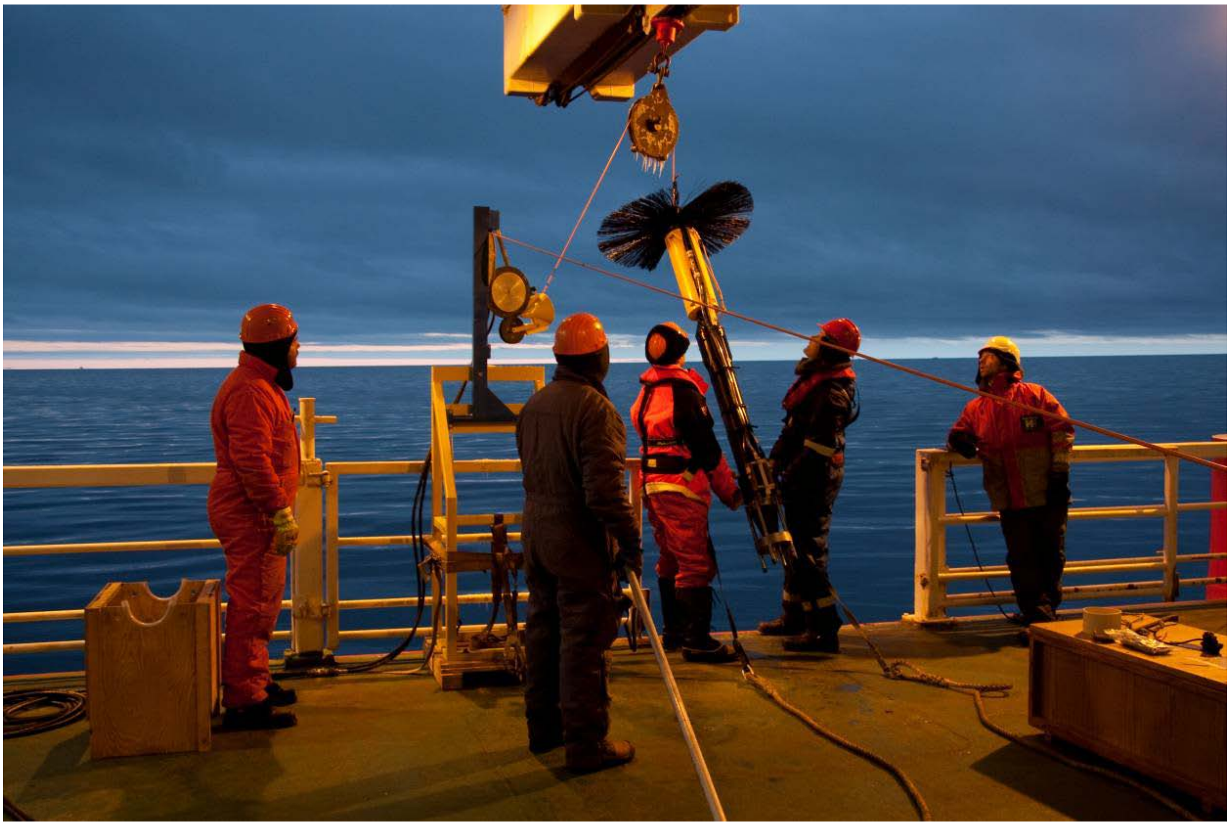
Report for Cruise ES033

Second ACES-FOCAS cruise to the southern Weddell Sea

RRS Ernest Shackleton

22 January to 7 March 2009



Compiled by Keith Nicholls from contributions by:

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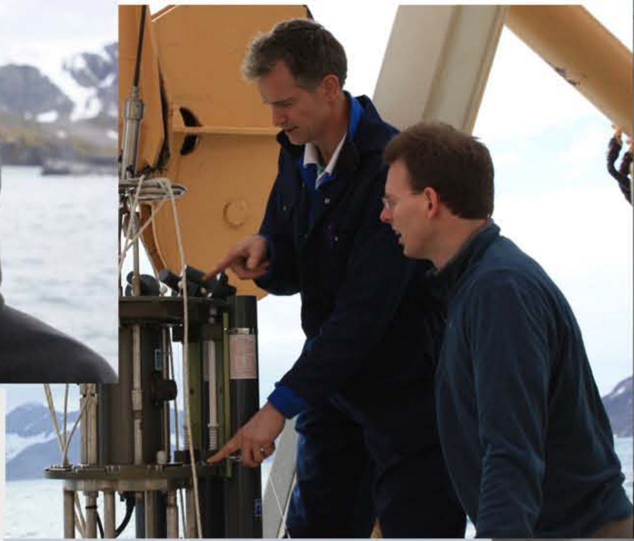


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Introduction

Overview

Various projects were involved in the cruise: SASSI (Synoptic Antarctic Shelf-Slope Interactions), an AFI-funded project whose PI is Professor Karen Heywood, UEA; the BAS core project ACES-FOCAS; the BAS LTMS-P programme, in collaboration with University of Bergen and Lamont-Doherty Earth Observatory; and BIAC (BIpolar Atlantic thermohaline Circulation), the Norwegian IPY programme. Additional projects were incorporated when HMS Endurance's Weddell Sea cruise was cancelled. These were primarily concerned with aerosol and air chemistry, and will not be discussed in this report.

The SASSI project involved the deployment of a current meter array across the continental shelf, shelfbreak and slope at around 17˚ West. The FOCAS element of the cruise aimed to recover moorings deployed two years previously, carry out a set of CTD sections repeating and complementing those of the previous cruise, and to deploy ten CTD tags on Weddell seals. The LTMS work was to turn around the Orkney Passage mooring array and the northern Weddell Sea M2 and M3 moorings, to recover mooring S2 at Filchner Sill, and to deploy a new style, bottom-mounted mooring at that same site. Additional LTMS-P work was the re-occupation of the Marguerite Bay CTD section, a task undertaken after the main cruise, during the last call to Rothera. Work for BIAC involved deployment of moorings over the continental slope west of Filchner Sill to monitor the Ice Shelf Water plume present in that location, and the use of a VMP microstructure profiler to study mixing processes in the plume.

Heavy sea ice, together with problems with some of the acoustic releases, prevented the recovery of several of the moorings, and the sea ice conditions prevented the BIAC plume study from going ahead at the preferred location. However, the BIAC team had been forewarned of this possibility and were able to switch to an alternate plan, which was carried out successfully. The CTD profiling work went smoothly, with full-depth LADCP profiles being recovered from 148 of the 175 casts. With one exception, the SASSI mooring array was successfully deployed, and a CTD/LADCP section recovered from along the array. All ten seal tags were successfully deployed on Weddell seals in the vicinity of Helmert Bank, at the eastern Filchner Sill. An additional activity was a multi-day yo-yo VMP sequence while the ship was moored at Brunt Ice Shelf during the final Halley call.

Personnel

Helen Atkinson	BAS	Air chemistry
John Beaton	SAMS	SASSI
Helge Bryhni	University of Bergen	BIAC
Cedric Chavanne	UEA	SASSI
Kjersti Daae	University of Bergen	BIAC
Brian Davison	University of Lancaster	Aerosols
Ilker Fer	University of Bergen	BIAC
Colin Griffiths	SAMS	SASSI
Bruce Huber	LDEO	LTMS (northern)
Keith Makinson	BAS	ACES-FOCAS, LTMS
Keith Nicholls	BAS	ACES-FOCAS, LTMS
Patrick Robinson	UC Santa Cruz	ACES-FOCAS (seals)

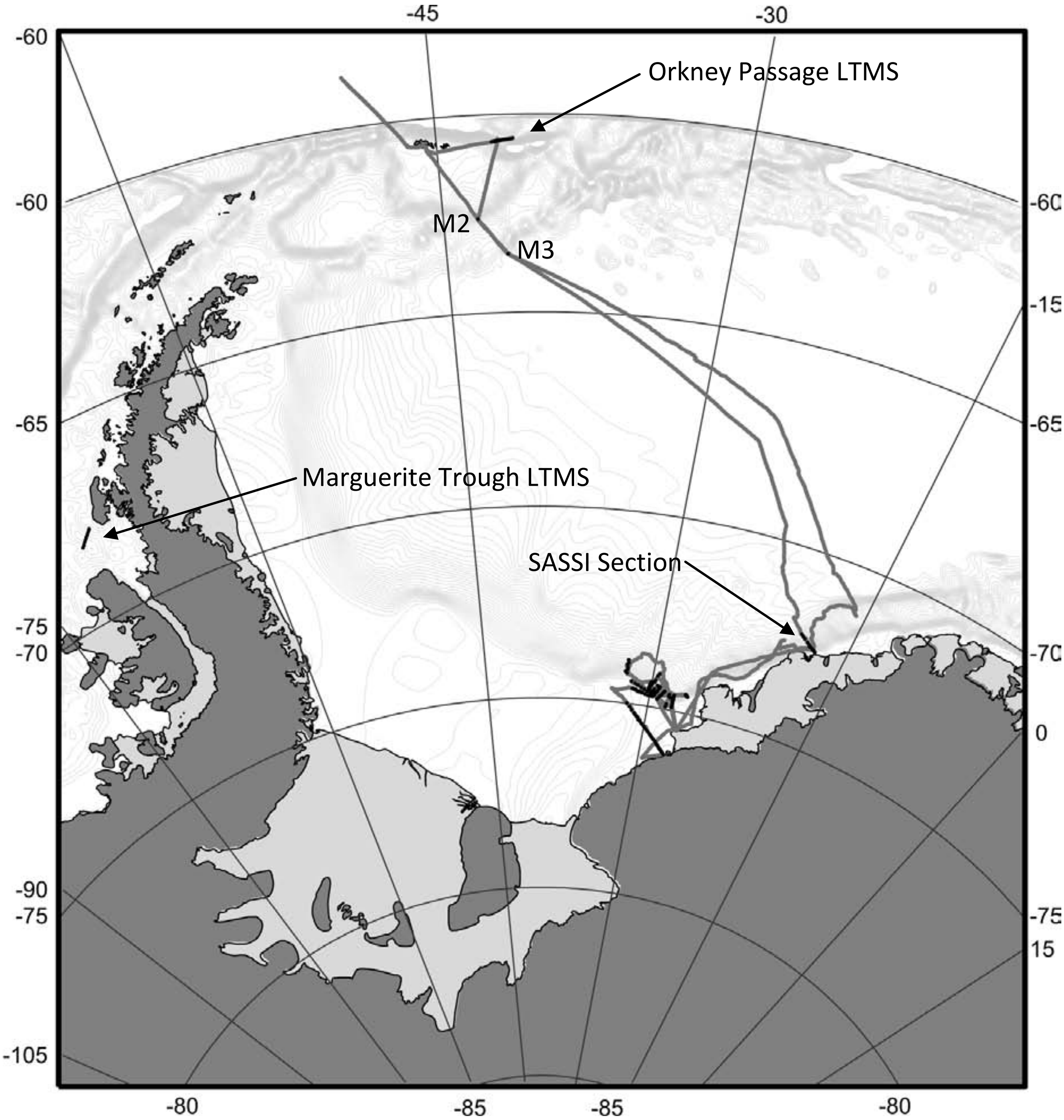


Figure 1. *Map showing cruise track (grey) and CTD stations (black). Bathymetric contours are in feint grey. Marguerite Bay LTMS CTD stations are included.*

Cruise narrative

The ship departed Stanley 22 January 2009, arriving at Signy on the 25th (see Figure Map). Three pax were dropped at Signy Base, and the ship departed for the location of mooring M2, a mooring deployed in early 2007. The mooring was recovered and a CTD cast was made at the site before sailing to M3. Nothing was heard from either of the paired releases at M3. We then sailed to the location for the deployment of the SASSI mooring array, arriving 29 January. A glut of sea ice was covering much of the area, but four of the six moorings could be deployed to make up the inshore part of the array at a longitude of ~018˚W. CTD/LADCP profiles were obtained at each mooring site.

The ship then sailed for Coast mooring, one of the FOCAS moorings, arriving 2 February. The mooring was released, but did not surface; it was finally recovered by dragging a wire across the mooring's location, which was determined precisely by triangulation.

