:24	24	-53.478	-39.3014	Net onboard
02/12/2012 05:17	25	-53.4929	-39.2505	CTD at surface
02/12/2012 05:26	25	-53.4931	-39.2509	CTD deployed
02/12/2012 05:46	25	-53.4931	-39.251	CTD at depth - cable 1500m - depth 3153m
02/12/2012 06:19	25	-53.4931	-39.251	CTD on deck
02/12/2012 09:00	026 / 027	-53.2921	-39.0849	Commenced Transect 2.1 (North to South). Deployed XBT.
02/12/2012 09:05	27	-53.2998	-39.0832	XBT OK. Increasing ships speed to 10kts.
02/12/2012 10:06	28	-53.4537	-38.991	Reducing speed to 6kts for XBT deployment.
02/12/2012 10:11	28	-53.4639	-38.984	XBT Deployed (ships speed 6kts)

02/12/2012 10:16	28	-53.472	-38.9814	XBT OK. Increasing ships speed to 10kts.
02/12/2012 11:15	29	-53.6321	-38.9316	Commenced slowing down to 6kts for XBT deployment.
02/12/2012 11:20	29	-53.6413	-38.9305	XBT Deployed (ships speed 6kts)
02/12/2012 11:26	29	-53.6509	-38.9313	XBT OK. Increasing ships speed to 10kts.
02/12/2012 12:22	30	-53.7994	-38.8794	Commenced slowing down to 6kts for XBT deployment.
02/12/2012 12:32	30	-53.818	-38.8738	XBT Deployed (ships speed 6kts)
02/12/2012 12:35	30	-53.8229	-38.8721	XBT OK. Increasing ships speed to 10kts.
02/12/2012 13:34	31	-53.9821	-38.8228	Commenced slowing down to 6kts for XBT deployment.
02/12/2012 13:40	31	-53.9933	-38.8187	XBT Deployed (ships speed 6kts)
02/12/2012 13:46	031 / 026	-54.0034	-38.8139	XBT OK. Increasing ships speed to 10kts. End of transect 2.1
02/12/2012 14:54	32	-53.9596	-38.5274	Commenced transect 2.2 (south to north).
02/12/2012 19:17	32	-53.2557	-38.7508	Completed transect 2.2. Repositioning vessel to CTD station.
02/12/2012 20:32	32	-53.4321	-38.6957	Vesel set up in DP auto head.
02/12/2012 20:33	33	-53.432	-38.6957	CTD off the deck.
02/12/2012 20:34	33	-53.432	-38.6957	CTD deployed.
02/12/2012 20:48	33	-53.432	-38.6952	Allowing vessel to drift westward to reduce lead on CTD wire.
02/12/2012 20:56	33	-53.4321	-38.6959	CTD at depth. Wire out 1000m. Water depth 3498m. Commenced recovery.
02/12/2012 21:26	33	-53.4321	-38.6986	CTD at the surface
02/12/2012 21:27	33	-53.4321	-38.6987	CTD on deck
02/12/2012 21:35	33	-53.4321	-38.6988	Midships gantry secure. Vessel off D.P. and moving off for RMT 8 fishing.
02/12/2012 21:39	34	-53.4305	-38.699	Vessel at speed 2.5kts. Commenced net deployment.
02/12/2012 21:41	34	-53.4285	-38.6995	Net at the stern.
02/12/2012 22:14	34	-53.4	-38.7075	Net veered to 499m. Commenced hauling.
02/12/2012 22:47	34	-53.3724	-38.7185	Net at the stern.
02/12/2012 22:50	34	-53.3698	-38.7196	Net on board. Bulwark door closed.
02/12/2012 22:55	34	-53.3625	-38.7219	Aft deck secure. Vessel proceeding downwind for target fishing.
02/12/2012 23:40	35	-53.4336	-38.6966	RMT 08 deployed
02/12/2012 23:53	35	-53.4248	-38.6992	Commenced hauling
03/12/2012 00:06	35	-53.4156	-38.7019	Net onboard
03/12/2012 03:50	36	-53.7962	-38.6047	RMT 08 deployed
03/12/2012 04:25	36	-53.7784	-38.5708	RMT 08 at depth cable 445m - commence hauling

03/12/2012 04:57	36	-53.762	-38.5406	Net at surface
03/12/2012 05:01	36	-53.7596	-38.5364	Net on board. Bulwark door closed.
03/12/2012 05:55	37	-53.7851	-38.5842	CTD off the deck
03/12/2012 06:00	37	-53.7851	-38.5842	CTD deployed
03/12/2012 06:05	37	-53.7851	-38.5842	CTD at depth - cable 195m - depth 207m
03/12/2012 06:23	37	-53.785	-38.5842	CTD on deck
03/12/2012 09:00	038 / 039	-53.9267	-38.2205	Commenced transect 3.1 (south to north). Deployed XBT (ships speed 6kts)
03/12/2012 09:01	39	-53.925	-38.221	XBT OK. Increasing ships speed to 10kts.
03/12/2012 10:04	40	-53.757	-38.2745	Reducing speed to 6kts for XBT deployment.
03/12/2012 10:08	40	-53.7492	-38.2768	XBT Deployed (ships speed 6kts)
03/12/2012 10:09	40	-53.7477	-38.2776	XBT OK. Increasing ships speed to 10kts.
03/12/2012 11:09	41	-53.5857	-38.331	Commenced slowing down to 6kts for XBT deployment.
03/12/2012 11:15	41	-53.5747	-38.3346	XBT Deployed (ships speed 6kts)
03/12/2012 11:20	41	-53.5665	-38.3372	XBT OK. Increasing ships speed to 10kts.
03/12/2012 12:20	42	-53.4072	-38.3884	Commenced slowing down to 6kts for XBT deployment.
03/12/2012 12:25	42	-53.3974	-38.3914	XBT Deployed (ships speed 6kts)
03/12/2012 12:31	42	-53.3877	-38.3944	XBT OK. Increasing ships speed to 10kts.
03/12/2012 13:29	43	-53.2361	-38.4439	Commenced slowing down to 6kts for XBT deployment.
03/12/2012 13:37	43	-53.2204	-38.4491	XBT Deployed (ships speed 6kts)
03/12/2012 13:43	043 / 038	-53.2107	-38.4523	XBT OK. Increasing ships speed to 10kts. End of transect 3.1
03/12/2012 15:00	44	-53.186	-38.1389	Commenced transect 3.2 (North to South)
03/12/2012 19:19	44	-53.8897	-37.9068	Completed transect 3.2. Repositioning vessel for shallow water mooring recovery.
03/12/2012 20:01	45	-53.8023	-37.9377	Vessel on station in DP 500m from buoy position.
03/12/2012 20:05	45	-53.8023	-37.9378	Hydrophone deployed. EA600 in passive.
03/12/2012 20:09	45	-53.8023	-37.9378	Hydrophone recovered. Vessel off DP and repositioning over buoy position.
03/12/2012 20:15	45	-53.7982	-37.9356	Vessel on DP over buoy position. Buoy rig visible on EA600 trace.
03/12/2012 20:28	45	-53.7979	-37.9361	Vessel off DP. Repositioning downwind for buoy release.
03/12/2012 20:42	45	-53.8016	-37.9378	Vessel on DP 400m downwind.
03/12/2012 20:45	45	-53.8016	-37.9378	Hydrophone deployed. EA600 in passive.
03/12/2012 20:46	45	-53.8016	-37.9378	Buoy released.
03/12/2012 20:47	45	-53.8016	-37.9378	Hydrophone recovered.

03/12/2012 20:48	45	-53.8016	-37.9378	Buoy sighted.
03/12/2012 20:49	45	-53.8016	-37.9378	Vessel moving in for recovery in JSAH.
03/12/2012 21:01	45	-53.7987	-37.9354	Riser hooked.
03/12/2012 21:04	45	-53.7986	-37.9354	Trimsin Buoys at the stern.
03/12/2012 21:04	45	-53.7986	-37.9354	Buoys clear around the stern.
03/12/2012 21:13	45	-53.7968	-37.9381	Buoy on deck.
03/12/2012 21:19	45	-53.7958	-37.9395	Releases on deck. Completed mooring recovery. Vessel stopped on station in DP.
03/12/2012 21:55	46	-53.7952	-37.9404	CTD off the deck.
03/12/2012 21:56	46	-53.7952	-37.9404	CTD deployed.
03/12/2012 22:07	46	-53.7952	-37.9404	CTD at depth. Wire out 300m. Water depth 315m. Commenced recovery.
03/12/2012 22:17	46	-53.7952	-37.9404	CTD at the surface
03/12/2012 22:18	46	-53.7952	-37.9404	CTD on deck
03/12/2012 22:23	46	-53.7952	-37.9404	Midships gantry secure. Vessel off D.P. and proceeding to CTD site 53.2S
03/12/2012 23:03	47	-53.7144	-37.9662	V/l on station in full auto DP
03/12/2012 23:09	47	-53.7142	-37.966	CTD deployed
03/12/2012 23:16	47	-53.7142	-37.966	CTD at depth. Wire out 125m. Water depth 134m. Commenced recovery.
03/12/2012 23:28	47	-53.7142	-37.966	CTD at surface
03/12/2012 23:31	47	-53.7142	-37.966	CTD on deck
03/12/2012 23:38	47	-53.7142	-37.966	Midships gantry secure. Vessel off D.P. and moving off for RMT 8 fishing
03/12/2012 23:43	48	-53.715	-37.9704	RMT 8 deployed
04/12/2012 00:16	48	-53.7377	-37.9804	Start hauling
04/12/2012 00:48	48	-53.7603	-37.9906	Net onboard
04/12/2012 02:52	49	-53.7272	-37.9667	RMT 8 deployed
04/12/2012 03:13	49	-53.7402	-37.9791	RMT at depth commence hauling
04/12/2012 03:20	49	-53.7439	-37.9822	RMT at surface
04/12/2012 03:27	49	-53.7478	-37.9864	RMT on deck
04/12/2012 07:04	50	-53.3595	-38.0842	CTD off the deck.
04/12/2012 07:06	50	-53.3596	-38.0842	CTD deployed.
04/12/2012 07:28	50	-53.3595	-38.0843	CTD at depth. Wire out 1000m. Water depth 2657m. Commenced recovery.
04/12/2012 07:58	50	-53.3595	-38.0843	CTD at the surface
04/12/2012 08:00	50	-53.3593	-38.0848	CTD on deck

04/12/2012 08:07	50	-53.3586	-38.0867	Midships gantry secure. Vessel off D.P. and proceeding to start of transect 4.1
04/12/2012 09:30	051 / 052	-53.1641	-37.9643	Commenced transect 4.1 (north to south). Deployed XBT (ships speed 6kts)
04/12/2012 09:35	52	-53.3596	-38.0844	XBT Failed
04/12/2012 09:36	53	-53.1738	-37.961	XBT Deployed (ships speed 6kts)
04/12/2012 09:41	53	-53.1814	-37.9585	XBT OK. Increasing ships speed to 10kts.
04/12/2012 10:39	54	-53.3288	-37.9098	Reducing speed to 6kts for XBT deployment.
04/12/2012 10:44	54	-53.3397	-37.9058	XBT Deployed (ships speed 6kts)
04/12/2012 10:47	55	-53.3444	-37.9041	XBT Deployed (ships speed 6kts)
04/12/2012 10:48	54	-53.346	-37.9036	XBT Failed
04/12/2012 10:52	55	-53.3523	-37.9016	XBT OK. Increasing ships speed to 10kts.
04/12/2012 11:50	56	-53.5091	-37.8493	Commenced slowing down to 6kts for XBT deployment.
04/12/2012 11:54	56	-53.517	-37.8465	XBT Deployed (ships speed 6kts)
04/12/2012 11:58	56	-53.5237	-37.8441	XBT OK. Increasing ships speed to 10kts.
04/12/2012 12:59	57	-53.688	-37.7888	Commenced slowing down to 6kts for XBT deployment.
04/12/2012 13:02	57	-53.6937	-37.7867	XBT Deployed (ships speed 6kts)
04/12/2012 13:03	57	-53.6953	-37.7861	XBT OK. Increasing ships speed to 10kts.
04/12/2012 14:05	58	-53.8633	-37.7297	Commenced slowing down to 6kts for XBT deployment.
04/12/2012 14:08	58	-53.8694	-37.7282	XBT Deployed (ships speed 6kts)
04/12/2012 14:09	058 / 051	-53.871	-37.7275	XBT OK. Increasing ships speed to 10kts. End of transect 4.1
04/12/2012 14:44	59	-53.8633	-37.591	Commenced slowing down to 6kts for XBT deployment.
04/12/2012 14:49	059 / 060	-53.8534	-37.5936	XBT Deployed (ships speed 6kts) Commenced transect 4.2 South to North
04/12/2012 14:51	59	-53.8501	-37.5942	XBT OK. Increasing ships speed to 10kts.
04/12/2012 15:58	61	-53.6753	-37.6533	XBT Deployed (ships speed 6kts)
04/12/2012 17:07	62	-53.4962	-37.7142	XBT Deployed (ships speed 6kts)
04/12/2012 18:16	63	-53.3212	-37.7718	XBT Deployed (ships speed 6kts)
04/12/2012 19:17	64	-53.1604	-37.8281	Reducing speed to 6kts for XBT deployment.
04/12/2012 19:24	60 / 64	-53.1475	-37.8324	Completed transect 4.2. XBT deployed. Ships speed 6kts.
04/12/2012 19:29	64	-53.1391	-37.8347	XBT O.K..
04/12/2012 21:35	65	-53.3538	-38.1183	Commenced deployment of RMT8. Heading 285. Speed 2.5kts.
04/12/2012 21:38	65	-53.3531	-38.1228	Net at the stern.
04/12/2012 22:18	65	-53.3416	-38.1872	RMT8 veered to 541m wire out. Commenced hauling.