CTD section A was occupied during January 3rd, and the ship then arrived at Mooring S2. Triangulation showed that the mooring was in an open pool within otherwise heavy sea ice, and the release was triggered. As in the case of the Coast Mooring, S2 did not ascend. The ice drift then caused the pack to cover the location and nothing more could be done. The new S2 mooring was then deployed, and the acoustic modem successfully tested. After checking to ensure that the old S2 mooring was still at the sea bed, the ship headed east and occupied CTD section B.

From this point onwards, the ship stopped to tag Weddell seals when appropriate candidates were identified. Ice cores were recovered during some of these opportunities as part of the air chemistry project. The ship visited mooring sites S4 and S4E during the occupation of Section B. The acoustic transponders on both moorings responded appropriately, but because of the difficult sea ice conditions they were not released. Sections C, D, E, F and G were then occupied over the next three and a half days, by which time all but 1 of the 10 seal tags had also been deployed. Also during this time the FOCAS mooring sites Slope North and Slope South were visited. Neither acoustic release responded. The sites were revisited later in the cruise, and, again, no response was received.

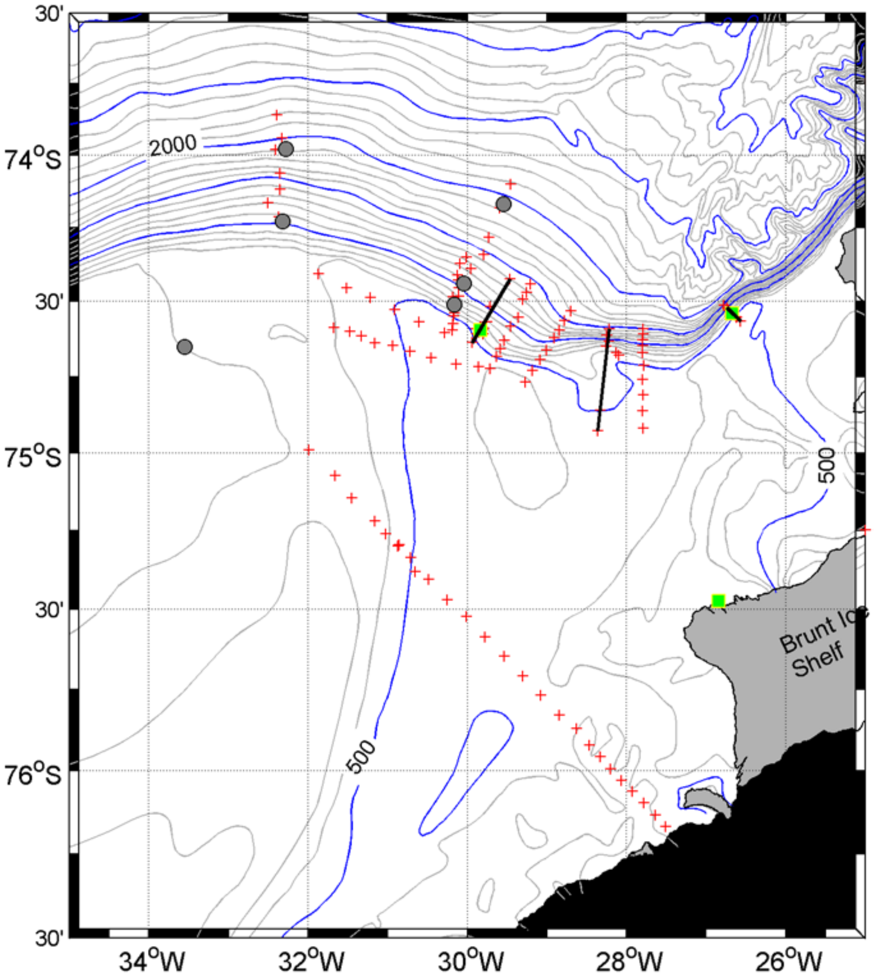


Figure 2. *Map showing activity in the vicinity of Brunt Ice Shelf. CTD stations (red cross), BIAC moorings (grey circles), VMP sections (black lines) and VMP/CTD yo-yo sites (green squares). The S2 mooring is the grey circle at the west side of the sill.*

The next week of the cruise was dedicated to BIAC, the Norwegian IPY programme. An attempt was made to reach the area of primary BIAC interest, but this was abandoned when it became apparent that conditions within the pack ice further to the west had worsened. The alternate plan involved deploying five instrument moorings on the Crary Fan (Figure 2), and undertaking a series of CTD/LADCP and VMP sections that complemented the CTD sections obtained to date.

Section H was occupied on Crary Fan, and two of the five BIAC moorings were deployed (BIACM1 and M2). A medivac to Halley delayed proceedings for 24 hr, after which Section I was occupied and the remaining three moorings deployed (BIACM5, BIACM4 and BIACM3). The ship was then mobilized for microstructure profiling (VMP). Over the following four and a half days, Sections J, K and L were occupied. Each section consisted of interleaved CTD/LADCP and VMP profiles. Sections J and L included 12-hour yo-yo stations in a water depth of around 600 m.

The ship again visited the locations of the FOCAS slope moorings to listen again for the acoustic releases, but to no avail. We then returned to Halley for the station's final call. A VMP yo-yo station was occupied for most of the period moored up at Brunt Ice Shelf, approximately three days in total. This was also an opportunity for Helen Atkinson to carry out an air chemistry experiment from a site near the ship, on the ice shelf itself.

After departing from Halley, the ship returned to the location of the SASSI section, from where the sea ice had cleared. The deep portion of the CTD/LADCP section was completed, and the final mooring deployed. A PIES (pressure inverted echo-sounder) was not deployed, as a result of a spurious diagnostic that erroneously suggested that the instrument had developed a fault.

The ship then returned to the location of the M3 mooring in the northern Weddell Sea, and a grid of listening points occupied in an attempt to communicate with either of the mooring's acoustic releases. Again, nothing was heard. A new M3 mooring was deployed and a CTD/LADCP profile obtained. The M2 site was then visited, and new M2 mooring deployed and CTD/LADCP profile obtained.

We sailed to Orkney Passage to service the BAS/LDEO mooring array. Mooring OP3 and OP2 were successfully released, but there was no response from the short but deep OP1. The OP CTD/LADCP section was occupied, and the two moorings OP2 and OP3 re-deployed. The SASSI project's PIES was deployed near the site of OP2.

With the Weddell science cruise now complete, the ship visited Signy, closing down the base and embarking the personnel. Ernest Shackleton arrived back at Stanley on 7th March 2009.

Keith Nicholls and Colin Griffiths remained on board for the final call to Rothera, in order to repeat the LTMS-P CTD section in Marguerite Bay.

CTD Operations

Winch

Description and installation

The CTD winch had originally been built for BAS in 1997. It was first used on *HMS Endurance* during the 1998 ROPEX cruise to the Weddell Sea. Maintenance and storage was arranged by BAS until the equipment was given to what was then known as UKORS, based at SOC (now NMF-SS at NOC). The winch was next used by BAS during the 2007 *Ernest Shackleton* cruise (ES031) to the Weddell Sea. This present cruise (ES033) is the winch's third outing.

The winch is hydraulically-powered, and has a built-in hydraulic power pack. It has a 10-foot container footprint. There is a built-in hydraulically-powered A-frame. The winch presently holds around 6000 metres of coaxial, electromechanical cable, and has been used for full-depth casts in 4700 metres of water. The winch was mounted amidships, on the starboard side, and CTD operations were not overly susceptible to poor weather conditions.

Various recommendations were made to improve the winch after its first season, some of which were acted upon. The biggest unresolved problem was the scrolling system, which, on one occasion during the second season, broke down entirely. The scrolling system was completely overhauled during 2008, and worked flawlessly during the entire ES033 cruise.

Comments, and problems encountered

Winch drum: The winch drum appeared to rotate perfectly true during the first shallow test cast. After the second cast, which was a deep cast, the drum was visible out of true, such that an interior guard fouled the left hand cheek (looking outboard) during part of the revolution. The guard had to be unbolted to remove the source of the abrasion. The scrolling was unaffected, and the alignment did not appear to worsen during the remainder of the cruise.

Hydraulic oil heater: The heater did not come on, even during very cold conditions. The fault was traced to the thermostat, which had to be bypassed. For the rest of the cruise the heater was switched on by hand when it was needed.

Drum rotation: As on previous cruises, the drum appears to rotate jerkily at slow speeds, between 15 and 60 m/min. This is most noticeable when the winch is cold, and while paying out.

Line-out and speed gauges: Towards the end of the cruise the line-out gauge on the remote control failed. The gauge on the main panel continued to work for a time, as did both wire speed gauges. The line-out gauge on the main panel then failed also. Later, both speed gauges stopped working. When the remote unit was opened up it became clear that sea water had got inside.

Responsiveness of remote control: A curious effect was that the remote payout/heave lever would initially not allow heave at the full speed allowed by the lever at the winch. After a few minutes the rate of heave did increase on the remote lever. This became particularly bad late in the cruise. It is possible that it is connected with water ingress.

Recommendations

Detachable main control panel: The winch is usually mounted in advance of the CTD work, and is likely to take a great deal of heavy weather. Even though the panel's cover is in place during transit to the work area, it is suffering a great deal of corrosion, and a detachable unit would increase the reliability of the winch as a whole.

Heated sheave wheel cheeks: As in the previous two seasons, the sheave suffered from icing, causing the wheel to bind occasionally. This can be dangerous, as it occurs during heaving, and the line-out gauge becomes inaccurate. The result can be that the CTD frame is nearer to the surface than the winch driver expects. Either heating the cheeks, or re-engineering the sheave arrangement to increase the gap between cheeks and wheel would resolve the problem.

Re-engineering remote box: The remote unit is crucial to the operation of the winch. Its enclosure should, however, be made watertight. The two very large cables connecting the remote control to the winch main panel are particularly ungainly, which makes it difficult to keep the unit out of the weather. It would be very beneficial for the link to be made either wireless, or with less bulky cabling so that the remote unit can be more easily unplugged and brought inside when not in use.

Containerised wet lab

Description and configuration for the cruise

A 10-foot shipping container had been modified for use as a water bottle annex, or wet lab, for use on RRS Ernest Shackleton during the 2006-07 FOCAS cruise to the Weddell Sea. The same wet lab, dubbed the "CTD Shack", was used during the present cruise. Rather than two container doors, the shack has a container-style cargo door and a personnel door. Along one wall there is a line of 12 pairs of clips to take Niskin bottles. The other wall is fitted with a bench. There is fluorescent lighting, a small convector heater, and a 240 V ship's power supply point. A cable gland allows cable access to the Shack.

The shack was used to house the deck unit for the CTD and the CTD computer, for decanting water samples from the Niskin bottles (which had to be removed from the CTD rosette and carried inside), and to house the computer used to configure and download data from the LADCPs.

A telephone connected to the ship's telephone system was installed, together with signal cabling to the EA600 precision echo-sounder on the bridge. Cabling was also installed to bring the CTD signal to the deck unit, and to connect the LADCP computer to the LADCP instruments between casts. Additional cabling was needed to connect a CCTV camera mounted on the exterior of the Shack to the camera controller and monitor inside.

The EA600 on the bridge combined a GPS feed and the picked depths from the echo sounder itself to form an NMEA output stream. That stream was converted to RS422 using an RS232 to RS422 converter, and then sent to the Shack using Cat5 cabling. In the Shack, another converter transformed the signal back to RS232, which was then presented to the CTD computer. The navigation program SeaClear II was installed on the CTD computer, and used to take and display the ship's location and the water depth on a bathymetric chart. SeaClear echoed the NMEA data strings to the NMEA input on the CTD deck unit. This was necessary as the precision of the GPS position strings from the EA600 was too high for the deck unit: it appeared to reject them as erroneous data. Once echoed from SeaClear, however, the position data were correctly interpreted by the deck unit.

Comments and suggestions for improvements

The arrangement worked as well as could be expected, bearing in mind the need to dismount bottles from the rosette and carry them to the shack for drawing samples. To make the procedure safer and less onerous new 2.5 litre Niskins were purchased for this cruise. Ten-litre Niskins had been the smallest available for previous cruises.

Having a CCTV system was highly beneficial, giving confidence to the operator inside the (windowless) Shack that the winch is functioning properly, and providing a means of visual communication from the winch operator to the CTD operator. It also meant that, when space had been made available by the removal of the LADCP computer, the winch remote control could be brought into the shack, routing the cables through the cable gland. This arrangement removed the need for personnel on deck during the cast and worked well for the Marguerite Bay LTMS section.

Useful improvements would be:

1. Installation of shelving above the bench: this would help clear the bench of water sampling consumables, such as caps, labels etc. and could be easily achieved using Unistrut components.
2. Installation of an additional heater, or the replacement of the present one with a more powerful unit. During the colder nights, the present heater struggled to keep the shack at an acceptable temperature.
3. Installation of a suitable door arrestor. The one supplied with the shack never worked properly.

CTD equipment

Description

NMF-SS supplied the CTD fit for the cruise. The fit consisted of:

stainless steel CTD frame;
24-way General Oceanics water bottle carousel, with the necessary battery pack;
Seabird SBE 9 plus CTD, including 2x pumped CT channels and pressure sensor;
Benthos altimeter;
Seabird SBE 11 plus deck unit, plus CTD computer and UPS.

The BIAC team supplemented the CTD system with a pair of 300kHz RDI LADCPs, which the ship's engineering department mounted on the CTD frame.

Performance

NMF-SS were unable to supply any spare sensors or pumps. Fortunately, both TC sensor pairs performed well, although the derived salinity from both showed a large offset from the salinometry (see salinometry section below). The initial SASSI CTD section showed very noisy CT data from the primary channel. This was traced to a damaged pump rotor, but the pump worked flawlessly once the shards of rotor had been removed.

With the exception of its reluctance to process the GPS data direct from the EA600 NMEA stream, the deck unit worked perfectly throughout the cruise, the UPS was of great value, and the performance of the NMF-SS-supplied computer was impressive, certainly compared with the PC that had been taken along as a backup.

The Benthos altimeter worked reasonably well: the worst case was a first bed return at a range of 27 m. When the CTD was stripped down at the end of the cruise, the pins on the altimeter plug showed evidence that there had been leaking during the cruise.

For work in cold climates the General Oceanics carousel should be avoided. In fact, if there is a likelihood of encountering freezing conditions the GO carousel is not a practical option. Many delays were caused by freezing up of the pins that need to be depressed to engage the lanyards when cocking bottles. A hair-drier had to be brought out on deck routinely to defrost the top of the carousel. On the other hand, the alkaline battery pack needed to power the GO rosette gave no trouble throughout the cruise, despite the cold conditions.

Water sampling

The particular Niskins that BAS purchased for the cruise had internal neoprene elastic to close the caps. A particular problem found using these bottles was that if they remained cocked for a few hours in cold conditions the neoprene did not return to its original length. At one point the lower cap on some of the bottles was hanging loosely. Clearly metal springs would have been more satisfactory. Poor closure accounted for several bad water samples until the problem was identified.

To obtain samples, the Niskins needed to be removed from the rosette and brought into the shack. The biggest problem encountered was ice in the samples. Once ice had formed, it is not possible to get a good sample for salinometry. In some cases, the problem was only icing in the spigots, in which case a good sample could be obtained once the spigot had thawed out.

Samples were drawn for salinity determination and/or $\delta^{18}O$ measurements. When full, crates of salinity samples were moved from the shack to the Wet Lab, where the NMF-SS Autosal had been installed. After a minimum of a day of acclimatizing, the salinity samples were run using standard procedures. The Autosal worked well, except for the failure of the cabinet cooling fan in the back panel. The panel was removed, and the salinometer temperature stabilized at a satisfactory level.

Salinities derived from the CTD system showed large offsets (~0.01) from the results of the salinometry. The large scatter seen in the comparison with salinometry (Figure B1) initially suggested that sampling technique was at fault. However, the scatter was later ascribed to difficulty with sampling in icing conditions, and faulty Niskin cap closures. Comparison with historical data supported the theory that there was a real offset in the conductivity sensors, despite the good agreement between the sensors themselves. Post-cruise calibrations showed no significant change since the calibrations undertaken during the summer prior to the cruise (2008). A similar effect was seen with different sensors, though the same models, during the 2006-07 cruise to the southern Weddell Sea.

LADCP

LADCPs were installed on the water bottle rosette on 25/01/2009. The Slave was upward-looking (SN 10012), the Master was downward-looking (SN 10151). They were connected using a co-axial cable fitted for two ADCPs. Filenames for the data were named ES033_XXX_LADCPM.000 for Master, or ES033_XXX_LADCPS.000 for slave, where XXX is the CTD station number.

The LADCPs were connected using a star-cable. The upward-looking Slave did not record during the first cast as a result of a software error, but worked properly from the second cast until one of its beams broke during cast 049. It was deployed until cast 059 when this malfunction was detected. Upon inspection of SN10012, after cast 59, corrosion due to leakage through transducer 1 was detected and photographed prior to cleaning.

At this point the master ADCP was also removed from the rosette, reserved for deployment at the BIAC sites. The master ADCP was re-installed prior to cast 087 and used for the remainder of the cruise.

For data processing, the NMEA latitude/longitude stream was recorded with each scan of the accompanying CTD profiles, which were later 1-s bin-averaged to match the LADCP data.

Following cast 025, at the same station location, seal-tags were attached to the rosette and 4 yo-yo casts were conducted, recorded in cast 026. For processing purposes, the original file was divided into subsections, one file for each down-up cast of the yo-yo cycle, using BBSub.exe from the RDI Tools. The new files, in raw format, are saved as 2601, 2602, 2603, and 2604, with the last figure corresponding to the cast number.

The setup files for the LADCPs are given in Appendix A

Microstructure profiling

The microstructure profiling was part of the Norwegian BIAC project. The equipment was the Vertical Microstructure Profiler (VMP-2000, SN 009) from Rockland Scientific International, which comprises the profiler itself, a winch, and a line puller mounted at the stern railings. In a normal configuration, a sheave is mounted between winch and line puller. During this cruise, because of the low headroom beneath the helideck, a sheave was arranged outboard of the line puller (see cover picture for configuration). This worked fine, with no evidence of signal contamination that would have resulted from a taut suspension tether.

The instrument is rated for 2000 m depth. It is a free-falling tethered instrument with power supplied to the instrument via the tether cable. Data are transmitted in real-time up the tether cable. From the slip rings on the winch, the signal/power cable ran via a cable gland into an interface and computer in the Wet Lab and displayed and logged on a Dell XPS M1330 laptop PC (winXP) with a UTRANS (Universal Serial Bus Transceiver) attached to the USB port and ODAS4-RT data acquisition software.

The VMP consists of a main pressure case machined for mounting accessories and sensors, a nose cone for fitting the microstructure sensors, and a fin attached at the rear. Fully assembled, its length is about 2.3 m, and its weight approximately 45 kg in air and 6 kg in water. VMP SN009 has a nominal fall rate of about 60 cm s^{-1} (about 10 cm s^{-1} slower than standard VMPs). The drag brushes, flotation, cable termination and a Sea-Bird SBE5 pump are mounted on the fin.

The main pressure case contains a set of three orthogonally mounted accelerometers for measuring profiler attitude (tilt) and profiler vibration levels in x/y/z coordinates and a pressure transducer (Kelley). Also housed in the pressure case is the electronics for signal conditioning, A/D conversion, data transmission and anti-aliasing filters. Up to six turbulence sensors can be mounted on the nose cone, protected by a probe guard. For this cruise the VMP was fitted with two air-foil shear probes, one FP07 fast-thermistor and a Sea-Bird SBE7 micro-conductivity probe.

A pair of Sea-Bird SBE-3 temperature and SBE-4 conductivity sensors provided precision CTD measurements, and are mounted on the pressure tube about 40 cm from the microstructure sensors. Signal-plus-signal-derivative were sampled on thermistors, micro-conductivity and pressure transducer (Mudge-Lueck technique), and the signal derivative from the shear probes. The set up file for the VMP is listed in Appendix F.

The VMP was deployed using a winch system manufactured by Sytech Research, Canada consisting of a winch that is directly driven by a hydraulic motor, a line-puller that continuously feeds the tether into the water and an electrically driven hydraulic pump that supplies hydraulic fluid to run the winch and line puller. The winch and line-puller system was specifically designed to operate the VMP and ensures that enough tether is fed into the ocean to maintain free-fall. The drum is fitted with 2500 m of 0.27" diameter cable.

Three personnel were required to run the system: one to run the PC and pass instructions to the winch operator, the winch operator himself and an additional person to watch the tether over the stern.

Profiling in sea ice was challenging. For most casts the ship was positioned in a pool of open water, the azimuthal thruster lowered and the propeller declutched, and the vessel moved slowly forwards. This removed any danger of the VMP tether becoming entwined in the propeller. However, the procedure became awkward if the ice was moving rapidly. The low temperatures caused icing of the outboard sheave and the sheaves in the line puller. The line puller sheaves in particular needed to be mechanically de-iced between each cast

Mooring activities

Mooring activities were a major part of the cruise, with most discrete projects having significant mooring components. The SASSI mooring array was prepared in the main cargo hold; the Norwegian BIAC array was prepared mainly on the helideck, with instruments being prepared in the dry lab; the CORC-ARCHES/BAS LTMS moorings were assembled on the afterdeck, with instruments being prepared in the wet lab. Mooring diagrams are given in Appendix D.

M2 and M3

Moorings M2 and M3 in the northern Weddell Sea (see Figure Map) are the two remaining moorings from the CORC-ARCHES northern Weddell array. These were last recovered and redeployed during ES031, in 2007. Unfortunately, only M2 was recovered this year; neither of the two paired releases on M3 responded to the acoustic command unit. M2 was recovered on the southbound leg of the cruise. This gave BH the opportunity to service the instruments and download the memory modules. On the northbound leg, towards the end of the cruise, a new M3 mooring was constructed and deployed, together with a much reduced version of M2.

SASSI moorings

The shallowest SASSI moorings, SASSI1, 2, 3 and 4, were deployed on the southbound leg of the cruise. SASSI 5 was deployed on the way north. The location of the mooring line is shown in the map in Figure 1.

Coast Mooring

Coast Mooring was deployed off the Luitpold Coast (south west of Brunt Ice Shelf) during ES031 in 2007. The acoustic release on the mooring responded to the command unit but did not arrive at the surface after the release was triggered. The mooring was only 10 m or so in height, but was in only in about 200 m of water. Following CG's advice, a line was rigged in a U shape, from the stern of the ship to the bow with 50-ton shackles used as weights to maintain the shape of the U. The ship was then slowly thrust over the site of the mooring, which then popped to the surface. We assume the acoustic release's hook had jammed in the release ring.

S2 and New S2

At the location of S2 the ice was moving relatively quickly, although there was an open pool available for the recovery of the mooring. Again, the release responded to the acoustic command unit and the release command was sent. But, again, the mooring failed to surface. We assume that the hook has again jammed in the release ring. The mooring was too deep to dredge with the line that was available and had to be left.

The new S2 bottom frame consisted of RDCP 600 SN 240, RCM-9, SN 1437 and Argos SN/id 266/46244, and was released on 04/02/2009 1400 UTC, at 74° 39.05′ S, 033° 32.97′ W where ship's echo sounder read 602 m. The host modem communication set-up is

Baud rate	57600
Data bit	8
Parity	None
Stop bit	1
Flow control	None

The frame was lowered attached with an acoustic release to ~550 m wire, and was released about 20 m above the bottom. Diagnostics of the frame release confirmed that the release was in upright orientation. Communication with the remote modem was established and the first data files were retrieved from the RDCP600. The frame release is an Ixsea Oceano type, SN 982 with codes:

Arm/range: 18C5
Diagnostic: Arm + 1849
Release: Arm + 1855

S4 and S4 East

S4 and S4E were deployed during ES031. They were visited during this cruise, and the acoustic releases responded appropriately. Heavy sea ice meant that we did not attempt to recover the moorings.

BIAC moorings

The BIAC moorings could not be deployed in the planned plume location as a result of the difficult sea ice conditions. Instead they were installed on the central Crary Fan and further to the east.

BIAC M1

M1 is deployed anchor first, on 10022009 1739UTC, at 74° 13.681′S, 032° 19.194′W. Echo depth was 1096 m, corrected 1070 m and 1081 dbar. Release is AR261 SN:50 with codes, INT: 9636, REL: 9635.