04/12/2012 22:51	65	-53.3316	-38.2406	Net at the stern.
04/12/2012 22:54	65	-53.3306	-38.2456	RMT8 on board.
05/12/2012 01:33	66	-53.6813	-38.0563	RMT 8 deployed
05/12/2012 01:44	66	-53.6757	-38.0678	Starting to haul
05/12/2012 02:00	66	-53.6678	-38.0842	Net onboard
05/12/2012 02:03	67	-53.6666	-38.0869	V/l on station in full auto DP
05/12/2012 02:19	67	-53.6666	-38.0869	CTD off the deck
05/12/2012 02:21	67	-53.6666	-38.0869	CTD deployed
05/12/2012 02:28	67	-53.6666	-38.0869	CTD at depth - cable 150m, depth - 158m
05/12/2012 02:39	67	-53.6666	-38.0869	CTD at surface
05/12/2012 02:43	67	-53.6666	-38.0869	CTD on deck
05/12/2012 02:54	67	-53.6657	-38.0921	V/l off DP
05/12/2012 11:07	68	-54.1589	-36.697	V/l in DP, at starboard anchor in Stromness Harbour
05/12/2012 11:28	68	-54.1589	-36.6961	CTD off the deck
05/12/2012 11:31	68	-54.1588	-36.6964	CTD deployed
05/12/2012 11:35	68	-54.1588	-36.6965	CTD at depth - cable 50m, depth - 76m
05/12/2012 11:38	68	-54.1589	-36.6965	CTD at surface
05/12/2012 11:40	68	-54.1588	-36.6965	CTD on deck
06/12/2012 10:58	69	-53.7978	-37.92	V/l on station on DP, for WCB mooring deployment
06/12/2012 11:46	69	-53.7979	-37.9241	V/l moving slowly ahead (1.2knots) towards mooring positon
06/12/2012 11:49	69	-53.7978	-37.9255	Buoy deployed
06/12/2012 11:54	69	-53.7979	-37.9286	Acoustic release attached
06/12/2012 11:59	69	-53.7978	-37.9316	Weight hung off
06/12/2012 12:03	69	-53.798	-37.9343	Acoustic release deployed
06/12/2012 12:07	69	-53.798	-37.9371	Mooring anchor deployed, buoy gone
06/12/2012 12:22	70	-53.7978	-37.9438	V/l stopped in full auto position DP for CTD at WCB mooring position
06/12/2012 12:23	70	-53.7978	-37.9439	CTD off the deck
06/12/2012 12:24	70	-53.7978	-37.9439	CTD deployed
06/12/2012 12:34	70	-53.7978	-37.9438	CTD at depth - cable 290m, depth - 320m
06/12/2012 12:39	70	-53.7978	-37.9438	CTD at surface
06/12/2012 12:41	70	-53.7978	-37.9438	CTD on deck

06/12/2012 13:07	70	-53.7978	-37.9439	V/l off DP, heading downwind for target fishing
06/12/2012 16:07	71	-53.9717	-37.5713	Vessel on DP to test RMT 25 gear
06/12/2012 16:24	71	-53.9717	-37.5716	Deploying Net Monitor for testing
06/12/2012 17:40	71	-53.9717	-37.5715	Recovering Net monitor - testing complete
06/12/2012 18:29	72	-53.9717	-37.5715	RMT 25 - DP off, increasing speed for deployment
06/12/2012 18:40	72	-53.9646	-37.5795	RMT 25 deployed
06/12/2012 19:06	72	-53.9472	-37.5978	Commenced recovery of the RMT25
06/12/2012 19:12	72	-53.9432	-37.6021	RMT 25 at the stern
06/12/2012 19:20	72	-53.9381	-37.6076	RMT 25 on deck. Bulwark door closed.
07/12/2012 10:58	73	-52.8091	-40.0498	V/l on station in full auto DP
07/12/2012 11:11	73	-52.809	-40.0498	CTD off the deck
07/12/2012 11:13	73	-52.8091	-40.0499	CTD deployed
07/12/2012 12:13	73	-52.809	-40.0499	CTD at depth - cable 3731m, depth - 3803m
07/12/2012 13:24	73	-52.8091	-40.0498	CTD at surface
07/12/2012 13:27	73	-52.809	-40.0498	CTD on deck
08/12/2012 10:38	74	-55.2024	-41.0568	CTD off the deck.
08/12/2012 10:40	74	-55.2024	-41.0567	CTD deployed.
08/12/2012 10:45	74	-55.2024	-41.0565	Commenced moving 090 at 0.8kts to reduce lead on CTD wire.
08/12/2012 11:17	74	-55.2025	-41.0439	CTD at depth - cable 2000m, depth - 3194m
08/12/2012 11:52	74	-55.2022	-41.0336	CTD at surface
08/12/2012 11:55	74	-55.2022	-41.0329	CTD on deck
08/12/2012 12:06	74	-55.2021	-41.033	V/l off DP moving to P2 mooring position
08/12/2012 12:49	75	-55.2351	-41.2295	V/l in DP, moving 1.5knots through the water for P2 mooring deployment
08/12/2012 12:53	75	-55.2352	-41.2299	Buoy deployed
08/12/2012 13:12	75	-55.2384	-41.2407	CTD deployed
08/12/2012 13:30	75	-55.2416	-41.2499	Trimsin buoys deployed
08/12/2012 13:37	75	-55.2425	-41.2521	Sediment trap and current meter deployed
08/12/2012 14:23	75	-55.2482	-41.2709	Acoustic release deployed
08/12/2012 14:31	75	-55.2492	-41.2743	Weight deployed. Depth 3383m
08/12/2012 14:48	75	-55.2512	-41.2817	Buoy submerged
08/12/2012 14:50	75	-55.2515	-41.2826	V/l stopped in auto position DP, depth 4211m, range 3603m

08/12/2012 15:00	75	-55.2515	-41.2828	V/l off DP
08/12/2012 15:20	75	-55.2391	-41.2832	Acoustic test 1 - range 3603m - depth 3393m
08/12/2012 15:36	75	-55.2403	-41.2556	Acoustic test 2 - range 3352 - depth 3860m
08/12/2012 15:40	75	-55.2403	-41.2556	Acoustic test 3 - range 3366m - depth 3586

Appendix H: AME Report and Instrument Calibration Sheets

Cruise:JR280 Start date:13/11/2012 Finish date:11/12/2012
Name of AME engineer: Seth Thomas
Name of principle scientist (PSO):Jon Watkins

Instrument	Used?	Comments
XBT (aft UIC) (PC, I/F box, handgun)	Y	
Scintillation counter (prep lab)		
AutoSal (labs on upper deck) S/N 63360		
AutoSal (labs on upper deck) S/N 65763		
AutoSal (labs on upper deck) S/N 68533		
Portasal S/N 68164		
Magnetometer STCM1 (aft UIC)	Y	
AME workshop PC	Y	

GPS, MRU, Gyro

GPS Furuno GP32 (bridge – port side)	Y	
DGPS Ashtec ADU5 (bridge – port side)	Y	
DGPS, MRU Seatex Seapath (UIC – swath suite)	Y	
DGPS Ashtec Glonass GG24 (bridge – starboard side)	Y	
Gyro synchro to RS232 Navitron NT925HDI (UIC – aft)	Y	
TSS HRP (UIC repeater)	Y	

ACOUSTIC

Instrument	Used?	Comments
ADCP (aft UIC)	Y	
Waterfall Hydrophone (aft UIC)		
EM122 (for'd UIC)	Y	
TOPAS (for'd UIC)	Y	
EPC plotter (used with TOPAS)	Y	
EK60 (mid UIC)	Y	
HP deskjet 1 (used with EK)		
HP deskjet 2 (used with EK)		
SSU (for'd UIC)	Y	
SVP S/N3298 (cage when unused)		
SVP S/N3314 (cage when unused)		
10kHz IOS pinger		
Sonardyne USBL (aft UIC)		

OCEANLOGGER

Instrument	Used?	Comments
Main logging PC hardware and software	Y	
Barometer (back of logger rack) #V145002 (7/03)	Y	
Barometer #V145003 (7/03)	Y	
TH1, Air humidity & temp (for'd mast) #60599556	Y	
TH2, Air humidity & temp (for'd mast) #60599558	Y	
Thermosalinograph SBE45 (prep lab) #4524698-0016		
Thermosalinograph SBE45 # 4538936-0130	Y	
Thermosalinograph SBE45 #4524698-0018 (7/04)		
Uncontaminated seawater temp SBE38 #		Not installed. Needs Coffer? Dam design. Simon Wright. Deck Engineer is Investigating options for installation.
SBE45 + SBE38 Interface #		Not installed into system. Needs SBE38 fitted for benefit of unit.
Fluorometer (prep lab)	Y	1 read error every 2hrs on average
Transmissometer C-STAR CST-396DR	Y	Flow tube replaced, no longer weeps at inlet.
TIR sensor (pyranometer) (for'd mast) #112993 TIR1	Y	
TIR sensor #112992 TIR2	Y	

OCEANLOGGER – cont.

PAR sensor (for'd mast) #110127 PAR1	Y	
PAR sensor #110126 PAR2	Y	
Flow meter + Transmitter (prep room) #11950	Y	
Uncontaminated seawater temp (transducer space)	Y	

CTD (all kept in cage/ sci hold when not in use)

Instrument	Used?	Comments
CTD PC	Y	
Deck unit 1 SBE11plus S/N 11P15759-0458		
Deck unit 2 SBE11plus S/N 11P20391-0502	Y	
Underwater unit SBE9plus #09P15759-0480 Press #67241		
Underwater unit SBE9plus #09P20391-0541 Press #75429		
Underwater unit SBE9plus #09P30856-0707 Press #89973	Y	
Underwater unit SBE9plus #09P35716-0771 Press #93686		
Carousel & pylon SBE32 #3215759-0173		
Carousel & pylon SBE32 #0248		
Carousel & Pylon 24 Bottle	Y	
CTD swivel linkage	Y	
CTD swivel S/N196115		
CTD swivel S/N196111	Y	

CTD contd – C & T & pumps – please state which primary and secondary

Temp sensor SBE3plus #03P2191		
Temp sensor SBE3plus #03P4874		
Temp sensor SBE3plus #03P5623	Y	Primary temp.
Temp sensor SBE3plus #03P5645	Y	Secondary temp.
Temp sensor SBE3plus #03P2366		
Temp sensor SBE3plus #03P2307		
Temp sensor SBE3plus #03P2705		
Temp sensor SBE3plus #03P2709		
Temp sensor SBE3plus #03P4235		
Temp sensor SBE3plus #03P4302		
Cond sensor SBE4C #044126	Y	Primary cond.
Cond sensor SBE4C #044087	Y	Secondary Cond.
Cond sensor SBE4C #041912		
Cond sensor SBE4C #042248		
Cond sensor SBE4C #042222		
Cond sensor SBE4C #041913		
Cond sensor SBE4C #042255		
Cond sensor SBE4C #042289		
Cond sensor SBE4C #042813		
Cond sensor SBE4C #042875		
Pump SBE5T # 54488		
Pump SBE5T # 54485		
Pump SBE5T # 54709	Y	Primary pump.
Pump SBE5T # 54488	Y	Secondary pump
Pump SBE5T # 52371		
Pump SBE5T		

# 52395		
Pump SBE5T # 52400		
Pump SBE5T # 53415		

CTD contd

Instrument	Used?	Comments
Fluorometer Aquatracka MkIII #0088-3598C		
Fluorometer Aquatracka MkIII # 12_8513_03	Y	
Fluorometer Aquatracka MkIII #088249		
Standards Thermometer SBE35 #3515759-0056	Y	
Standards Thermometer SBE35 #3515759-0005		
Standards Thermometer SBE35 # 3527735-0024		
Standards Thermometer SBE35 # 3535231-0047		
Altimeter PA200 #2130.26993		
Altimeter PA200 #7742.163162		
Altimeter PA200 #244738	Y	
Altimeter PA200 #2130.27001		
Transmissometer C-Star #CST-1279DR		
Transmissometer C-Star #CST-527DR	Y	
Transmissometer C-Star CST 846DR		
Oxygen sensor SBE43 #0242		
Oxygen sensor SBE43 #0245		
Oxygen sensor SBE43 #0620		
Oxygen sensor SBE43 #2290	Y	
Oxygen sensor SBE43 #0676		
PAR sensor #7235		
PAR sensor #70441	Y	
PAR sensor #7252		

PAR sensor #7274		
PAR sensor #7275		
LADCP #14443		
LADCP #15060		
LADCP #14897		
LADCP Battery Pack		
AME Laptop (BBTalk)		

CTD contd

Notes on any other part of CTD e.g. faulty cables, wire drum slip ring, bottles, swivel, frame, tubing etc.		Lanyards tight (but still usable) with larger rosette and offset pylon due to NOC frame being used.