The knot attaching a gash nylon rope to the top of the mooing for the final part of the deployment came undone, which meant that the final part of the release was not fully controlled.

BIAC M2

Anchor-first deployment of the original M2 was not successful. Halfway through the deployment a 100 m Kevlar line broke in the middle. The line was loaded with about 660 kg anchor weight and parted on 11/02/2009 at 0140 UTC, at 73° 58.9′S, 032° 24.5′W (echo depth 1887 m) before any flotation elements were attached to the line. The following instruments were lost: AR191 SN006 Acoustic release; SBE37s SN 5399 / 5450 / 5407; SBE39s SN 3567 / 3568; RCM7 SN 3651; Aquadopp 1.2kHz SN 0649.

Using the remaining instruments and mooring material, a shortened mooring was designed and deployed successfully. M2 was deployed, anchor last, on 11/02/2009 at 1806 UTC, at

73° 58.678′S 032° 16.682′W. Echo depth was 1960 m, corrected to 1913 m and 1940 dbar. Release used is AR661 SN:264 (INT: 9170; REL: 9179).

The Kevlar line that parted on M2 had been used on an unknown number of moorings in the past, and might have suffered damage. The suspicion therefore fell on the line itself. However, anchor-first deployments with reused Kevlar line are routine on Norwegian ships, and free of incidents. It is therefore possible that some responsibility might lie with the methods used in the deployment: the lack of equipment on the Shackleton makes anchor-first an awkward technique.

BIAC M3

Deployed anchor last. 13/02/2009 1627 UTC, 74° 30.633′S 030° 09.906′W, Echo depth 753 m, corrected 728 m, 735 dbar.

Release Ixsea Oceano 2500 SN 950. Arm+range: 1814. Release: Arm + 1855.

BIAC M4

Deployed anchor last. 13/02/2009 at 1237 UTC, 74° 26.278′S 030° 02.639′W, Echo depth 1092 m, corrected 1059 m, 1071 dbar.

Release Ixsea Oceano 2500 SN 949. Arm+range: 1813. Release: Arm + 1855.

BIAC M5

Deployed anchor last. 12/02/2009 2242 UTC, 74° 10.15′S 029° 32.60′W, Echo depth 1976 m, corrected 1928 m, 1956 dbar.

Release Ixsea Oceano 2500 SN 948. Arm+range: 1812. Release: Arm + 1855.

Slope North and Slope South

The ship visited the locations of these moorings on two occasions, but nothing was heard from either acoustic release.

Orkney Passage moorings

OP3 and OP2 were recovered from Orkney Passage. Unfortunately, there was no response from OP1, the shortest and deepest of the OP moorings. Several hours were spent gridding the area, attempting to contact the acoustic release, but to no avail. OP2 and 3 were re-deployed. OP3, the furthest up the slope, was reset at its original location. Based on a detailed CTD/LADCP section, OP2 was reset a little further down the slope.

Seal tagging

Introduction

Four Weddell seals were tagged during ES031. The tags were SMRU SRDLs, with a CTD head of manufactured by Valeport. The success of the deployments in 2007 prompted a further campaign during ES033.

Six new tags were supplied by BAS, and a further four, rebatteried tags were supplied by Dan Costa's group from UC Santa Cruz. PR, from UC Santa Cruz, managed the tagging work. All ten tags were successfully attached to seals of a variety of age and size, male and female.

Calibration check

A board was constructed on which all ten tags could be mounted and attached to the CTD frame for CTD cast 026. The sea floor pressure was 538 dbar. The water column was profiled five times, with the frame not being brought out of the water between casts.

Inspection of the data from the tags showed that the C and T sensors on one of the rebatteried devices had failed. This tag was finally deployed with a behavioural program, and not the program generally used for CTD tags.

Method

The capture methods used by PR were slightly different to those used on ES031. Once the candidate seal had been sighted, the ship manoeuvred up to the floe and the team were deposited on the ice using a Wor Geordie. Guided by radio from the bridge, the team found the seal, and two personnel worked their way around to distract the animal while PR prepared an intramuscular dose of Zoletil. Once injected, the drug took around 20 minutes to take effect, when the animal could be approached and, if necessary, a netting head bag applied. An intravenous needle was set, in case more drugs were needed to keep the animal sedated during the procedure. Ketamine was administered as required.

Girth and length measurements were made and the tag was attached using Araldite. Most tags were attached to the upper neck of their host seal (Figure 3a). A particular problem encountered this season was that most of the seals had not completed their moult. They moult first on the top of the head, the moult continuing in a line down the back and spreading sideways across their shoulders and back. The tags could therefore be attached quite early in the moult process. However, the early loss of some of the tags suggested that they had detached, presumably as a result of the state of moult, the positioning of the tags, or some problem with the gluing procedure. The one tag (10613) positioned to the top of the head of a particularly poorly moulted animal (Figure 3b) remained attached throughout the winter.

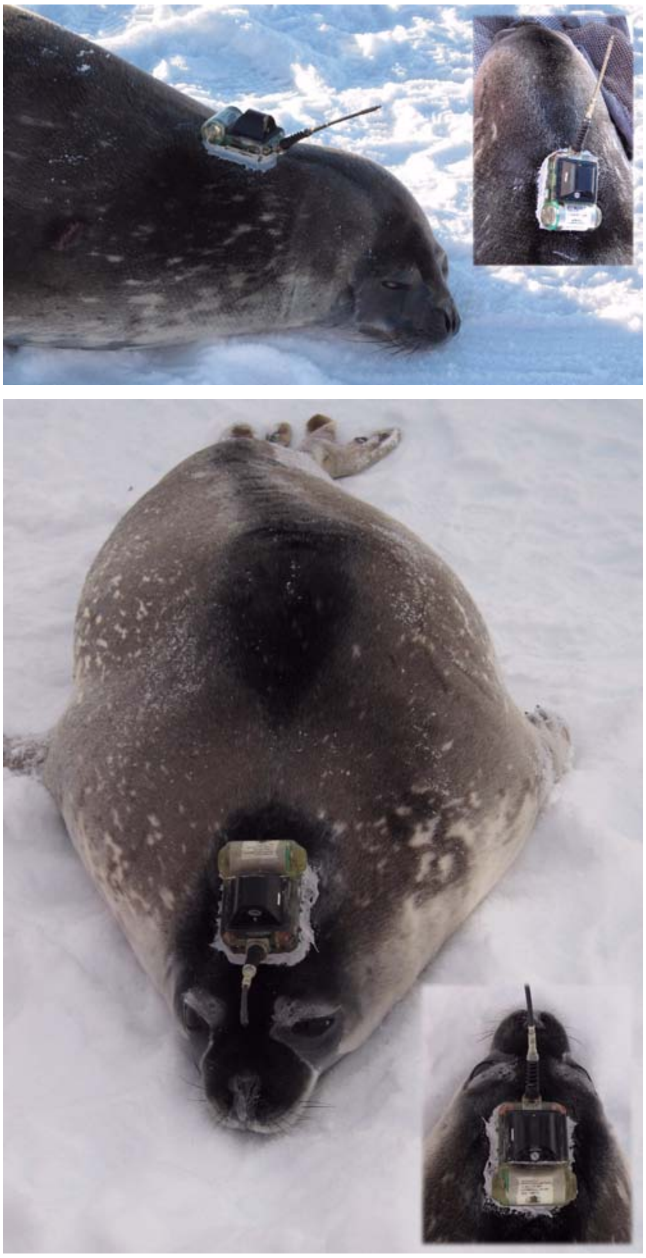


Figure 3. *(a) Upper picture – tag 10858, positioned on upper neck. (b) Lower picture – tag 10613, positioned on top of head.*

Deployment of sea ice drifters

While in the south western Weddell Sea three sea ice drifters were deployed for a SAMS study. The drifters were deployed between 1100 and 1400, 18th February 2009, on three neighbouring ice floes at about 75° 36'.2S, 029° 52'.0W (in the vicinity of CTD station ES033-137). Two drifters were still operational as of 29 October 2009.

The drifters each had a temperature sensor chain. Chain J was deployed in ice 103.5 cm thick, covered by 8 cm snow. Sensor 29 was at the top of the snow, with sensors 31 to 40 on the ice. Chain I was deployed on ice 159.5 cm thick, with no snow covering, with sensors 22 to 29 on the ice. Chain H was deployed in ice 138.5 cm thick, with a 6 cm covering of snow. Sensor 23 was at the snow surface, with sensors 25 to 32 on the ice.

Acknowledgements

The science team are deeply indebted to the officers and crew of *RRS Ernest Shackleton* for their enthusiastic support throughout the cruise. Particular thanks go to the engineering department, which expended a lot of effort on various projects connected with the science work. Excellent food from the cooking staff helped maintain spirits; support and professionalism from Captain Harper's bridge team meant a great deal was accomplished; and the deck personnel demonstrated great ingenuity in utilising the ship's equipment to perform some unaccustomed mooring tasks.

Appendix A. Setup files for LADCPs

Master LADCP setup file:

```
; Append command to the log file: "C:\Fer\ES033\ladcp\Mladcp.log"
$lC:\Fer\ES033\ladcp\Mladcp.log
$P ;
$P
$P ******* LADCP Master. Looking down************
$P * Master and Slave will ping at the same time
$P *********************************************
; Send ADCP a BREAK
$B
; Wait for command prompt (sent after each command)
$W62
;**Start**
; Display real time clock setting
tt?
$W62
; Set to factory defaults
CR1
$W62
; use WM15 for firmware 16.3
WM15
$W62
; Save settings as User defaults
CK
$W62
; Name data file
RN MLADCP
$W62
; Set transducer depth to zero
ED0000
$W62
; Set salinity to 35ppt
ES35
$W62
; Set system coordinate.
EX11111
$W62
; SET AS MASTER ADCP
SM1
$W62
; TRANSMITS SYNCHRONIZING PULSE BEFORE EACH WATER PING
SA001
$W62
; SYNCHRONIZING PULSE SENT ON EVERY PING
SI0
$W62
; WAIT 75 MILLISECONDS
SW75
$W62
; Set one ensemble/sec
TE00000100
$W62
; Set one second between pings
TP000100
$W62
; Set LADCP to output Velocity, Correlations, Amplitude, and Percent Good
LD111100000
$W62
; Set one ping per ensemble. Use WP if LADCP option is not enabled.
LP1
$W62
; Set to record 25 bins. Use WN if LADCP option is not enabled.
LN025
$W62
; Set bin size to 400 cm. Use WS if LADCP option is not enabled.
LS400
$W62
; Set blank to 176 cm (default value) Use WF if LADCP option is not enabled.
LF0176
$W62
; Set max radial (along the axis of the beam) water velocity to 170 cm/sec.
; Use WV if LADCP option is not enabled.
LV170
$W62
; Set ADCP to narrow bandwidth and extend range by 10%
LW1
$W62
; Set to use a fixed speed of the sound
EZ0111111
$W62
; Set speed of sound value. 1500 m/sec is default.
EC1500
$W62
; Heading alignment set to 0 degrees
EA00000
$W62
; Heading bias set to 0 degrees
EB00000
$W62
; Record data internally
CF11101
$W62
; Save set up
CK
$W62
; Start pinging
CS
; Delay 3 seconds
$D3
$p
$P Please disconnect the ADCP from the computer.
$P
; Close the log file
$l
; Exit BBTalk
;$X
```

Slave LADCP setup file

```
; Append command to the log file: "C:\Fer\ES033\ladcp\Sladcp.log"
$lC:\Fer\ES033\ladcp\Sladcp.log
$P ;
$P
$P ************ LADCP Slave. looking up ********
$P
; Send ADCP a BREAK
$B
; Wait for command prompt (sent after each command)
$W62
;**Start**
; Display real time clock setting
tt?
$W62
; Set to factory defaults
CR1
$W62
; use WM15 for firmware 16.3
WM15
$W62
; Save settings as User defaults
CK
$W62
; Name data file
RN SLADCP
$W62
; Set transducer depth to zero
ED0000
$W62
; Set salinity to 35ppt
ES35
$W62
; Set system coordinate.
EX11111
$W62
; Set as Slave ADCP
SM2
$W62
; LISTENS FOR SYNCHRONIZING PULSE BEFORE EACH PING
SA001
$W62
; WAIT UP TO 300 SECONDS FOR SYNCHRONIZING PULSE
ST0300
$W62
```

```
; Set one ensemble/sec
TE00000100
$W62
; Set one second between pings
TP000100
$W62
; Set LADCP to output Velocity, Correlations,
Amplitude, and Percent Good
LD111100000
$W62
; Set one ping per ensemble. Use WP if LADCP
option is not enabled.
LP1
$W62
; Set to record 25 bins. Use WN if LADCP option
is not enabled.
LN025
$W62
; Set bin size to 400 cm. Use WS if LADCP option
is not enabled.
LS400
$W62
; Set blank to 176 cm (default value) Use WF if
LADCP option is not enabled.
LF0176
$W62
; Set max radial (along the axis of the beam)
water velocity to 170 cm/sec.
; Use WV if LADCP option is not enabled.
LV170
$W62
; Set ADCP to narrow bandwidth and extend range
by 10%
LW1
$W62
; Set to use a fixed speed of the sound
EZ0111111
$W62
; Set speed of sound value. 1500 m/sec is
default.
EC1500
$W62
; Heading alignment set to 0 degrees
EA00000
$W62
; Heading bias set to 0 degrees
EB00000
$W62
; Record data internally
CF11101
$W62
; Save set up
CK
$W62
; Start pinging
CS
; Delay 3 seconds
$D3
$p
*************************************************
$P Please, disconnect the ADCP from the computer.
$P **********************************************
; Close the log file
$l
; Exit BBTalk
;$X
```

Single LADCP setup file

```
; Append command to the log file:
"C:\Fer\ES033\adcp\Oneladcp_log.txt"
$lC:\Fer\ES033\adcp\Oneladcp_log.txt
;
$P
*************************************************
$P ****LADCP Deployment with one ADCP. *********
$P
*************************************************
; Send ADCP a BREAK
$B
; Wait for command prompt (sent after each
command)
$W62
;**Start**
; Display real time clock setting
tt?
$W62
; Set to factory defaults
CR1
$W62
; use WM15 for firmware 16.3
WM15
$W62
; Save settings as User defaults
CK
$W62
; Name data file
RN MLADCP
$W62
; Set transducer depth to zero
ED0000
$W62
; Set salinity to 35ppt
ES35
$W62
; Set system coordinate.
EX11111
$W62
; Set one ensemble/sec
TE00000100
$W62
; Set one second between pings
TP000100
$W62
; Set LADCP to output Velocity, Correlations,
Amplitude, and Percent Good
LD111100000
$W62
; Set one ping per ensemble. Use WP if LADCP
option is not enabled.
LP1
$W62
; Set to record 25 bins. Use WN if LADCP option
is not enabled.
LN025
$W62
; Set bin size to 400 cm. Use WS if LADCP option
is not enabled.
LS400
$W62
; Set blank to 176 cm (default value) Use WF if
LADCP option is not enabled.
LF0176
$W62
; Set max radial (along the axis of the beam)
water velocity to 176 cm/sec.
; Use WV if LADCP option is not enabled.
LV170
$W62
; Set ADCP to narrow bandwidth and extend range
by 10%
LW1
$W62
; Set to use a fixed speed of the sound
EZ0111111
$W62
; Set speed of sound value.   1500 m/sec is
default.
EC1500
$W62
; Heading alignment set to 0 degrees
EA00000
$W62
; Heading bias set to 0 degrees
EB00000
$W62
; Record data internally
CF11101
$W62
; Save set up
CK
$W62
; Start pinging
CS
; Delay 3 seconds
$D3
$p
***********************************************
$P Please disconnect the ADCP from the computer.
$P
; Close the log file
$l
; Exit BBTalk
;$X
```

Appendix B. CTD stations, bottle data and CTD configuration

Table of CTD stations, showing station number, date, latitude and longitude, corrected EA600 depth (m), and the maximum depth and pressure of the cast (m and db respectively).

001	26 Jan 2009 14:14:39	62 37.440	43 14.888	3046		3093
002	31 Jan 2009 05:49:42	72 24.010	18 2.310	1613	1605	1628
003	31 Jan 2009 11:20:03	72 26.300	17 43.310	986	1003	1016
004	31 Jan 2009 15:48:16	72 27.480	17 37.760	471	470	477
005	31 Jan 2009 18:24:34	72 29.270	17 28.390	262	259	263
006	02 Feb 2009 20:02:31	76 10.060	27 30.480	265	266	272
007	02 Feb 2009 21:05:17	76 8.060	27 38.410	307	313	318
008	02 Feb 2009 22:00:42	76 5.760	27 47.100	362	355	361
009	02 Feb 2009 22:48:46	76 3.760	27 55.710	314	315	319
010	02 Feb 2009 23:46:12	76 1.790	28 3.660	360	358	363
011	03 Feb 2009 00:50:16	75 59.610	28 11.970	342	338	343
012	03 Feb 2009 01:39:23	75 57.470	28 19.920	369	366	371
013	03 Feb 2009 02:30:47	75 55.300	28 28.050	369	364	369
014	03 Feb 2009 03:42:46	75 52.220	28 37.740	380	377	382
015	03 Feb 2009 04:43:46	75 49.720	28 50.480	429	423	430
016	03 Feb 2009 05:49:50	75 46.130	29 4.650	400	397	402
017	03 Feb 2009 06:54:55	75 42.480	29 18.340	443	439	446
018	03 Feb 2009 07:57:29	75 38.850	29 32.410	463	457	463
019	03 Feb 2009 09:30:44	75 35.170	29 46.570	421	420	427
020	03 Feb 2009 11:21:49	75 31.390	30 0.490	424	421	427
021	03 Feb 2009 12:45:29	75 28.180	30 14.990	414	409	415
022	03 Feb 2009 14:00:17	75 24.340	30 29.150	430	429	436
023	03 Feb 2009 15:03:14	75 22.900	30 39.120	453	454	461
024	03 Feb 2009 16:17:21	75 20.220	30 42.940	462	460	467
025	03 Feb 2009 17:26:58	75 18.040	30 52.630	531	528	536
026	03 Feb 2009 18:13:34	75 17.890	30 52.090	530	526	534
027	03 Feb 2009 20:08:31	75 15.640	31 1.760	576	575	585
028	03 Feb 2009 21:34:21	75 13.240	31 9.660	608	608	617
029	03 Feb 2009 23:31:11	75 8.720	31 27.120	614	612	621
030	04 Feb 2009 01:09:10	75 4.350	31 39.620	620	618	627
031	04 Feb 2009 03:07:40	74 59.380	31 59.530	592	592	601
032	05 Feb 2009 01:49:01	74 35.240	31 40.830	581	574	583
033	05 Feb 2009 03:17:54	74 36.050	31 28.610	553	549	557
034	05 Feb 2009 05:44:33	74 36.880	31 19.890	546	538	546
035	05 Feb 2009 07:14:17	74 38.250	31 9.550	522	519	527
036	05 Feb 2009 12:15:53	74 38.790	30 56.120	501	494	502
037	05 Feb 2009 17:40:32	74 40.000	30 43.320	473	468	475
038	06 Feb 2009 00:43:55	74 41.230	30 27.410	440	435	441
039	06 Feb 2009 02:23:37	74 42.510	30 8.560	423	420	426
040	06 Feb 2009 03:53:06	74 43.080	29 51.410	403	399	404
041	06 Feb 2009 06:01:10	74 36.220	30 17.130	430	424	431
042	06 Feb 2009 07:38:29	74 34.030	30 36.280	462	463	469
043	06 Feb 2009 09:29:22	74 31.600	30 54.690	490	489	496
044	06 Feb 2009 11:14:03	74 29.110	31 13.180	521	518	526
045	06 Feb 2009 13:03:23	74 27.240	31 30.900	550	549	557
046	06 Feb 2009 14:52:08	74 24.350	31 52.150	572	570	579
047	06 Feb 2009 19:41:55	74 21.060	30 0.900	1360	1360	1379
048	06 Feb 2009 21:22:22	74 22.330	30 5.740	1251	1259	1277
049	06 Feb 2009 22:56:08	74 24.600	30 7.670	1107	1101	1117
050	07 Feb 2009 00:29:10	74 25.680	30 6.980	1045	1051	1067
051	07 Feb 2009 02:01:29	74 27.230	30 6.640	959	969	982
052	07 Feb 2009 06:26:17	74 29.010	30 10.660	820	806	818
053	07 Feb 2009 07:31:10	74 30.040	30 10.510	753	735	746
054	07 Feb 2009 08:31:23	74 31.490	30 10.280	652	629	638
055	07 Feb 2009 09:47:28	74 32.270	30 9.750	590	545	552
056	07 Feb 2009 10:37:34	74 32.850	30 10.540	489	456	463
057	07 Feb 2009 14:32:16	74 34.470	30 10.660	425	423	430
058	07 Feb 2009 15:24:56	74 35.710	30 11.540	429	424	431
059	07 Feb 2009 19:07:51	74 43.410	29 42.820	390	388	394
060	07 Feb 2009 22:34:12	74 40.930	29 38.210	416	422	430
061	07 Feb 2009 23:46:29	74 39.430	29 35.130	574	584	592
062	08 Feb 2009 00:38:23	74 37.730	29 32.320	731	733	744
063	08 Feb 2009 02:41:22	74 34.960	29 27.620	941	936	949
064	08 Feb 2009 04:01:52	74 33.130	29 21.640	1095	1078	1094
065	08 Feb 2009 05:40:33	74 29.590	29 18.310	1264	1246	1264
066	08 Feb 2009 07:17:31	74 28.200	29 15.410	1346	1327	1348
067	08 Feb 2009 08:55:00	74 26.400	29 12.450	1452	1434	1456
068	08 Feb 2009 12:41:46	74 35.430	27 47.590	1438	1457	1479
069	08 Feb 2009 14:17:45	74 36.530	27 47.510	1257	1297	1315
070	08 Feb 2009 15:38:52	74 37.620	27 48.170	1098	1092	1108
071	08 Feb 2009 16:37:50	74 38.870	27 47.840	898	897	910
072	08 Feb 2009 17:35:05	74 40.250	27 47.910	691	687	697
073	08 Feb 2009 18:27:03	74 40.250	27 47.900	692	694	704
074	08 Feb 2009 19:57:05	74 42.730	27 46.860	475	480	487
075	08 Feb 2009 21:03:38	74 45.560	27 48.060	471	466	472
076	08 Feb 2009 22:04:30	74 48.590	27 47.600	465	461	468
077	08 Feb 2009 23:07:47	74 51.820	27 47.740	456	452	459
078	09 Feb 2009 00:09:32	74 55.170	27 47.280	445	442	449
079	09 Feb 2009 03:34:32	74 46.100	29 16.360	376	368	374
080	09 Feb 2009 04:31:18	74 43.730	29 10.790	436	431	438
081	09 Feb 2009 05:30:48	74 41.610	29 5.140	541	534	542
082	09 Feb 2009 06:57:24	74 39.760	29 0.320	759	743	753
083	09 Feb 2009 08:25:02	74 37.270	28 54.710	1081	1064	1079
084	09 Feb 2009 09:35:37	74 35.740	28 50.870	1264	1259	1276
085	09 Feb 2009 11:50:01	74 33.850	28 47.050	1470	1471	1493
086	09 Feb 2009 13:31:51	74 31.850	28 42.100	1563	1559	1582
087	10 Feb 2009 07:18:42	74 9.870	32 30.410	1255	1243	1260
088	10 Feb 2009 09:49:07	74 12.820	32 22.160	1065	1053	1068
089	10 Feb 2009 21:41:00	73 58.890	32 24.480	1838	1822	1850
090	11 Feb 2009 04:08:24	73 51.640	32 23.590	2155	2144	2178
091	11 Feb 2009 06:40:16	73 56.500	32 19.700	1945	1927	1957
092	11 Feb 2009 10:16:42	74 3.750	32 21.120	1587	1564	1588
093	11 Feb 2009 12:41:27	74 7.140	32 21.020	1408	1388	1410
094	12 Feb 2009 23:27:53	74 6.070	29 27.460	2056	2046	2078
095	13 Feb 2009 02:01:08	74 10.860	29 35.640	1902	1891	1920
096	13 Feb 2009 04:40:09	74 16.970	29 43.760	1648	1640	1666
097	13 Feb 2009 06:55:26	74 20.440	29 47.860	1460	1446	1469
098	13 Feb 2009 08:43:07	74 23.400	29 57.540	1250	1228	1247
099	13 Feb 2009 12:50:31	74 26.020	30 1.660	1074	1068	1083
100	13 Feb 2009 14:41:46	74 28.930	30 6.590	864	864	876
101	13 Feb 2009 16:46:26	74 30.970	30 9.540	862	700	710
102	14 Feb 2009 08:57:14	74 30.700	26 46.690	1310	1357	1377
103	14 Feb 2009 12:05:21	74 31.230	26 44.360	952	963	977
104	14 Feb 2009 17:44:17	74 31.700	26 42.610	778	774	784
105	14 Feb 2009 21:21:30	74 32.270	26 40.460	562	565	573
106	15 Feb 2009 00:28:46	74 33.210	26 36.770	444	441	448
107	15 Feb 2009 01:26:33	74 33.900	26 33.860	447	449	456
108	15 Feb 2009 03:05:27	74 32.340	26 40.500	555	554	562
109	15 Feb 2009 04:57:37	74 32.310	26 40.440	556	558	565
110	15 Feb 2009 07:34:07	74 32.360	26 40.520	554	554	562
111	15 Feb 2009 09:06:35	74 32.330	26 40.430	552	553	562
112	15 Feb 2009 10:50:57	74 32.340	26 40.430	553	554	562
113	15 Feb 2009 13:02:58	74 32.340	26 40.430	553	554	562
114	15 Feb 2009 14:57:09	74 32.340	26 40.460	557	557	565
115	15 Feb 2009 16:58:02	74 32.350	26 40.450	553	555	563
116	15 Feb 2009 20:48:57	74 35.420	28 13.270	1411	1410	1431
117	16 Feb 2009 01:42:30	74 36.700	28 14.920	1176	1165	1182
118	16 Feb 2009 05:26:09	74 37.880	28 13.430	958	948	961
119	16 Feb 2009 09:19:09	74 38.910	28 15.250	765	768	779
120	16 Feb 2009 13:18:40	74 40.210	28 7.540	596	633	641
121	16 Feb 2009 14:26:39	74 40.750	28 5.790	529	534	541
122	16 Feb 2009 19:52:06	74 51.630	28 19.810	494	489	495
123	16 Feb 2009 21:19:29	74 55.650	28 21.850	454	446	452
124	17 Feb 2009 03:02:03	74 25.480	29 28.000	1382	1368	1388
125	17 Feb 2009 09:25:05	74 31.010	29 42.930	979	965	979
126	17 Feb 2009 12:32:15	74 34.010	29 45.220	782	779	790
127	17 Feb 2009 16:43:51	74 36.150	29 51.040	557	560	567
128	17 Feb 2009 18:12:46	74 36.510	29 52.850	556	502	510
129	17 Feb 2009 21:39:37	74 38.170	29 56.480	415	409	416
130	17 Feb 2009 22:40:38	74 35.800	29 50.910	580	581	590
131	18 Feb 2009 00:47:03	74 34.950	29 49.910	658	668	678
132	18 Feb 2009 02:56:50	74 35.510	29 53.500	558	559	567
133	18 Feb 2009 04:57:46	74 35.720	29 50.840	587	574	583
134	18 Feb 2009 06:56:25	74 36.460	29 48.270	582	564	572
135	18 Feb 2009 09:01:18	74 35.390	29 47.510	658	648	658
136	18 Feb 2009 10:52:07	74 35.680	29 48.630	624	613	622
137	18 Feb 2009 12:40:10	74 35.980	29 50.420	578	570	578
138	23 Feb 2009 12:22:34	72 26.410	17 43.970	1010	1009	1022
139	23 Feb 2009 13:58:28	72 24.770	17 51.990	1482	1472	1493
140	23 Feb 2009 15:51:16	72 21.750	18 6.850	1745	1737	1762
141	23 Feb 2009 17:49:47	72 19.050	18 19.130	2166	2195	2229
142	23 Feb 2009 20:12:14	72 14.920	18 39.050	2650	2656	2700
143	24 Feb 2009 03:54:15	72 12.570	18 49.270	2944	913	925
144	24 Feb 2009 05:03:33	72 10.330	19 0.110	3140	764	774
145	27 Feb 2009 12:45:27	63 31.410	41 46.050	4541	4525	4617
146	28 Feb 2009 04:03:42	62 36.810	43 14.770	3037	3025	3076
147	01 Mar 2009 00:21:11	60 37.640	41 44.560	2695	2712	2757
148	01 Mar 2009 02:50:24	60 37.840	41 50.220	2920	2939	2989