AME UNSUPPORTED INSTRUMENTS BUT LOGGED

Instrument	Used?	Comments
EA600 (bridge and UIC remote)	Y	
Anemometer	Y	
Gyro	Y	
DopplerLog	Y	
EMLog	Y	
CLAM winch monitoring system	Y	

At the end of the cruise, please ensure that:

- the XBT is left in a suitable state (store in cage if not to be used for a while – do not leave on deck or in UIC as it will get kicked around). Remove all deck cables at end of cruise prior to refit.
- the salinity sample bottles have been washed out and left with deionised water in – please check this otherwise the bottles will build up crud and have to be replaced.
- the CTD is left in a suitable state (washed (including all peripherals), triton + deionised water washed through TC duct, empty syringes put on T duct inlets to keep dust out and stored appropriately). Be careful about freezing before next use – this will damage the C sensors (run through with used standard seawater to reduce the chance of freezing before the next use). Remove all the connector locking sleeves and wash with fresh water. Blank off all unconnected connectors. See the CTD wisdom file for more information. If the CTD is not going to be used for a few weeks, at the end of your cruise please clean all connectors and attach dummy plugs or fit the connectors back after cleaning if they are not corroded.

- the CTD winch slip rings are cleaned if the CTD has been used – this prevents failure through accumulated dirt.
- the SVP is left in a suitable state (washed and stowed). Do not leave this on deck without a cover for any length of time as it rusts. Stow inside at end of cruise.
- all manuals have been returned to the designated drawers and cupboards.
- you clean all the fans listed below every cruise or every month, whichever is the longer.

Please clean the intake fans on the following machines:

Instrument	Cleaned?
Oceanlogger	Y
EM120, TOPAS, NEPTUNE UPSs	Y
Seatex Seapath	Y
Topas tweendeck	Y
EM120 Tween deck	Y

Additional notes and recommendations for change / future work

Tritech	Product Test Record Altimeter	Form No.	Page	Rev.
		0286-STF-00001	1 of 1	1

Part Number -	10127 232
Serial Number -	244738
Model -	PA200/20-6K8

Configuration Details

Frequency/Range (Serial)	COMMS MAIN	ANALOGUE OUT
200KHz 20deg/0.7-100M	N/A	ANA 0-5V
Body Configuration	Power	ANA Scaling
Straight S/S (6800m) (6K8)	15V (9-20V)	100 M
Operational Outputs	SW Config	Software
Free Run ASCII	3P2 FR MNE	ECHO_1sec.hex
Max No Detect(MNE)	Data Format	Speed of Sound
....	9600,1,8,1	1473m/s

Build Details

ITEM	Part No.	Ser. No	Rev.	Mod.
XDCR Moulding	02460	246430	A	
XDCR Endcap	02394	20878-14	C	
Body Tube	00969	21180-04	C	
Connector Endcap	06707	4203-3	C	
Special Conn	Subconn	MCBH4M SS	A	
CPU PCB	02218	234228	F	A
SON PCB	08488	245384	F	A
(COMMS PCB)	02216	243609	F	A
INP PCB	06238	238012	H	A

Testing Details

TEST	Date	Tested By	Details	
Calibration	09 May 2012	L.A.W	Voltage levels set to +/-0.2V or 1dB	
Pressure Test	04 May 2012	L.A.W	Pressure -	6000psi
24Hr Soak Test	04 May 2012	L.A.W		
Chassis Voltage	10 May 2012	L.A.W	Result (mV) -	5
Final Inspection	10 May 2012	L.A.W		

Notes

Unit pressure tested to 6600psi at TU. Unit fitted with 12V fuse. Unit calibrated with 1Hz Ping rate software (Echo 1sec.hex). ***Pinouts:*** *pin 1- 0Vdc, pin 2 - Analogue O/P, Pin 3 - Analogue GND, Pin 4 - +Vdc*

Equipment Details

Equipment Used	Cal No.
Multi-Meter	**093**
PSU	**053**
Oscilloscope	**072**
Echo Simulator	**157**
P/Test Gauge	**177**

Completed By -	10 May 2012
Technician -	L.A.W

C1

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA
Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4087
CALIBRATION DATE: 19-Apr-12

SBE4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

```
g =  -9.96036279e+000
h =   1.23524413e+000
i =  -2.45620460e-003
j =   2.30694549e-004
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =   8.66373209e-008
b =   1.22769872e+000
c =  -9.94038648e+000
d =  -7.57875744e-005
m =   6.9
CPcor = -9.5700e-008 (nominal)
```

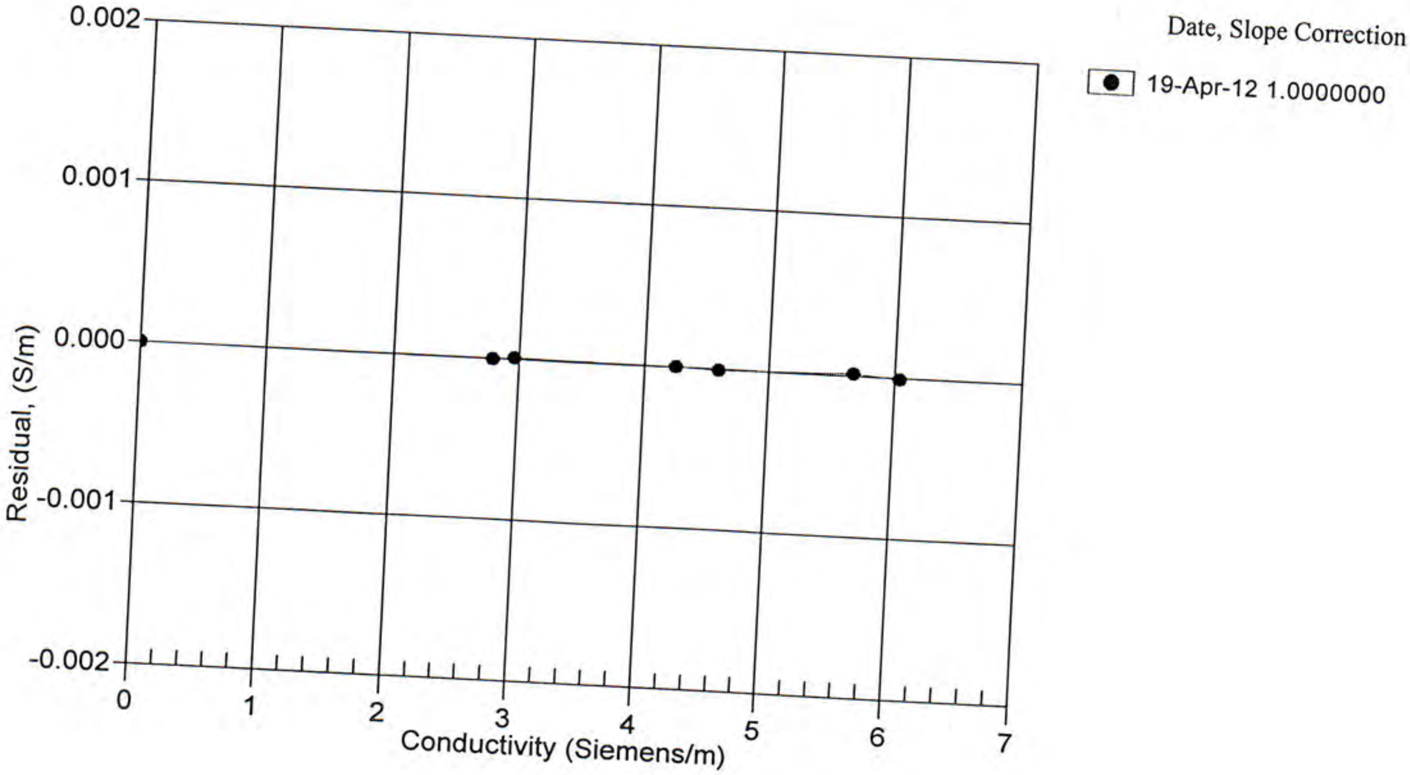
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.84553	0.00000	0.00000
-1.0001	34.5837	2.78757	5.54915	2.78757	-0.00001
0.9999	34.5844	2.95802	5.67274	2.95802	0.00001
14.9999	34.5864	4.24637	6.53116	4.24638	0.00000
18.4999	34.5871	4.59122	6.74223	4.59121	-0.00001
28.9999	34.5866	5.66890	7.36245	5.66892	0.00001
32.4999	34.5813	6.03962	7.56385	6.03961	-0.00001

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



C2

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA
Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4126
CALIBRATION DATE: 13-Apr-12

SBE4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

```
g = -9.94279356e+000
h =  1.24324961e+000
i = -2.27836797e-003
j =  2.19477346e-004
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  1.67327213e-007
b =  1.23634759e+000
c = -9.92477326e+000
d = -7.56488395e-005
m =  6.6
CPcor = -9.5700e-008 (nominal)
```

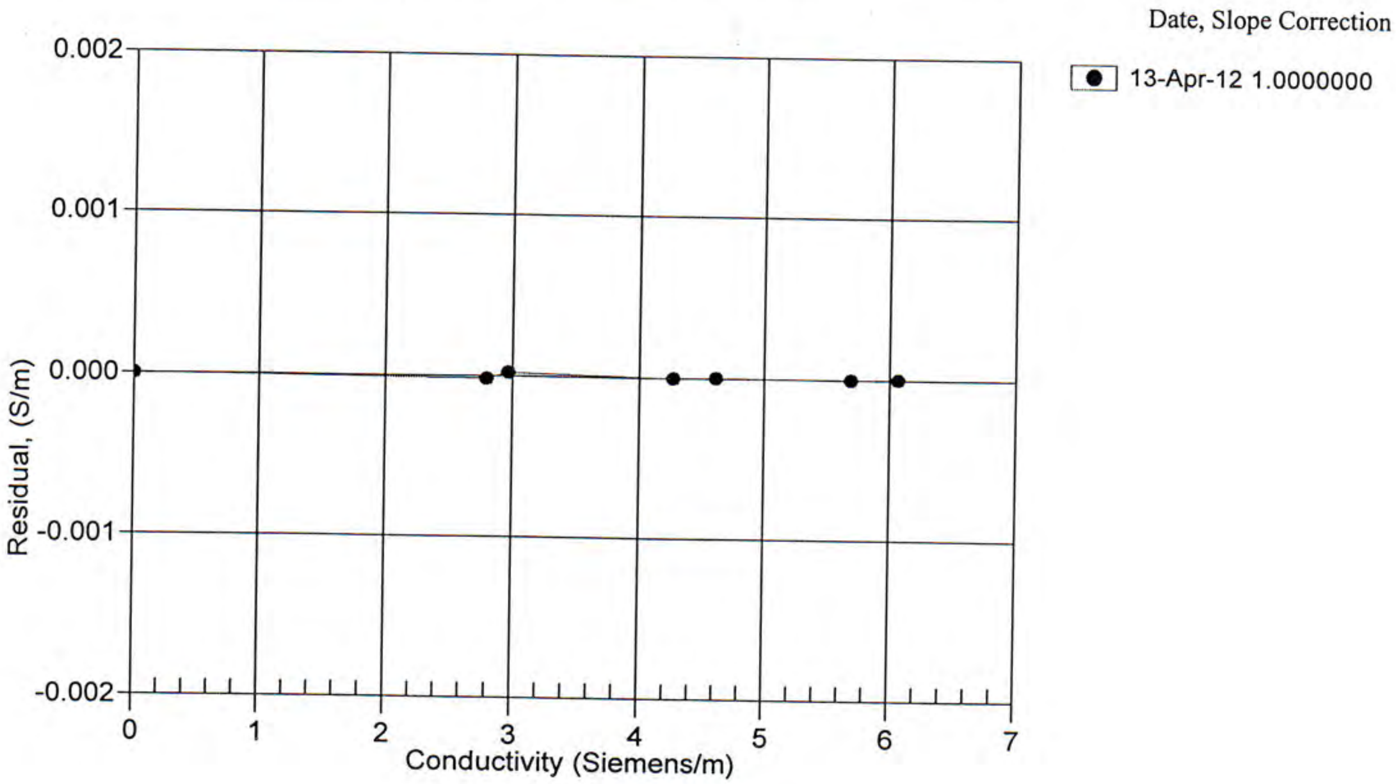
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.83332	0.00000	0.00000
-1.0001	34.7355	2.79867	5.53654	2.79865	-0.00002
0.9999	34.7359	2.96974	5.66001	2.96976	0.00002
14.9999	34.7385	4.26307	6.51748	4.26307	-0.00000
18.4999	34.7390	4.60921	6.72830	4.60921	0.00000
28.9999	34.7390	5.69107	7.34778	5.69107	-0.00000
32.4999	34.7340	6.06325	7.54898	6.06325	0.00000

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



CERTIFICATE OF CALIBRATION

All test equipment and standards used are of known accuracy and traceable to national standards. Details of test equipment and standards relevant to this certificate are available upon request.

Chelsea Technologies Group Ltd

55 Central Avenue
West Molesey
Surrey KT8 2QZ
United Kingdom
Tel: +44 (0)20 8481 9000
Fax: +44 (0)20 8941 9319
sales@chelsea.co.uk
www.chelsea.co.uk

Date of Issue: 15th June 2012

Part Number: 0088-3598C

WOT Number: WO128513

Description: AQUATRACKA MKIII

Serial Number: 12-8513-003

REPORT

The fluorimeter was exposed to various concentrations of Chlorophyll-a dissolved in acetone in addition to pure water and pure acetone. The following formula was derived from the readings to relate instrument output to chlorophyll-a concentration.

$$\text{Conc.} = (0.007621 \times 10^{\text{Output}}) - 0.014260$$

Where:-

Conc. = fluorophor concentration in μg/l
Output = Aquatracka output in volts

The above formula can be used in the range 0 - 100 microgrammes per litre to an uncertainty of 0.02 microgrammes per litre plus 3% of value.

Notes

The above formula has been derived using Chlorophyll-a dissolved in acetone. No guarantee is given as to the performance of the instrument to biologically active chlorophyll in sea-water.

The zero offset has been determined in the laboratory using purified water from a reverse osmosis/ion exchange column. It is possible that purer water may be found in clean deep ocean conditions. Under these conditions, the offset shown in the above formula should be replaced by the antilogarithm of the Aquatracka output in the purest water found, multiplied by the scale factor.

UKAS MANAGEMENT SYSTEMS 005 SGS
UKAS QUALITY MANAGEMENT 005 SGS

Registration No: 00832429
Registered at the above address

Distribution List: Works Order Traveller **Product History Folder (Electronic Copy)**

Chelsea Technologies Group Ltd
Certificate Of Calibration

Fluorimeter calibration readings

Ambient temperature 20°C

Output for detector mechanically blanked 0.2079 Volts

Output for pure water 0.2721 Volts

chlorophyll concentration in acetone (μg/l)	Output (volts)
Acetone (pure)	0.3175
0.1	1.1503
0.3	1.5848
1.0	2.1406
3.0	2.6307
9.9	3.1361
29.1	3.6011
90.9	4.0630

The uncertainty of the chlorophyll concentration is estimated not to exceed 3%. The uncertainty of output voltage measurement is estimated not to exceed 2mV.

Equipment used during calibration:-
Thurlby Dvm Cil 024
Weir Psu Cil 098

Signed **Date 15th June 2012**

M.J.Nicholson

DO

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 2290
CALIBRATION DATE: 31-Mar-12

SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS

Soc = 0.3979
Voffset = -0.4913
Tau20 = 1.57

A = -2.0922e-003
B = 1.0378e-004
C = -1.6935e-006
E nominal = 0.036

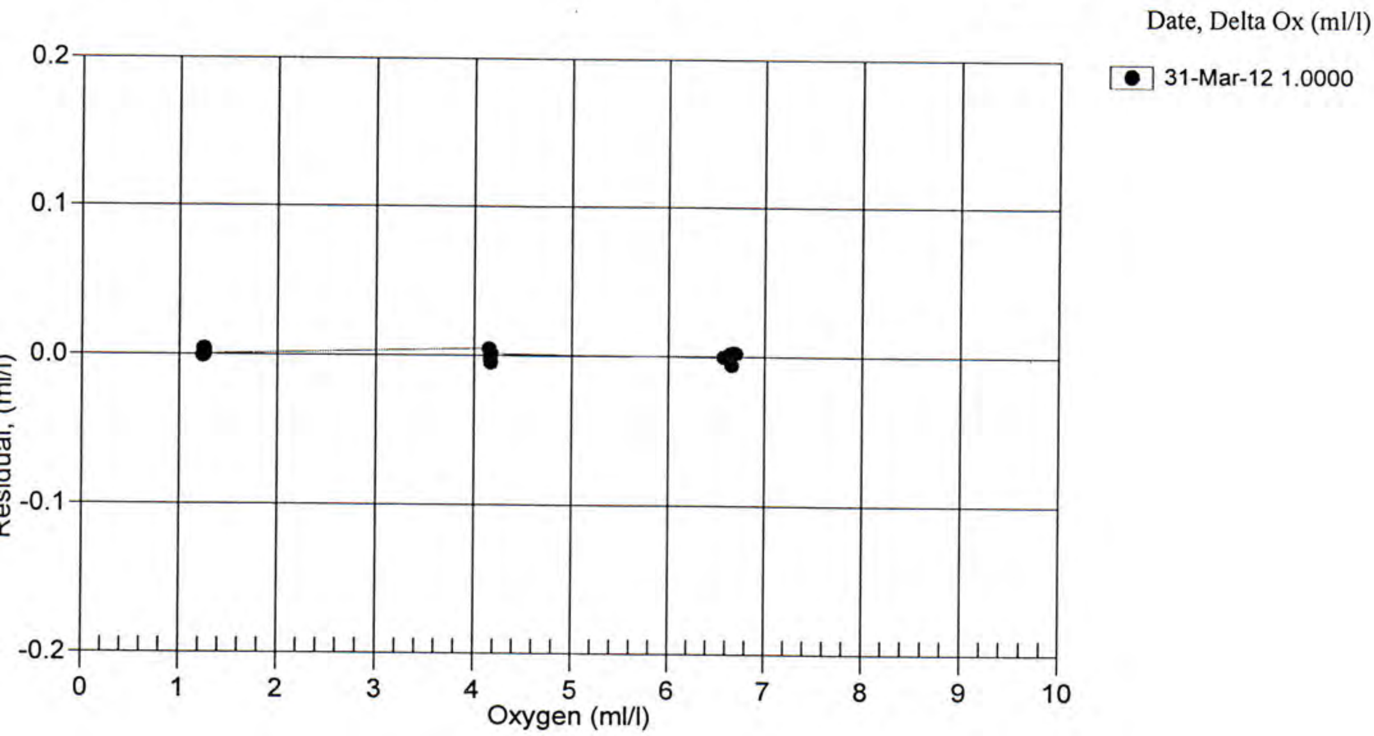
NOMINAL DYNAMIC COEFFICIENTS

D1 = 1.92634e-4
D2 = -4.64803e-2

H1 = -3.30000e-2
H2 = 5.00000e+3
H3 = 1.45000e+3

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.24	2.00	0.00	0.814	1.24	-0.00
1.25	6.00	0.00	0.854	1.25	-0.00
1.25	12.00	0.00	0.912	1.25	-0.00
1.25	30.00	0.00	1.095	1.25	0.00
1.25	26.00	0.00	1.053	1.25	0.00
1.25	20.00	0.00	0.992	1.25	0.00
4.15	26.00	0.00	2.359	4.16	0.00
4.17	2.00	0.00	1.576	4.16	-0.00
4.17	6.00	0.00	1.704	4.17	-0.00
4.17	20.00	0.00	2.161	4.17	0.00
4.17	12.00	0.00	1.898	4.17	-0.00
4.18	30.00	0.00	2.506	4.18	0.00
6.58	30.00	0.00	3.665	6.58	-0.00
6.65	12.00	0.00	2.736	6.65	0.00
6.66	26.00	0.00	3.478	6.65	-0.01
6.68	6.00	0.00	2.436	6.68	0.00
6.68	20.00	0.00	3.169	6.68	0.00
6.70	2.00	0.00	2.239	6.70	0.00

Oxygen (ml/l) = Soc * (V + Voffset) * (1.0 + A * T + B * T^2 + C * T^3) * OxSol(T,S) * exp(E * P / K)
V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU] K = temperature [deg K]
OxSol(T,S) = oxygen saturation [ml/l], P = pressure [dbar], Residual = instrument oxygen - bath oxygen



Calibration Date: 05/16/12 **Job No.:**

Model Number: [illegible]

Serial Number: [illegible]

Operator: [illegible]

Standard Lamp: [illegible]

Operating Voltage Range: 6 to 15 VDC (+)

Note: The QCP2300-HP output is a voltage that is proportional to the log of the incident irradiance.

To calculate irradiance, use this formula:

Irradiance = Calibration factor * (10^Light Signal Voltage - 10^Dark Voltage)

Dry Calibration Factor:	**3.06E+12**	**quanta/cm²·sec per volt**	**5.08E-06**	**µEinsteins/cm²·sec per volt**
Wet Calibration Factor:	**3.29E+12**	**quanta/cm²·sec per volt**	**5.46E-06**	**µEinsteins/cm²·sec per volt**

Sensor Test Data and Results[2)]

Sensor Supply Current (Dark):	[illegible]	mA		
Supply Voltage:	[illegible]	Volts		
Lamp Integrated PAR Irradiance:	[illegible]	quanta/cm²·sec	0.01746	µEinsteins/cm²sec
Immersion Coefficient:	0.931			

Nominal Filter OD	Expected Transmission	Calibrated Trans.	Sensor Voltage	Expected Voltage	Voltage % Error	Measured Trans.	Transmission Error (%)	Test Irrad. (quanta/cm²·sec)
No Filter	100%	100.00%	[illegible]	3.536	0%	100.00%	0.0	1.05E+16
0.3	50%	36.10%	[illegible]	3.094	0%	36.04%	0.2	3.79E+15
0.5	32%	27.60%	[illegible]	2.977	0%	27.90%	-1.1	2.93E+15
1	10%	9.27%	[illegible]	2.503	1%	9.59%	-3.3	1.01E+15
2	1%	1.11%	[illegible]	1.581	2%	1.17%	-4.9	1.23E+14
3	0.10%	0.05%	[illegible]	0.264	47%	0.06%	-13.2	6.51E+12
RG780	0.00%	0.00%		0.006	0%	0.00%	-100.0	4.21E+10

Dark Before:	[illegible]	Volts
Light - No Filter Hldr.:	[illegible]	Volts
Dark After - NFH:	[illegible]	Volts
Average Dark	0.0059	Volts

Notes:

1. Annual calibration is recommended.

2) This section is for internal use and for more advanced analysis.