149	01 Mar 2009 05:17:46	60 38.340	41 55.880	2689	3512	3575
150	01 Mar 2009 08:25:01	60 38.690	41 58.030	3756	3793	3863
151	01 Mar 2009 11:44:33	60 38.860	42 0.100	3961	4000	4075
152	01 Mar 2009 14:59:29	60 38.990	42 0.970	4085	4115	4194
153	01 Mar 2009 18:14:16	60 38.990	42 2.220	3644	4060	4138
154	01 Mar 2009 21:21:35	60 39.200	42 4.490	3654	3757	3826
155	02 Mar 2009 00:20:54	60 39.370	42 6.340	3349	3391	3451
156	02 Mar 2009 03:10:10	60 39.470	42 7.680	3174	3243	3298
157	02 Mar 2009 05:41:29	60 39.630	42 9.020	2697	2953	3003
158	02 Mar 2009 08:07:30	60 39.730	42 10.220	2461	2480	2519
159	02 Mar 2009 10:14:46	60 39.850	42 11.440	1936	1959	1988
160	02 Mar 2009 12:13:18	60 39.970	42 12.800	1598	1582	1604
161	02 Mar 2009 13:59:25	60 40.420	42 18.310	1240	1311	1329
162	02 Mar 2009 15:33:29	60 40.630	42 22.780	1077	1068	1083
163	02 Mar 2009 23:49:39	60 37.200	41 39.030	2587	2585	2625
164	03 Mar 2009 02:16:12	60 36.800	41 33.530	2358	2350	2387
165	03 Mar 2009 04:23:23	60 36.440	41 28.510	2239	2238	2276
166	03 Mar 2009 06:35:15	60 36.040	41 22.830	1652	1673	1697
167	17 Mar 2009 21:32:53	68 2.720	70 45.340	163	161	165
168	17 Mar 2009 22:40:51	68 0.160	70 37.940	699	699	709
169	18 Mar 2009 00:18:01	67 56.910	70 28.900	854	851	862
170	18 Mar 2009 01:55:07	67 54.080	70 20.810	935	928	944
171	18 Mar 2009 03:27:27	67 51.560	70 13.620	625	621	629
172	18 Mar 2009 05:05:53	67 48.780	70 5.580	595	591	600
173	18 Mar 2009 06:23:12	67 46.020	69 57.980	699	700	709
174	18 Mar 2009 08:07:22	67 43.360	69 50.340	457	464	471
175	18 Mar 2009 09:10:46	67 42.170	69 46.880	280	280	286

Table of station number, rosette position, pressure and differences from salinometry for primary and secondary CTD channels.

001	2	3091	0.006	0.010
001	4	3091	0.006	0.010
001	6	3028	0.008	0.012
001	8	2505	0.007	0.010
001	10	1996	0.007	0.009
001	12	1488	0.013	0.010
001	14	981	0.011	0.010
001	16	496	0.009	0.011
001	22	139	0.207	0.210
002	2	1627	0.005	0.010
002	22	201	0.009	0.010
002	6	1423	0.008	0.010
002	14	701	0.003	0.010
002	10	994	0.011	0.011
003	2	1016	0.011	0.010
003	8	841	0.014	0.011
003	12	496	-0.055	0.009
003	14	294	0.011	0.011
003	22	27	-0.183	0.004
004	2	477	0.014	0.010
004	4	327	0.004	0.011
004	6	198	0.009	0.010
004	10	22	-0.115	0.010
004	8	72	0.031	0.013
005	2	263	0.013	0.010
005	4	155	0.002	0.009
005	6	67	-0.012	0.007
006	2	272	0.008	0.011
006	4	196	0.010	0.012
006	6	52	0.011	0.013
007	6	64	0.009	0.012
007	4	214	0.010	0.012
007	2	317	0.008	0.010
008	2	361	0.008	0.011
008	4	204	0.007	0.010
008	6	53	0.009	0.011
009	2	319	0.008	0.010
009	4	208	0.008	0.010
009	8	50	0.008	0.010
010	1	363	0.007	0.009
010	2	363	-0.010	-0.009
010	4	203	-0.050	-0.048
011	1	342	0.006	0.009
011	2	342	-0.015	-0.013
011	3	239	-0.028	-0.026
011	4	239	-0.054	-0.052
012	1	371	0.006	0.008
012	2	371	-0.017	-0.015
012	3	227	-0.017	-0.015
013	1	369	0.007	0.010
013	2	369	-0.006	-0.004
013	3	264	-0.020	-0.018
013	4	264	-0.041	-0.039
013	5	178	-0.101	-0.098
014	1	382	0.006	0.010
014	2	382	-0.045	-0.042
014	3	305	-0.024	-0.022
015	1	430	0.005	0.009
015	2	430	-0.158	-0.156
016	1	402	0.007	0.009
016	2	402	-0.139	-0.136
017	1	446	0.005	0.005
017	2	446	-0.222	-0.223
018	1	463	0.007	0.009
018	2	463	-0.240	-0.238
018	3	143	-0.245	-0.243
019	2	427	-0.151	-0.149
019	1	427	0.006	0.008
020	1	427	0.006	0.008
020	2	427	-0.120	-0.118
021	1	415	0.004	0.006
021	2	415	-0.116	-0.114
022	1	436	0.006	0.008
022	2	436	-0.132	-0.129
023	1	461	0.004	0.007
023	3	366	-0.100	-0.098
023	3	366	-0.101	-0.099
023	4	366	-0.283	-0.281
024	1	467	0.011	0.013
024	4	426	-0.156	-0.154
024	5	360	-0.104	-0.101
025	2	536	-0.052	-0.050
025	1	536	0.011	0.014
025	3	475	-0.143	-0.140
026	4	90	0.008	0.010
027	1	585	0.009	0.011
027	2	585	-0.080	-0.078
027	6	174	0.011	0.014
028	2	617	0.010	0.012
028	4	427	0.011	0.013
028	8	84	0.010	0.012
029	2	621	0.014	0.016
029	4	356	0.008	0.011
029	6	69	0.010	0.012
030	2	627	-0.023	-0.020
030	4	396	0.019	0.021
030	6	215	0.004	0.006
030	8	103	0.010	0.012
031	2	601	0.009	0.011
031	4	404	0.057	0.059
031	6	154	0.016	0.018
032	2	582	0.016	0.018
032	4	491	0.009	0.011
032	6	313	0.009	0.011
032	8	123	0.009	0.011
033	12	405	0.009	0.011
033	10	557	0.009	0.011
033	14	244	0.008	0.010
033	16	143	0.007	0.010
034	2	546	0.009	0.012
034	4	354	0.010	0.013
034	6	163	0.009	0.011
034	8	22	0.009	0.011
035	2	527	0.010	0.012
035	4	385	0.009	0.011
035	6	153	0.013	0.015
036	2	501	0.010	0.012
036	4	203	0.009	0.011
036	6	22	0.010	0.012
037	2	475	0.011	0.013
037	4	153	0.009	0.012
038	2	440	0.010	0.013
038	2	440	0.010	0.013
038	4	153	0.009	0.011
039	2	426	0.011	0.013
039	4	305	0.010	0.013
039	6	163	0.012	0.015
040	2	404	0.012	0.015
040	4	304	0.012	0.015
040	6	153	0.008	0.012
041	2	430	0.011	0.014
041	4	254	0.011	0.015
041	6	103	0.004	0.007
042	4	355	0.011	0.014
042	6	203	0.012	0.015
043	2	496	0.008	0.012
043	4	204	0.008	0.011
044	2	526	0.008	0.012
044	4	304	0.005	0.009
044	6	103	0.010	0.014
045	2	557	0.010	0.013
045	4	104	0.014	0.017
046	4	538	0.004	0.007
046	6	493	0.008	0.012
047	2	1379	0.009	0.012
047	8	398	0.008	0.011
047	6	879	-0.218	-0.215
047	4	1062	0.008	0.011
048	2	1277	0.010	0.013
048	4	964	0.008	0.011
048	6	761	0.007	0.011
048	8	356	0.009	0.011
048	12	153	0.011	0.014
049	2	1117	0.014	0.017
049	4	941	0.008	0.011
049	6	437	0.009	0.011
049	8	142	0.010	0.013
050	4	1013	0.009	0.012
050	8	308	0.015	0.018
050	6	732	0.008	0.011
051	2	982	0.014	0.017
051	4	901	0.013	0.016
051	6	526	0.014	0.016
051	8	203	0.012	0.015
052	2	818	0.010	0.013
052	4	506	0.011	0.014
052	6	304	0.013	0.016
053	2	746	0.010	0.013
053	4	465	0.008	0.011
053	6	213	0.010	0.012
054	2	630	0.012	0.014
054	4	305	0.009	0.011
055	2	551	0.014	0.017
055	4	117	0.008	0.011
056	2	463	0.010	0.014
056	4	153	0.009	0.012
057	2	430	0.010	0.012
057	4	385	0.009	0.011
057	6	204	0.010	0.012
058	2	431	0.013	0.016
058	4	376	0.009	0.012
058	6	309	0.010	0.010
059	2	394	0.008	0.010
059	4	359	0.008	0.011
059	6	255	0.008	0.010
060	2	430	0.012	0.015
060	4	405	0.005	0.007
060	8	203	0.007	0.010
060	10	128	0.007	0.010
061	2	592	0.008	0.010
061	4	421	0.009	0.012
061	6	319	0.007	0.010
061	8	220	0.009	0.011
062	2	743	0.008	0.010
062	4	546	0.007	0.010
062	6	264	0.008	0.011
063	2	949	0.013	0.015
063	4	890	0.008	0.011
063	6	305	0.007	0.010
064	2	1094	0.008	0.011
064	4	876	0.008	0.011
064	6	305	0.010	0.012
065	2	1264	0.008	0.011
065	4	911	0.012	0.014
065	6	305	0.008	0.011
066	2	1347	0.009	0.012
066	4	760	0.009	0.011
066	6	305	0.076	0.078
067	4	963	0.007	0.010
068	2	1479	0.008	0.011
068	4	1114	0.007	0.010
068	6	305	0.402	0.404
069	2	1315	0.008	0.010
069	4	1004	0.008	0.010
069	6	823	0.007	0.009
069	8	303	0.007	0.009
070	2	1108	0.007	0.010
070	4	1006	0.007	0.010
070	6	556	0.007	0.009
070	8	305	0.008	0.010
071	2	909	0.009	0.011
071	4	655	-0.006	-0.009
071	6	303	0.008	0.010
072	2	697	0.008	0.011
072	4	631	0.003	0.006
072	6	305	0.009	0.011
073	2	702	0.008	0.011
073	4	448	0.009	0.012
073	6	103	0.009	0.012
074	2	487	0.012	0.015
074	4	324	0.010	0.013
074	6	144	0.012	0.015
074	8	34	0.009	0.012
075	2	472	0.011	0.014
075	4	345	0.012	0.015
075	6	183	0.019	0.022
076	2	468	0.011	0.014
076	4	204	0.012	0.014
077	2	459	0.012	0.015
077	4	355	0.012	0.014
077	6	153	0.020	0.023
078	2	449	0.013	0.016
078	4	370	0.013	0.016
078	6	275	0.006	0.009