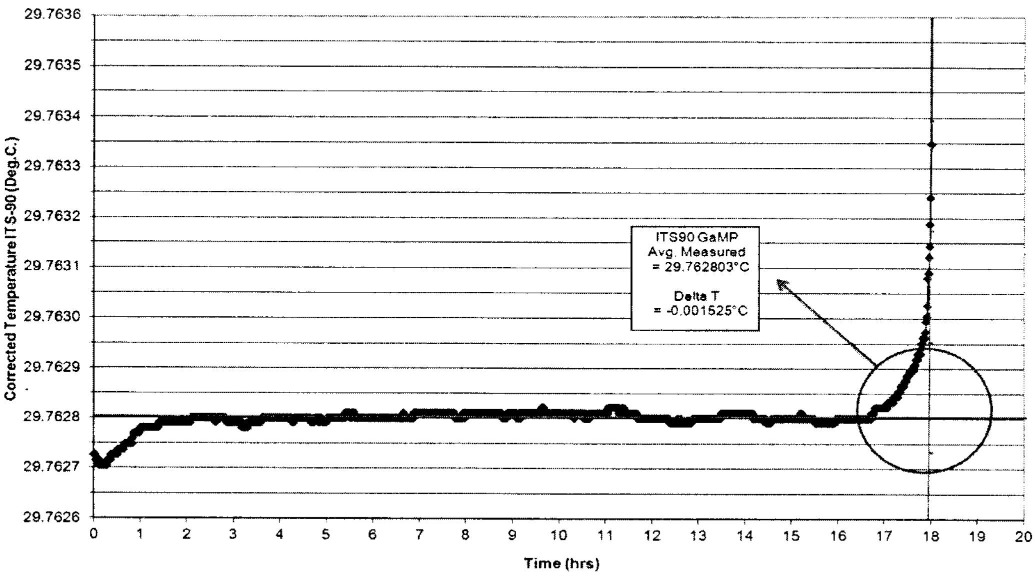
Gallium Melt Fixed Point Calibrations - Continued

This unit was calibrated on two days with the following results:

Isotech s/n 507	Ideal Measurements	Initial Coefficients 11-Apr-12	Initial Coefficients 13-Apr-12
Average Temperature at Measurement Site:	29.764328 °C	29.762763 °C	29.762803 °C
Drift Offset		-0.001565 °C	-0.001525 °C

Figure 3 details the initial calibration performed on 13 APR 2012. These data were used together with the triple point of water calibration data to generate new and final fixed point coefficients.

Figure 3: Gallium Melt Fixed Point Calibration
Slope = 1.000000 Offset = 0.000000



Final Instrument Configuration

Data from the fixed point calibrations illustrated previously were used to generate new slope and offset coefficients. Instrument SBE 35 SN 0056 has been recalibrated with the following coefficients:

Linearization Coefficients: 25-Jul-04	Fixed Point Coefficients: 13-Apr-12
a0 = 6.21309178e-003 a1 = -1.79041309e-003 a2 = 2.52591332e-004 a3 = -1.38534713e-005 a4 = 2.89868583e-007	Slope = 1.000012 Offset = 0.001178

Sea-Bird GmbH

Postfach 1167, 87401 Kempten, Germany

Phone: +49 831 960994 701 Fax: +49 831 960994 709 Email: seabird.eu@seabird.com

SENSOR SERIAL NUMBER: 0707
CALIBRATION DATE: 22-Aug-12

SBE9plus PRESSURE CALIBRATION DATA
10000 psia S/N 89973

DIGIQUARTZ COEFFICIENTS:

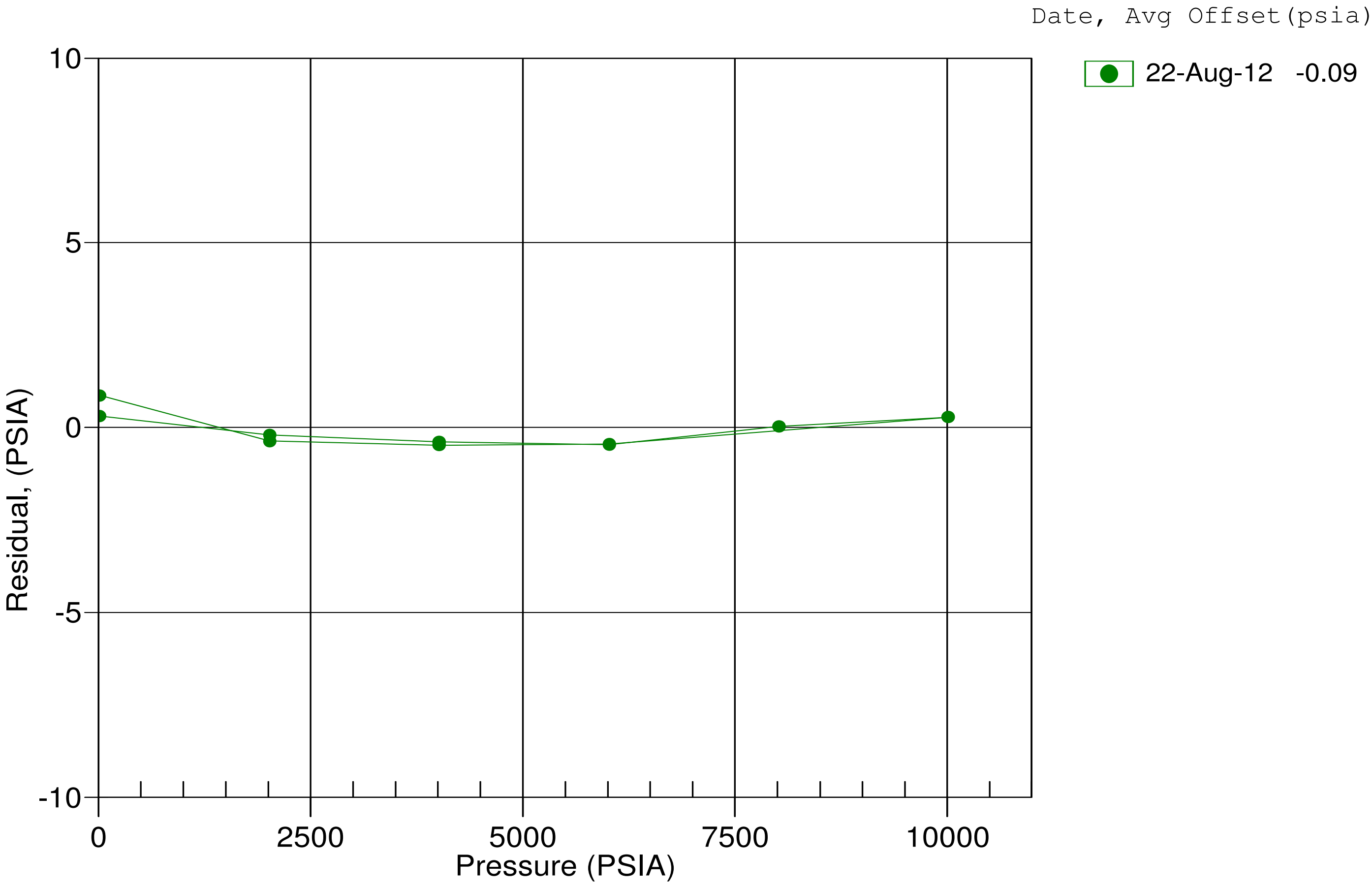
```
C1 =    -4.925971e+004
C2 =    -2.136250e-001
C3 =     9.435710e-003
D1 =     3.900400e-002
D2 =     0.000000e+000
T1 =     2.983458e+001
T2 =    -3.883229e-004
T3 =     3.262440e-006
T4 =     3.429810e-009
T5 =     0.000000e+000
```

AD590M, AD590B, SLOPE AND OFFSET:

```
AD590M =    1.27750e-002
AD590B =   -9.39146e+000
Slope =     1.00010
Offset =   -1.2714 (dbars)
```

PRESSURE (PSIA)	INST OUTPUT(Hz)	INST TEMP(C)	INST OUTPUT (PSIA)	CORRECTED INST OUTPUT (PSIA)	RESIDUAL (PSIA)
13.626	33531.21	20.9	16.333	14.489	0.863
2014.282	34203.76	21.6	2015.566	2013.914	-0.368
4013.980	34861.20	21.6	4014.956	4013.496	-0.484
6013.704	35504.54	21.8	6014.516	6013.249	-0.456
10013.336	36751.98	21.9	10014.494	10013.611	0.275
8013.357	36134.63	21.9	8014.458	8013.383	0.026
6013.753	35504.62	22.0	6014.548	6013.281	-0.472
4013.853	34861.30	22.0	4014.913	4013.454	-0.399
2014.018	34203.87	22.1	2015.466	2013.814	-0.204
13.734	33531.39	22.2	15.886	14.042	0.308

Residual = corrected instrument pressure - reference pressure



Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 5623
CALIBRATION DATE: 13-Apr-12

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.33512720e-003
h = 6.27614049e-004
i = 1.98087267e-005
j = 1.51407011e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS

a = 3.68121439e-003
b = 5.90405299e-004
c = 1.49503660e-005
d = 1.51541038e-006
f0 = 2931.200

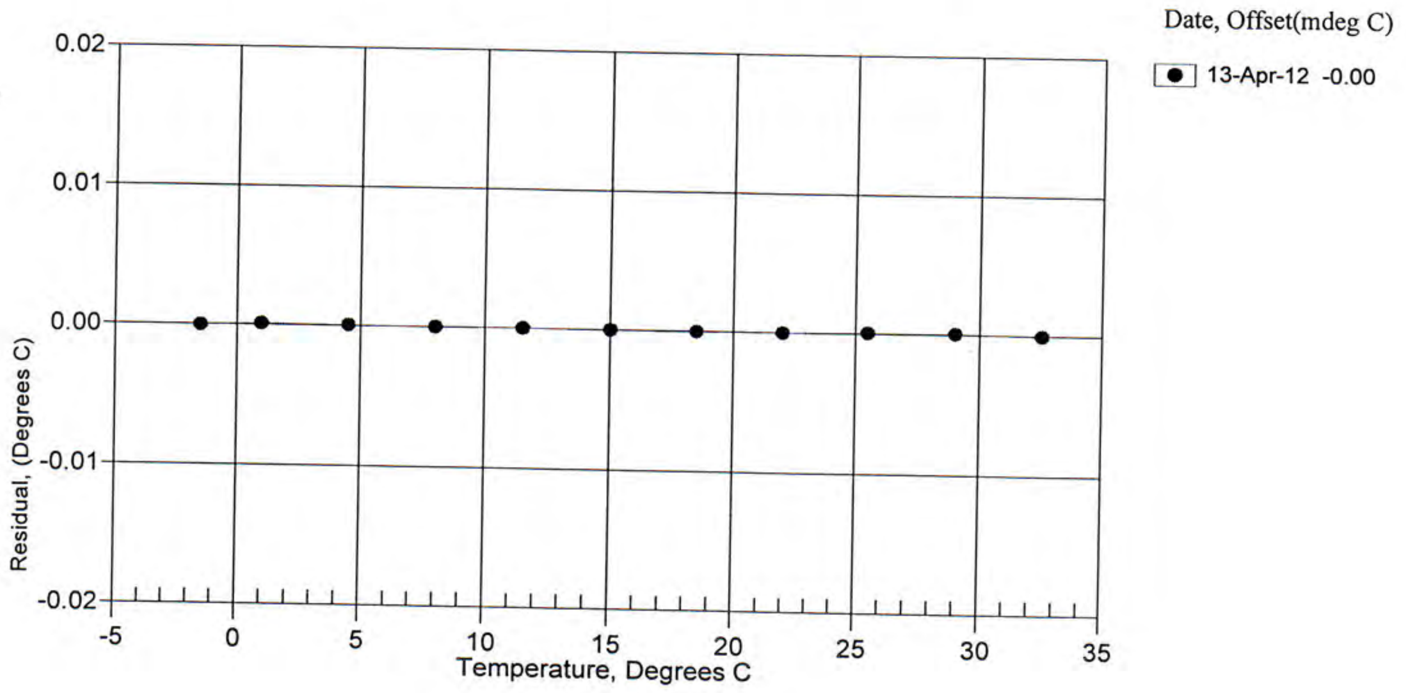
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5001	2931.200	-1.5002	-0.00005
0.9999	3102.996	1.0000	0.00007
4.5000	3355.644	4.5000	0.00002
8.0000	3622.837	8.0000	-0.00002
11.5000	3905.008	11.5000	-0.00000
15.0000	4202.561	15.0000	-0.00002
18.5000	4515.902	18.5000	-0.00003
22.0000	4845.428	22.0000	-0.00001
25.5000	5191.520	25.5000	0.00005
29.0000	5554.541	29.0000	0.00005
32.5000	5934.846	32.5000	-0.00005

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA
Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 5645
CALIBRATION DATE: 12-Apr-12

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.35334476e-003
h = 6.30144469e-004
i = 2.00303701e-005
j = 1.51938536e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS

a = 3.68121347e-003
b = 5.91676066e-004
c = 1.50337203e-005
d = 1.52073462e-006
f0 = 3010.224

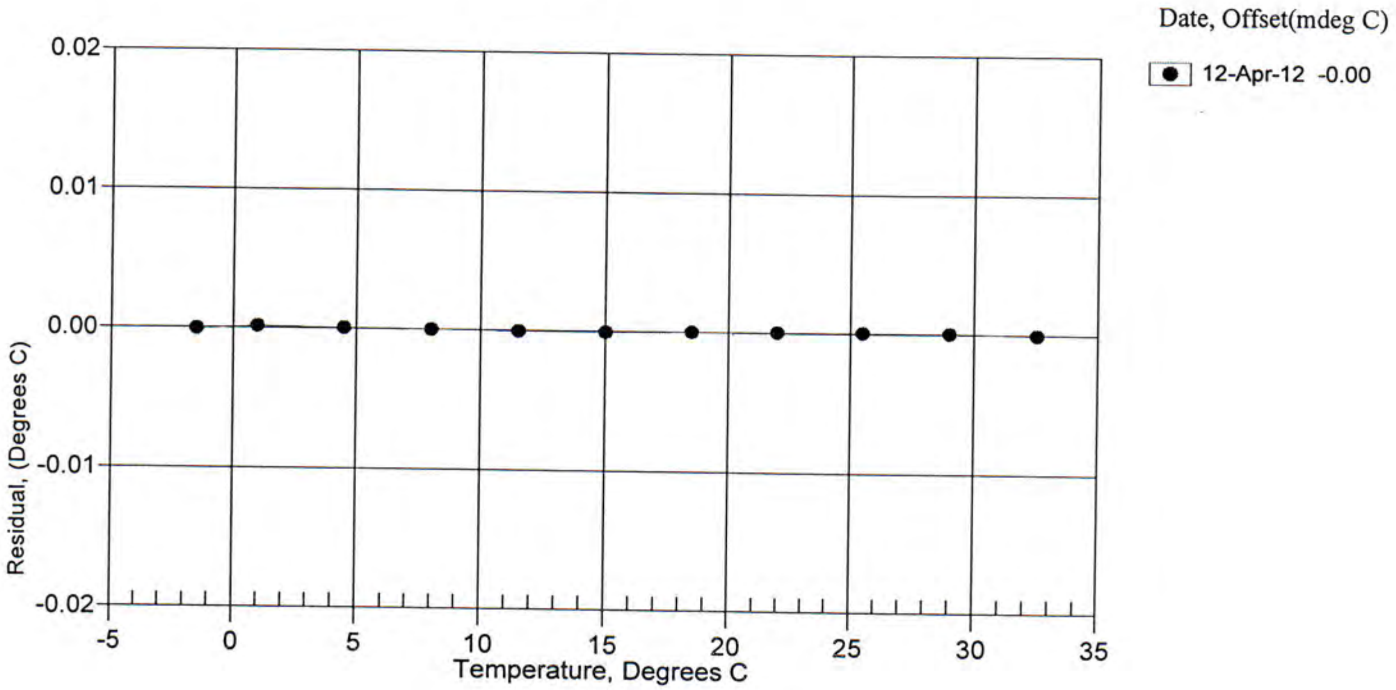
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	3010.224	-1.5001	-0.00008
0.9999	3186.260	1.0000	0.00011
4.5000	3445.108	4.5000	0.00004
8.0000	3718.816	8.0000	-0.00001
11.5000	4007.816	11.4999	-0.00006
15.0000	4312.532	14.9999	-0.00005
18.5000	4633.373	18.5000	-0.00000
22.0000	4970.730	22.0000	0.00002
25.5000	5324.997	25.5001	0.00006
29.0000	5696.541	29.0000	0.00003
32.5000	6085.726	32.4999	-0.00005

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



PO Box 518
620 Applegate St.
Philomath, OR 97370

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

WET Labs

C-Star Calibration

Date September 6, 2012 S/N# CST-527DR Pathlength 25cm

	Analog output
V_d	**0.059 V**
V_{air}	**4.806 V**
V_{ref}	**4.649 V**

Temperature of calibration water	**20.1** °C
Ambient temperature during calibration	**21.4** °C

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x, in meters): $Tr = e^{-cx}$

To determine beam transmittance: $Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$

To determine beam attenuation coefficient: $c = -1/x * \ln (Tr)$

V_d Meter output with the beam blocked. This is the offset.
V_{air} Meter output in air with a clear beam path.
V_{ref} Meter output with clean water in the path.
Temperature of calibration water: temperature of clean water used to obtain V_{ref}.
Ambient temperature: meter temperature in air during the calibration.
V_{sig} Measured signal output of meter.

VAISALA

CALIBRATION CERTIFICATE

Instrument	Digital barometer
Model	PTB210 Class B
Serial number	V1450002
Manufacturer	Vaisala Oyj, Finland
Calibration date	2000-04-10

The barometric pressure transmitter PTB210 has been compared at room temperature with Vaisala PTB220A working standards, calibrated on 20th of December 1999 with Ruska 2465 pressure balance primary standard at the Vaisala Measurement Standards Laboratory (Certificate no. G12203). All results are traceable to NIST.

Measurement results	Reference pressure [hPa]	Observed output [hPa]	Correction [hPa]
	509.80	509.81	-0.01
	609.70	609.71	-0.01
	699.78	699.78	0.00
	809.53	809.52	0.01
	909.38	909.38	0.00
	950.42	950.42	0.00
	999.65	999.64	0.01
	1097.53	1097.52	0.01

To obtain the true pressure, add the correction to the barometer reading. Interpolated corrections may be used at intermediate readings of the scale of the barometer.

For Vaisala Oyj

Technician

Vaisala Oyj
Vanha Nurmijärventie 21
FIN-01670 Vantaa, Finland

Tel. (+ 358 9) 894 9658
Telefax (+ 358 9) 894 9295
http://www.vaisala.com

Domicile Vantaa, Finland
Trade Reg. No. 96.607

VAISALA

CALIBRATION CERTIFICATE

Instrument	Digital barometer
Model	PTB210 Class B
Serial number	V1450003
Manufacturer	Vaisala Oyj, Finland
Calibration date	2000-04-10

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	950.42	950.42	0.00
	999.65	999.64	0.01
	1097.53	1097.52	0.01

To obtain the true pressure, add the correction to the barometer reading. Interpolated corrections may be used at intermediate readings of the scale of the barometer.

For Vaisala Oyj

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PO Box 518
620 Applegate St.
Philomath, OR 97370

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

C-Star Calibration

Date August 16, 2012 S/N# CST-396DR Pathlength 25 cm

	Analog output
V_d	**0.059 V**
V_{air}	**4.758 V**
V_{ref}	**4.660 V**

Temperature of calibration water	**23.2** °C
Ambient temperature during calibration	**21.4** °C

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x, in meters): $Tr = e^{-cx}$

To determine beam transmittance: $Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$

To determine beam attenuation coefficient: $c = -1/x * \ln(Tr)$

V_d Meter output with the beam blocked. This is the offset.
V_{air} Meter output in air with a clear beam path.
V_{ref} Meter output with clean water in the path.
Temperature of calibration water: temperature of clean water used to obtain V_{ref}.
Ambient temperature: meter temperature in air during the calibration.
V_{sig} Measured signal output of meter.

Calibration Certificate

LITREMETER
Specialist flow measurement engineering

TRANSMITTER
05/811950

WO 8497

Serial No	05/811950	*Meter Factor*	10715 Pulses/litre
Meter Description	05SPFA40CE	*Temp Rating*	70°C
Flow Range	0.02 - 1.3 l/min	*Press Rating*	40 bar

Body Code BODLUSN40WS
Part Construction:
Body 316 SS
Connection 1/4"BSP
Jet JET05LU
Socket Caps M416SC
O-Rings ORV027-Viton
Electronics EXDIR+

Test Flow Rate l/min	Pulses per litre	*Frequency Hz*
1.2956	10662	*230.237*
0.9977	10716	*178.187*
0.8241	10742	*147.540*
0.6271	10801	*112.889*
0.4072	10884	*73.867*
0.2334	10862	*42.252*
0.1206	10605	*21.315*
0.0572	10227	*9.750*
0.0222	9222	*3.412*

Ring Code RXPFASC6
Part Construction:

Ring Material 316SS
Bearing Holder 316SS
Cup Material Sapphire
Grub 316SS

Rotor Code ROTXPFASSJ6HS
Part Construction:

Rotor Material PFA
Shaft 316SS
Ball Material Sapphire
Ferrites 6 Sealed

Frequency Output:
1.300 l/min = 232.16 Hz
0.280 l/min = 50.00 Hz
0.336 l/min = 60.00 Hz

British Antarctic Survey

Calibrated by: Rig No: 013

Fluid: Water

M J Horne. Date: 09/06/11

Litre Meter Limited * Hart Hill Barn * Granborough Road * North Marston * Buckingham * MK18 3RZ
Tel: +44(0)1296 670200 * Fax: +44(0)1296 670999 * email: sales@litremeter.com

PAR

KIPP & ZONEN
SINCE 1830

CALIBRATION CERTIFICATE
PAR QUANTUM SENSOR

CERTIFICATE NUMBER	4674110127
SENSOR MODEL	PQS 1
SERIAL NUMBER	110127
SENSITIVITY	5.51 μV/μmol/s•m² at normal incidence and solar radiation at airmass 1.5
IMPEDANCE	240 Ohm
TEMPERATURE	22 ±2 °C
REFERENCE PYRANOMETER	Kipp & Zonen PQS 1 sn REF 2
CALIBRATION DATE	05-Jan-2011 (recalibration is recommended every two years)
IN CHARGE OF TEST	K.Lansbergen

Calibration procedure

Exact interchange of test PQS 1 and reference PQS 1 in a horizontal parallel beam of filtered light (NIR reducing filter) from a Xenon lamp. The photosynthetic photon flux density was approx. 400 μmol/s.m2. The Instrument temperature was approx. 25 °C.

Hierarchy of traceability

The reference PQS 1 has been calibrated **on 7 July 2010** against a standard of known spectral irradiance, the 1000 W DXW tungsten halogen lamp OL 200A-H-S, **S-961** supplied by Optronics Laboratories Inc. The standard lamp **S-961** has been calibrated with a filter radiometer at the Metrology Research Institute of the Helsinki University of Technololgy (HUT) on **12 June 2009** for a vertical distance of 412.5 mm and a lamp current of 8.0000 A. The trapdetector (UVFR-8) of the filter radiometer is traceable to the cryogenic electrical substitution radiometer of SP,Sweden.

The calibration of the reference PQS 1 was done at Kipp & Zonen with a lamp current of 8.0000 ±0.0005 A. The instrument was placed at a vertical distance of **412.5** ±1 mm between lamp filament and PQS 1 diffuser surface. The theoretically calculated PAR irradiance at the diffuser surface should be **231.7** μmol/s.m2. A trend (growth) interpolation is done between the spectral irradiance values supplied at intervals of 50 nm. The instrument temperature was approx. **30** ±5 °C.

Correction applied

Correction for false NIR-response during calibration of the reference PQS 1 is necessary. With a RG780 cut-on filter, covering the PQS 1, the response to the abundant NIR radiation in the lamp spectrum was measured. The response on NIR is divided by 0.917 to correct for the reflection losses of the filter. (Fortunately the amount of NIR is negligible during calibration of production PQS 1's in the beam of a Xenon lamp, because of the NIR-absorbing heat filter).The three measured sensitivities were **4.415, 4.408** and **4.401** with a mean of: **4.408** μV/μmol/s.m².