078	8	163	0.012	0.015
079	2	373	0.012	0.015
079	2	373	0.012	0.015
079	4	164	0.015	0.018
079	4	164	0.012	0.015
080	2	437	0.010	0.014
080	2	437	0.010	0.014
080	4	302	0.011	0.014
080	4	302	0.012	0.015
081	2	541	0.012	0.015
081	2	541	0.012	0.015
081	4	452	0.008	0.011
081	4	452	0.009	0.011
081	6	303	0.009	0.012
081	6	303	0.011	0.014
082	2	751	0.012	0.015
082	2	751	0.011	0.014
082	4	299	0.011	0.014
082	4	299	0.011	0.014
083	2	1079	0.010	0.013
083	4	304	0.011	0.013
084	2	1275	0.010	0.013
084	2	1275	0.010	0.013
084	4	203	0.010	0.013
084	4	203	0.012	0.014
085	2	1493	0.011	0.014
085	2	1493	0.011	0.014
085	4	305	0.011	0.014
085	4	305	0.012	0.014
086	2	1582	0.010	0.013
086	2	1582	0.010	0.013
086	4	304	0.010	0.013
086	4	304	0.010	0.013
087	2	1260	0.011	0.014
087	2	1260	0.010	0.013
087	4	870	0.014	0.017
087	4	870	0.011	0.014
087	6	305	0.011	0.013
087	6	305	0.010	0.013
088	2	1068	0.012	0.015
088	4	1068	0.014	0.017
088	6	405	0.014	0.016
088	8	405	0.016	0.018
088	10	103	0.014	0.016
088	12	103	0.016	0.019
089	2	1850	0.011	0.014
089	10	254	0.011	0.014
089	4	1850	0.010	0.013
089	8	1013	0.011	0.013
089	6	1013	0.011	0.014
089	12	254	0.012	0.014
090	2	2178	0.010	0.013
090	4	1873	0.010	0.012
090	6	1568	0.007	0.010
090	8	1264	0.010	0.013
090	10	961	0.009	0.012
090	12	154	0.010	0.012
091	2	1957	0.010	0.013
091	4	1723	0.008	0.011
091	6	1469	0.007	0.010
091	8	1216	0.009	0.012
091	10	962	0.008	0.011
091	12	204	0.010	0.012
092	2	1588	0.009	0.012
092	4	1588	0.009	0.012
092	6	1114	0.009	0.012
092	8	1114	0.010	0.012
092	10	306	0.010	0.012
092	12	306	0.006	0.009
093	2	1410	0.008	0.011
093	4	1410	0.010	0.013
093	6	1114	0.008	0.010
093	8	1114	0.009	0.012
094	2	2077	0.009	0.012
094	4	2077	0.009	0.011
094	6	1417	0.009	0.011
094	8	1417	0.010	0.012
094	10	254	0.010	0.012
095	2	1920	0.008	0.010
095	4	1920	0.008	0.011
095	6	1267	0.009	0.011
095	8	1267	0.009	0.012
095	10	305	0.010	0.012
096	2	1666	0.009	0.012
096	4	1666	0.009	0.012
096	6	1014	0.009	0.012
096	8	1014	0.010	0.013
096	10	306	0.009	0.012
097	2	1469	0.009	0.012
097	4	1469	0.010	0.013
097	6	1012	0.010	0.012
097	8	1012	0.009	0.012
097	10	305	0.010	0.012
098	2	1246	0.018	0.021
098	4	1246	0.009	0.012
098	6	912	0.010	0.013
098	8	912	0.010	0.013
098	10	305	0.012	0.015
099	2	1083	0.013	0.016
099	4	1083	0.039	0.042
099	6	911	0.020	0.023
099	8	911	0.022	0.025
099	10	305	0.010	0.013
100	2	876	0.010	0.013
100	4	875	0.010	0.013
100	6	795	0.011	0.014
100	8	305	0.011	0.013
100	10	305	0.011	0.013
101	2	710	0.010	0.013
101	4	710	0.010	0.014
101	6	614	0.006	0.008
101	8	302	0.012	0.014
102	2	1377	0.011	0.014
102	4	1377	0.013	0.016
102	6	906	0.011	0.014
102	8	906	0.011	0.013
102	10	304	0.011	0.013
103	2	977	0.011	0.014
103	4	977	0.012	0.014
103	6	305	0.012	0.014
104	2	783	0.011	0.014
104	4	783	0.011	0.013
104	6	557	0.010	0.013
104	8	304	0.012	0.014
104	10	304	0.012	0.014
105	2	573	0.010	0.011
105	4	304	0.011	0.013
105	6	141	0.012	0.014
106	2	448	0.011	0.011
106	4	304	0.012	0.014
106	6	163	0.012	0.014
107	2	456	0.011	0.013
107	4	304	0.010	0.013
107	6	304	0.011	0.014
108	2	562	0.012	0.014
108	4	304	0.017	0.019
109	2	565	0.009	0.012
109	4	304	0.023	0.025
110	2	562	0.011	0.012
110	4	304	0.011	0.014
111	2	562	0.005	0.007
111	4	304	0.011	0.013
112	2	562	0.011	0.013
112	4	305	0.010	0.012
113	2	562	0.015	0.016
113	4	305	0.077	0.079
114	2	426	0.026	0.028
114	4	305	0.012	0.014
115	6	527	0.010	0.012
115	8	304	0.012	0.014
116	2	1012	0.034	0.035
116	4	296	0.012	0.014
118	2	961	0.011	0.014
119	4	204	0.011	0.013
119	2	779	0.011	0.014
120	4	302	0.011	0.013
120	2	641	0.011	0.014
121	4	203	0.012	0.015
121	2	530	0.010	0.010
122	6	495	0.015	0.017
122	8	365	0.010	0.012
123	6	204	0.019	0.022
123	4	406	0.015	0.017
123	2	451	0.015	0.017
124	2	1388	0.014	0.016
124	6	1114	0.015	0.017
124	4	1265	0.013	0.015
124	10	809	0.011	0.014
124	16	153	0.013	0.015
124	12	457	0.012	0.014
124	8	962	0.011	0.013
124	14	305	0.015	0.018
125	6	204	0.014	0.016
125	4	820	0.014	0.016
125	2	979	0.014	0.017
126	2	790	0.012	0.014
126	8	103	0.015	0.017
126	6	356	0.011	0.013
126	4	608	0.008	0.010
127	2	566	0.013	0.015
127	6	204	0.011	0.014
127	8	104	0.012	0.015
127	4	305	0.012	0.014
128	4	440	0.010	0.013
128	8	143	0.014	0.017
128	6	243	0.012	0.014
128	2	509	0.011	0.014
129	2	415	0.010	0.013
129	6	204	0.013	0.016
129	8	22	0.011	0.013
129	4	351	0.011	0.013
130	4	253	0.011	0.014
130	6	254	0.014	0.016
130	2	589	0.013	0.015
131	2	678	0.013	0.017
131	6	285	0.014	0.016
131	4	507	0.013	0.015
132	4	476	0.008	0.011
132	2	567	0.014	0.017
132	6	254	-0.101	-0.099
133	4	507	0.010	0.013
133	2	583	0.012	0.014
133	6	154	0.012	0.014
134	2	572	0.016	0.018
134	4	455	0.013	0.015
134	6	203	0.015	0.016
135	6	204	0.012	0.015
135	2	657	0.012	0.014
135	4	475	0.014	0.016
136	4	495	0.012	0.013
136	6	304	0.013	0.016
136	2	622	0.014	0.016
137	22	77	0.011	0.013
137	6	465	0.012	0.014
137	10	354	0.011	0.014
137	24	22	0.013	0.015
137	12	299	0.011	0.014
137	4	521	0.012	0.014
137	14	243	0.013	0.015
137	8	410	0.011	0.014
137	20	131	0.014	0.016
137	16	188	0.012	0.014
137	2	578	0.011	0.014
138	2	1021	0.011	0.013
138	8	809	0.012	0.014
138	16	405	0.010	0.013
138	20	203	0.011	0.013
139	2	1493	0.008	0.011
139	4	1011	0.010	0.013
139	8	405	0.011	0.013
139	10	254	0.012	0.014
140	2	1761	0.010	0.013
140	4	859	0.010	0.013
140	8	404	0.010	0.012
140	10	253	0.011	0.013
141	2	2229	0.010	0.013
141	4	1315	0.009	0.011
141	6	859	0.010	0.012
141	12	253	0.011	0.013
142	2	1687	0.011	0.013
142	4	1015	0.010	0.012
143	2	925	0.011	0.014
143	4	435	0.011	0.013
143	8	132	0.010	0.012
144	2	773	0.011	0.014
144	4	405	0.012	0.015
144	8	133	0.009	0.012
146	2	3075	0.011	0.014
146	4	2972	0.011	0.013
146	6	1715	0.011	0.013
146	8	507	0.011	0.013
147	2	2755	0.010	0.012
147	4	2534	0.009	0.011
147	6	1514	0.010	0.013
147	8	750	0.011	0.012
147	10	406	0.010	0.012
148	2	2988	0.009	0.012
148	4	2693	0.010	0.012
148	6	2008	0.010	0.013
148	8	1502	0.011	0.013
149	2	3574	0.010	0.013
149	4	2893	0.011	0.013
149	6	2211	0.010	0.012
149	8	1216	0.010	0.013
149	10	913	0.011	0.013
150	2	3862	0.011	0.013
150	4	3297	0.010	0.012
150	6	2584	0.010	0.012
150	8	1772	0.010	0.012
150	10	1012	0.010	0.012
150	12	506	0.010	0.013
151	2	4075	0.010	0.012
151	4	3551	0.010	0.012
151	6	3039	0.010	0.012
151	8	1720	0.010	0.013
151	10	708	0.011	0.013
152	2	4193	0.010	0.012
152	4	3552	0.010	0.012
152	6	3041	0.010	0.012
152	8	2025	0.010	0.013
152	10	710	0.010	0.013
153	2	4136	0.009	0.012
153	4	3504	0.009	0.011
153	6	2482	0.009	0.011
153	8	2000	0.010	0.012
153	10	761	0.010	0.013
154	2	3825	0.010	0.012
154	4	3146	0.010	0.013
154	6	2500	0.010	0.012
154	8	1715	0.011	0.013
154	10	850	0.011	0.013
155	2	3449	0.009	0.012
155	4	2943	0.010	0.012
155	6	2439	-0.243	-0.240
155	8	1694	0.011	0.013
155	10	889	0.010	0.012
156	2	3297	0.009	0.012
156	4	2701	0.010	0.012
156	6	2197	0.009	0.012
156	8	1500	0.010	0.013
156	10	750	0.010	0.012
157	2	3002	0.011	0.014
157	4	2500	0.010	0.012
157	6	1992	0.010	0.013
157	8	759	0.011	0.014
158	2	2512	0.010	0.012
158	4	1507	0.012	0.014
158	6	1013	0.012	0.014
158	8	505	0.012	0.014
159	2	1987	0.011	0.013
159	4	1721	0.011	0.014
159	6	1315	0.010	0.013
159	8	1316	0.020	0.022
159	10	1315	0.008	0.011
160	2	1346	-0.006	-0.003
160	4	1602	0.015	0.018
160	6	1392	0.018	0.020
160	8	1074	0.017	0.019
161	2	1329	0.011	0.013
161	4	1257	0.010	0.013
161	6	1012	0.011	0.013
161	8	651	0.010	0.013
162	2	1083	0.010	0.012
162	4	1011	0.011	0.013