A second correction factor of **0.993** is applied to this sensitivity figure to give proper μmol/s.m2 results under hemispherical sunlight at airmass 1.5. This is necessary because of the non-ideal quantum-response curve of the PQS 1. The correction is calculated by convoluting the spectral response of an ideal PAR sensor and of the PQS 1 sn REF 2 with resp. the DXW lamp spectrum and the airmass 1.5 spectrum. The airmass 1.5 spectrum is taken from the international standard ISO 9845-1 and also with this radiation spectrum the false NIR response is negligible.
The sensitivity of the reference PQS 1 for AM1.5 radiation is: **4.38** μV/μmol/s.m2

Notice

The calibration certificate supplied with the instrument is at the date of first use. Even though the calibration certificate is dated relative to manufacture, or recalibration, the instrument does not undergo any sensitivity changes when kept in the original packing. From the moment the instrument is taken from its packaging and exposed to irradiance the sensitivity may deviate with time. See the 'non-stability' value (% change in sensitivity per year) given in the radiometer specifications.

Kipp & Zonen B.V.
Delftechpark 36, 2628 XH Delft
P.O. Box 507, 2600 AM Delft
The Netherlands

T: +31 (0) 15 2755 210
F: +31 (0) 15 2620 351
info@kippzonen.com
www.kippzonen.com

VAT no.: NL0055.74.857.B.01
Trade Register no.: 27239004
Member of HMEI

PAR

CALIBRATION CERTIFICATE
PAR QUANTUM SENSOR

CERTIFICATE NUMBER	4674110126
SENSOR MODEL	PQS 1
SERIAL NUMBER	110126
SENSITIVITY	5.56 µV/µmol/s•m² at normal incidence and solar radiation at airmass 1.5
IMPEDANCE	240 Ohm
TEMPERATURE	22 ±2 °C
REFERENCE PYRANOMETER	Kipp & Zonen PQS 1 sn REF 2
CALIBRATION DATE	05-Jan-2011 (recalibration is recommended every two years)
IN CHARGE OF TEST	K.Lansbergen

Calibration procedure

Exact interchange of test PQS 1 and reference PQS 1 in a horizontal parallel beam of filtered light (NIR reducing filter) from a Xenon lamp. The photosynthetic photon flux density was approx. 400 µmol/s.m2. The Instrument temperature was approx. 25 °C.

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A second correction factor of **0.993** is applied to this sensitivity figure to give proper µmol/s.m2 results under hemispherical sunlight at airmass 1.5. This is necessary because of the non-ideal quantum-response curve of the PQS 1. The correction is calculated by convoluting the spectral response of an ideal PAR sensor and of the PQS 1 sn REF 2 with resp. the DXW lamp spectrum and the airmass 1.5 spectrum. The airmass 1.5 spectrum is taken from the international standard ISO 9845-1 and also with this radiation spectrum the false NIR response is negligible.
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info@kippzonen.com
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VAT no.: NL0055.74.857.B.01
Trade Register no.: 27239004
Member of HMEI

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0130
CALIBRATION DATE: 21-Apr-05

SBE 45 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

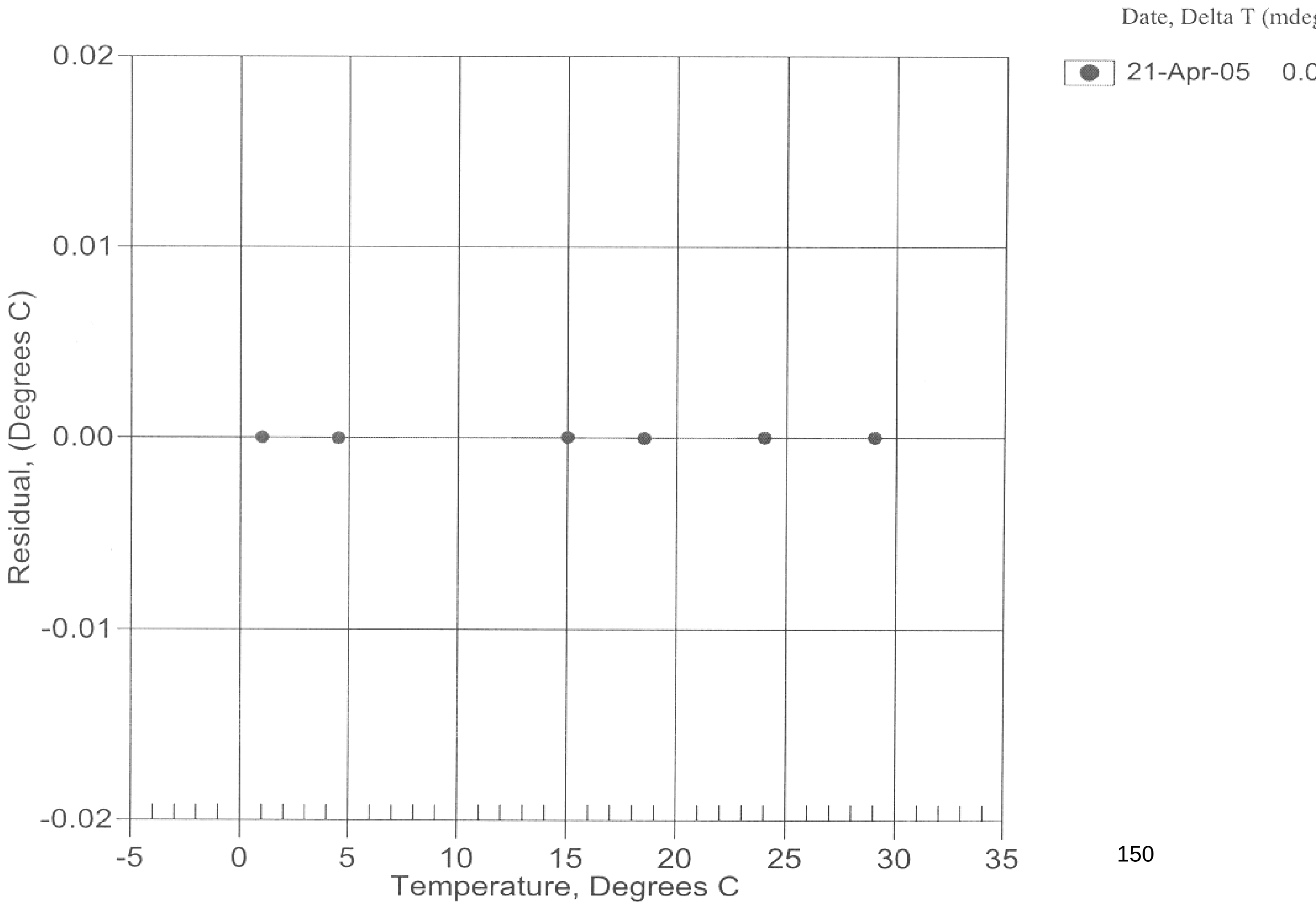
ITS-90 COEFFICIENTS

a0 = -2.479447e-004
a1 = 3.137811e-004
a2 = -4.923863e-006
a3 = 2.163881e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	791644.1	1.0000	0.0000
4.5000	678866.5	4.5000	-0.0000
15.0000	436364.6	15.0000	0.0000
18.5000	378890.0	18.5000	-0.0000
24.0000	305252.0	24.0000	0.0000
29.0000	252305.1	29.0000	0.0000

Temperature ITS-90 = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0130
CALIBRATION DATE: 21-Apr-05

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -1.032189e+000
h = 1.329214e-001
i = -2.217002e-004
j = 3.297668e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 3.4350e-006

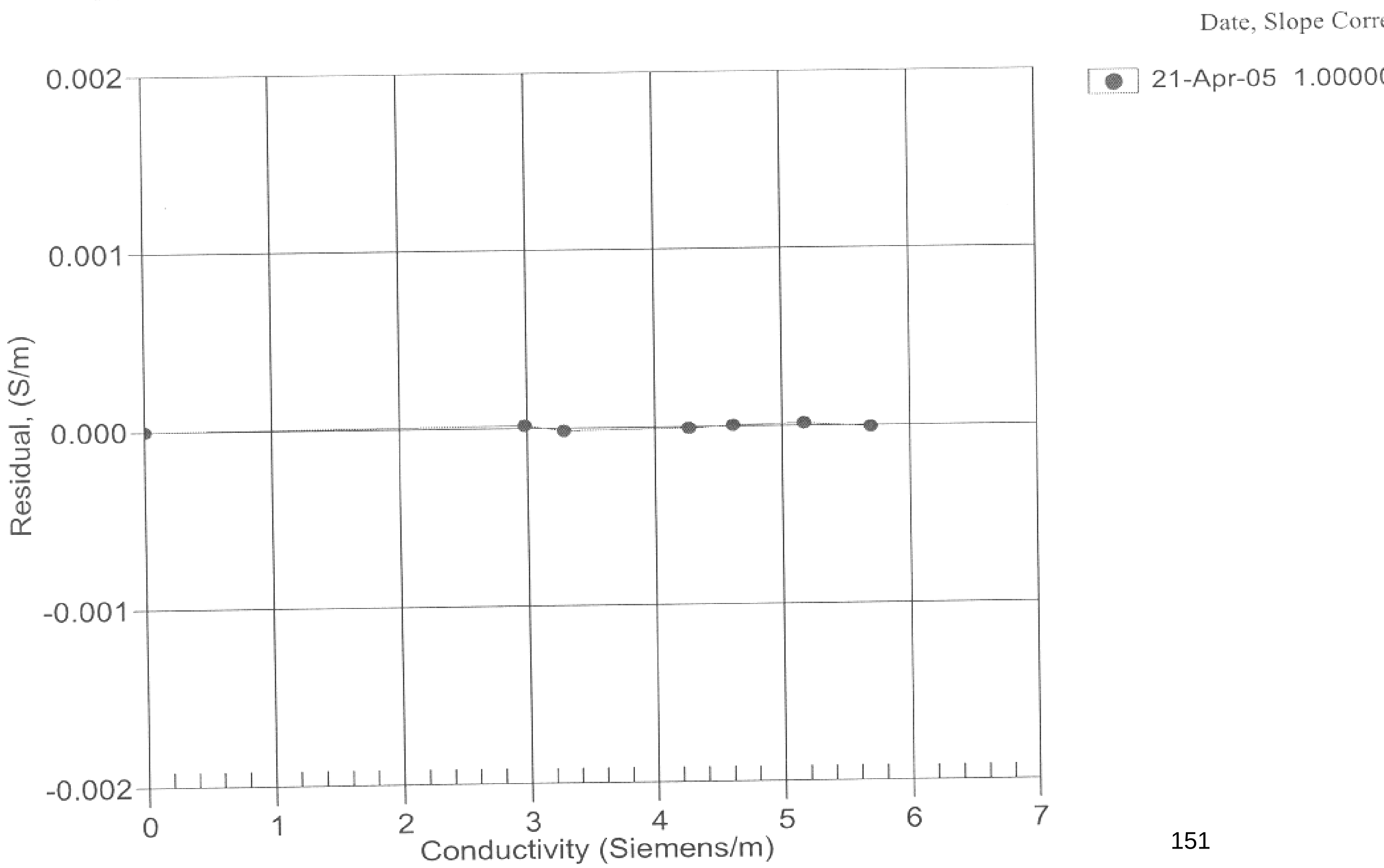
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2790.34	0.00000	0.00000
1.0000	34.8520	2.97873	5497.79	2.97874	0.00002
4.5000	34.8316	3.28603	5703.83	3.28601	-0.00002
15.0000	34.7873	4.26843	6316.86	4.26842	-0.00001
18.5000	34.7774	4.61377	6518.39	4.61377	0.00000
24.0000	34.7663	5.17201	6831.28	5.17202	0.00001
29.0000	34.7600	5.69413	7111.12	5.69413	-0.00001

f = INST FREQ * sqrt(1.0 + WBOTC * t) / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



Product Qualification

rotronic
LEADING IN HUMIDITY MEASUREMENT

Device type	**MP402H-050300**
Serialnumber	**0060743898**
RPC-number	**5-0125332275**

ROTRONIC AG certifies that this product meets the technical requirements defined in the specifications published for this product. The values reported below are valid for the specific product and serial number mentioned in this certificate. These values have been generated using calibrated precision test instruments.

Final Test

Firmware	V1.5-1
Analog Output	Out1: Humi 0..100%rH (0..20mA) Set: 40.00%rH, measured 39.92%rH (7.983mA) Out2: Temp -40..60°C (0..20mA) Set: 20.00°C, measured 19.95°C (11.989mA)
Printnumber	na
RS485-Address	0

Final test passed – 27.04.2011 – quality engineer: U. Sutter

ROTRONIC AG, Grindelstrasse 6, CH - 8303 Bassersdorf
www.rotronic-humidity.com

Product Qualification

rotronic
LEADING IN HUMIDITY MEASUREMENT

Device type	**MP402H-050300**
Serialnumber	**0060743896**
RPC-number	**5-0125329315**

ROTRONIC AG certifies that this product meets the technical requirements defined in the specifications published for this product. The values reported below are valid for the specific product and serial number mentioned in this certificate. These values have been generated using calibrated precision test instruments.

Final Test

Firmware	V1.5-1
Analog Output	Out1: Humi 0..100%rH (0..20mA) Set: 40.00%rH, measured 39.91%rH (7.981mA) Out2: Temp -40..60°C (0..20mA) Set: 20.00°C, measured 19.97°C (11.993mA)
Printnumber	na
RS485-Address	0

Final test passed – 27.04.2011 – quality engineer: U. Sutter

ROTRONIC AG, Grindelstrasse 6, CH - 8303 Bassersdorf
www.rotronic-humidity.com

CERTIFICATE OF FACTORY CALIBRATION **ROTRONIC AG**

Device Type:	**HC2-S3**
Serial No:	**0060599556 (V1.7)**
RPC:	**4-0123232415**

ROTRONIC AG certifies that this instrument meets the published specifications. It has been calibrated using standards and instruments as stated below and corresponds to the test requirements of ISO 9001-2008. The reference and service standards are traceable to national standards. The calibrated values are valid under above mentioned conditions only at the time of measurement and are referenced to the indicated references and working standards.

Reference system
HC2-S(SCS CERTIFIED)

Temperature adjustment [°C]

	Adjusted
1	0.00

Humidity adjustment [%rh]

	Adjusted	@ Temp[°C]
1	34.65	23.50
2	11.35	23.45
3	78.58	23.56

Temperature calibration [°C]

	Reference	Calibrated
1	23.57	23.55

Humidity calibration [%rh]

	Reference	Calibrated	@ Temp[°C]
1	79.41	79.53	23.53

Calibration Date: 16.03.2011
Finaltest - CH-8303 Bassersdorf, 19.03.2011, FZY-08002-V1, Inspector: F.Wolfensberger

CERTIFICATE OF FACTORY CALIBRATION **ROTRONIC AG**

Device Type:	**HC2-S3**
Serial No:	**0060599558 (V1.7)**
RPC:	**4-0119462370**

ROTRONIC AG certifies that this instrument meets the published specifications. It has been calibrated using standards and instruments as stated below and corresponds to the test requirements of ISO 9001-2008. The reference and service standards are traceable to national standards. The calibrated values are valid under above mentioned conditions only at the time of measurement and are referenced to the indicated references and working standards.

Reference system
HC2-S(SCS CERTIFIED)

Temperature adjustment [°C]

	Adjusted
1	-0.10

Humidity adjustment [%rh]

	Adjusted	@ Temp[°C]
1	34.65	23.48
2	11.40	23.45
3	78.45	23.57

Temperature calibration [°C]

	Reference	Calibrated
1	23.59	23.53

Humidity calibration [%rh]

	Reference	Calibrated	@ Temp[°C]
1	79.36	79.34	23.55

Calibration Date: 16.03.2011
Finaltest - CH-8303 Bassersdorf, 19.03.2011, FZY-08002-V1, Inspector: F.Wolfensberger

TIR

KIPP & ZONEN
SINCE 1830

CALIBRATION CERTIFICATE

CERTIFICATE NUMBER	004742112993
PYRANOMETER MODEL	SP Lite2
SERIAL NUMBER	112993
SENSITIVITY	**72.8** μV/W/m^2 at normal incidence and airmass 1.5 solar irradiance
IMPEDANCE	47 Ohm (nominal)
TEMPERATURE	22 ±2 °C
REFERENCE PYRANOMETER	Kipp & Zonen SP LITE sn064310 active from January 1, 2009
CALIBRATION DATE	26-Jan-2011 (recalibration is recommended every two years)
IN CHARGE OF CALIBRATION	K.Lansbergen

Calibration procedure

The indoor calibration procedure is based on a comparison with a reference SP LITE under an artificial sun fed by an AC voltage stabiliser. It embodies a 150 W Metal-Halide high-pressure gas discharge lamp. Behind the lamp is a reflector with a diameter of 16.2 cm. The reflector is 110 cm above the SP LITE stand producing a vertical beam. The irradiance at the SP LITE is approximately 500 W/m². First the signal of the reference SP LITE is registered. Next the signal is registered of one or more test SP LITE's in the same position as the reference SP LITE was before. Finally the reference SP LITE signal is registered again. A non-stability check is done and if OK (<1% drift), the test SP LITE sensitivity is calculated from the ratio; test signal / mean reference signal. Because test and reference SP LITE are of the same model, the indoor conditions have at principle no influence on the transfer of calibration. The above sensitivity is theoretically best for conditions as during the calibration of the reference SP LITE outdoors in Delft.

Hierarchy of traceability

The SP LITE sn064310 has been compared in Delft on July 24, 2008 with the sun and sky and reflected ground radiation as source under clear sky conditions. The global tilted radiation was measured with a pyranometer CM 11 sn913550. This reference pyranometer was compared with the sun and sky as source at the World Radiation Center Davos in summer 2007.

The instruments were placed side by side on a tracking platform in such a way that the direct radiation was always normal incident. Because the sensitivity of the SP LITE is spectrum dependent and changes during the day, Kipp & Zonen decided to calibrate its reference SP LITE only for Airmass 1.5 conditions (at 10:45 and 17:00 civil time). The instrument temperatures at these moments were ~27°C respectively 30 °C and the irradiance values ranged from 950 to 1000 W/m². The sky was blue and without clouds.

One sensitivity is determined from the measurement series consisting of 21 instantaneous voltage readings of the reference SP LITE and the belonging irradiance values as measured with the CM 11(applying its sensitivity of 4.70 μV/W/m² and taking into account its zero-offset) at civil time 17:00 with Airmass 1.5 conditions. The calculated mean sensitivity and its standard deviation (σ) for this time is 77.2±0.1 μV/W/m². The series were taken from a continuous record and log file of half minute averaged values (sampling time 1 s) which started not before 11:30. Consequently the second relevant mean sensitivity for Airmass 1.5 (at time 10:45) is estimated 77±0.5 μV/W/m² from an extrapolation (backwards) of the daily curve of SP LITE sensitivity. The average sensitivity and its standard deviation (σ) of the reference SP LITE for Airmass 1.5 hemispherical solar irradiance should be 77.1 ±0.3 μV/W/m².

Justification of total instrument calibration uncertainty

The combined uncertainty of the result of the calibration is the positive "root sum square" of three uncertainties.
1. The standard uncertainty due to random effects during the calibration of the reference SP LITE as given in the traceability text: **±0.3/77.1= ±0.4%**.
2. The standard uncertainty in the voltage ratio SP LITE / reference SP LITE due to lamp instability (measurements not simultaneously) is estimated to be ±1%.
3. The standard uncertainty due to spread in spectral response of an individual SP LITE relative to the reference SP LITE is considered to be ±2%.

This uncertainty accounts for a possible different voltage ratio during calibration with the Metal-Halide lamp spectrum indoors relative to the voltage ratio outdoors at AM1.5 conditions. (Each time the reference SP LITE is calibrated outdoors a random sample from stock is recalibrated outdoors and is checked for being within ±2% of its original sensitivity)
The combined expanded uncertainty is stated as twice (k= 2) the positive "root sum square" of these three standard uncertainties:
2*√(0.4^2 + 1^2 + 2^2)= **±4.5%**.

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Member of HMEI

TIR

KIPP & ZONEN
SINCE 1830

CALIBRATION CERTIFICATE

CERTIFICATE NUMBER	004742112992
PYRANOMETER MODEL	SP Lite2
SERIAL NUMBER	112992
SENSITIVITY	**71.5** µV/W/m² at normal incidence and airmass 1.5 solar irradiance
IMPEDANCE	47 Ohm (nominal)
TEMPERATURE	22 ±2 °C
REFERENCE PYRANOMETER	Kipp & Zonen SP LITE sn064310 active from January 1, 2009
CALIBRATION DATE	26-Jan-2011 (recalibration is recommended every two years)
IN CHARGE OF CALIBRATION	K.Lansbergen

Calibration procedure

The indoor calibration procedure is based on a comparison with a reference SP LITE under an artificial sun fed by an AC voltage stabiliser. It embodies a 150 W Metal-Halide high-pressure gas discharge lamp. Behind the lamp is a reflector with a diameter of 16.2 cm. The reflector is 110 cm above the SP LITE stand producing a vertical beam. The irradiance at the SP LITE is approximately 500 W/m². First the signal of the reference SP LITE is registered. Next the signal is registered of one or more test SP LITE's in the same position as the reference SP LITE was before. Finally the reference SP LITE signal is registered again. A non-stability check is done and if OK (<1% drift), the test SP LITE sensitivity is calculated from the ratio; test signal / mean reference signal. Because test and reference SP LITE are of the same model, the indoor conditions have at principle no influence on the transfer of calibration. The above sensitivity is theoretically best for conditions as during the calibration of the reference SP LITE outdoors in Delft.

Hierarchy of traceability

The SP LITE sn064310 has been compared in Delft on July 24, 2008 with the sun and sky and reflected ground radiation as source under clear sky conditions. The global tilted radiation was measured with a pyranometer CM 11 sn913550. This reference pyranometer was compared with the sun and sky as source at the World Radiation Center Davos in summer 2007.

The instruments were placed side by side on a tracking platform in such a way that the direct radiation was always normal incident. Because the sensitivity of the SP LITE is spectrum dependent and changes during the day, Kipp & Zonen decided to calibrate its reference SP LITE only for Airmass 1.5 conditions (at 10:45 and 17:00 civil time). The instrument temperatures at these moments were ~27°C respectively 30 °C and the irradiance values ranged from 950 to 1000 W/m². The sky was blue and without clouds.

One sensitivity is determined from the measurement series consisting of 21 instantaneous voltage readings of the reference SP LITE and the belonging irradiance values as measured with the CM 11(applying its sensitivity of 4.70 µV/W/m² and taking into account its zero-offset) at civil time 17:00 with Airmass 1.5 conditions. The calculated mean sensitivity and its standard deviation (σ) for this time is 77.2±0.1 µV/W/m². The series were taken from a continuous record and log file of half minute averaged values (sampling time 1 s) which started not before 11:30. Consequently the second relevant mean sensitivity for Airmass 1.5 (at time 10:45) is estimated 77±0.5 µV/W/m² from an extrapolation (backwards) of the daily curve of SP LITE sensitivity. The average sensitivity and its standard deviation (σ) of the reference SP LITE for Airmass 1.5 hemispherical solar irradiance should be 77.1 ±0.3 µV/W/m².

Justification of total instrument calibration uncertainty

The combined uncertainty of the result of the calibration is the positive "root sum square" of three uncertainties.

1. The standard uncertainty due to random effects during the calibration of the reference SP LITE as given in the traceability text: **±0.3/77.1= ±0.4%**.
2. The standard uncertainty in the voltage ratio SP LITE / reference SP LITE due to lamp instability (measurements not simultaneously) is estimated to be ±1%.
3. The standard uncertainty due to spread in spectral response of an individual SP LITE relative to the reference SP LITE is considered to be ±2%.

This uncertainty accounts for a possible different voltage ratio during calibration with the Metal-Halide lamp spectrum indoors relative to the voltage ratio outdoors at AM1.5 conditions. (Each time the reference SP LITE is calibrated outdoors a random sample from stock is recalibrated outdoors and is checked for being within ±2% of its original sensitivity)

The combined expanded uncertainty is stated as twice (k= 2) the positive "root sum square" of these three standard uncertainties:

2*√(0.4^2 + 1^2 + 2^2)= ±4.5%.

Notice

The calibration certificate supplied with the instrument is at the date of first use. Even though the calibration certificate is dated relative to manufacture, or recalibration, the instrument does not undergo any sensitivity changes when kept in the original packing. From the moment the instrument is taken from its packaging and exposed to irradiance the sensitivity may deviate with time. See the 'non-stability' value (% change in sensitivity per year) given in the radiometer specifications.

Kipp & Zonen B.V.
Delftechpark 36, 2628 XH Delft
P.O. Box 507, 2600 AM Delft
The Netherlands

T: +31 (0) 15 2755 210
F: +31 (0) 15 2620 351
info@kippzonen.com
www.kippzonen.com

VAT no.: NL0055.74.857.B.01
Trade Register no.: 27239004
Member of HMEI