162	6	759	0.010	0.013
162	8	552	0.011	0.013
162	10	303	0.009	0.012
163	2	2623	0.010	0.012
163	4	2123	0.010	0.013
163	6	1617	0.010	0.013
164	2	2385	0.010	0.012
164	4	2001	0.010	0.012
164	6	1498	0.010	0.012
164	8	997	0.010	0.013
165	2	2274	0.008	0.011
165	4	1690	0.009	0.012
165	6	1199	0.010	0.012
165	8	746	0.010	0.013
166	2	1697	0.010	0.013
166	4	1012	0.010	0.012
166	6	505	0.010	0.012
167	2	164	0.006	0.009
167	4	101	0.011	0.014
167	6	48	0.014	0.015
168	2	707	0.010	8.791
168	4	600	0.011	0.643
168	6	500	0.010	0.013
168	8	401	0.010	0.013
168	10	301	0.011	0.014
168	12	200	0.011	12.335
168	16	20	0.013	0.016
169	2	861	0.011	0.014
169	4	701	0.011	0.014
169	6	500	0.011	0.014
169	8	300	0.010	0.013
169	10	101	-0.026	-0.025
169	12	20	0.008	0.010
170	2	943	0.011	0.014
170	4	788	0.011	0.014
170	6	600	0.010	0.013
170	8	399	0.010	0.013
170	10	200	0.009	0.012
170	12	21	0.012	0.014
171	2	628	0.011	0.014
171	4	452	0.010	0.013
171	6	302	0.011	0.014
171	8	199	0.007	0.011
171	10	100	-0.019	-0.004
171	12	21	0.012	0.015
172	2	598	0.011	0.013
172	4	501	0.012	0.015
172	6	400	0.011	0.014
172	8	300	0.028	0.031
172	10	202	0.010	0.012
172	12	100	0.005	0.009
173	2	709	0.010	0.013
173	4	491	0.010	0.013
173	6	301	0.010	0.013
173	8	200	0.009	0.012
173	10	101	0.003	0.006
173	12	20	0.012	0.015
174	2	295	0.024	0.026
174	4	467	0.001	0.004
174	6	420	-0.034	-0.031
174	7	350	-0.142	-0.139
175	2	285	0.010	0.013
175	4	230	0.011	0.014
175	6	170	0.011	0.013
175	12	13	0.012	0.015

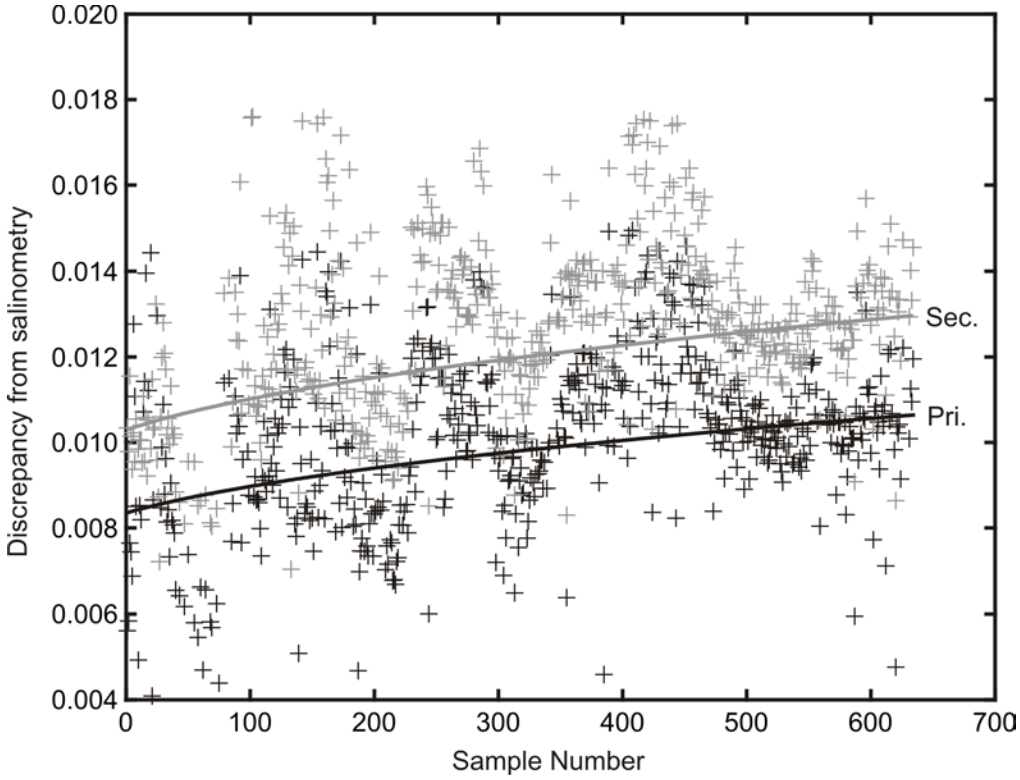


Figure B1. *Discrepancies from salinometry for primary (black) and secondary (grey) CTD channels, outliers excluded. Note lower scatter later in cruise when conditions were warmer.*

Station number, Bottle number, pressure, calibrated salinity and in situ temperature for each delta-18O sample.

1	1	3091	34.641	-0.492
1	2	3091	34.641	-0.492
1	8	496	34.676	0.473
1	11	139	34.430	-1.441
2	1	1627	34.672	0.225
2	3	1423	34.673	0.291
2	4	1212	34.671	0.365
2	5	994	34.682	0.551
2	6	897	34.674	0.555
2	7	701	34.632	0.349
2	8	602	34.620	0.359
2	9	399	34.435	-1.408
2	11	201	34.351	-1.815
3	1	1016	34.658	0.414
3	3	926	34.646	0.405
3	4	841	34.640	0.486
3	5	688	34.516	-0.628
3	6	496	34.391	-1.638
3	7	294	34.349	-1.813
3	8	152	34.327	-1.745
3	9	62	34.198	-1.382
3	11	27	33.987	-1.573
4	1	477	34.381	-1.676
4	2	327	34.352	-1.805
4	3	198	34.341	-1.805
4	4	72	34.201	-1.412
4	5	22	33.785	-1.361
4	6	12	33.786	-1.229
5	1	263	34.354	-1.797
5	2	155	34.301	-1.792
5	3	67	34.127	-1.515
5	4	27	33.786	-1.385
6	1	272	34.341	-1.841
6	2	196	34.314	-1.819
6	3	52	34.279	-1.340
7	1	317	34.358	-1.832
7	2	214	34.334	-1.840
7	3	64	34.290	-1.375
8	1	361	34.365	-1.835
8	2	204	34.342	-1.823
8	3	53	34.300	-1.317
9	1	319	34.365	-1.837
9	3	99	34.325	-1.723
9	4	50	34.307	-1.283
10	1	363	34.378	-1.822
10	2	203	34.362	-1.838
10	4	41	34.304	-1.281
11	1	342	34.379	-1.826
11	2	239	34.358	-1.837
11	3	128	34.323	-1.796
11	4	52	34.296	-1.308
12	1	371	34.389	-1.763
12	2	227	34.365	-1.832
12	3	128	34.340	-1.799
13	1	369	34.396	-1.755
13	2	264	34.383	-1.777
13	3	178	34.357	-1.837
13	4	107	34.334	-1.782
13	5	16	34.247	-1.030
14	1	382	34.444	-1.664
14	2	305	34.392	-1.702
14	3	154	34.361	-1.841
15	1	430	34.529	-1.622
15	2	154	34.364	-1.838
16	1	402	34.510	-1.623
16	2	127	34.366	-1.837
17	1	446	34.601	-2.000
17	2	164	34.369	-1.834
18	1	463	34.612	-2.056
18	2	143	34.366	-1.835
18	3	12	34.119	-1.542
19	1	427	34.522	-1.679
19	2	124	34.367	-1.838
20	1	427	34.491	-1.147
20	2	143	34.366	-1.836
21	1	415	34.485	-1.283
21	2	143	34.360	-1.835
22	1	436	34.508	-1.422
22	2	203	34.371	-1.829
23	1	461	34.659	-2.005
23	2	366	34.475	-1.168
23	3	153	34.367	-1.838
23	4	17	34.183	-1.781
24	1	467	34.661	-2.002
24	2	426	34.645	-2.031
24	4	345	34.483	-1.310
24	5	139	34.371	-1.834
25	1	536	34.685	-1.917
25	2	475	34.623	-2.102
25	3	237	34.472	-1.521
26	4	90	34.381	-1.814
27	1	585	34.683	-1.914
27	2	356	34.594	-2.012
28	1	617	34.674	-1.917
28	2	427	34.617	-2.043
28	4	84	34.388	-1.839
29	1	621	34.680	-1.916
29	2	356	34.596	-2.071
29	3	69	34.386	-1.840
30	1	627	34.688	-1.914
30	2	396	34.603	-2.049
30	3	215	34.483	-1.656
30	4	103	34.402	-1.837
31	1	601	34.662	-1.959
31	2	404	34.598	-2.066
31	3	154	34.439	-1.776
32	1	582	34.645	-1.966
32	2	491	34.611	-2.086
32	3	313	34.473	-1.219
32	4	123	34.366	-1.841
33	1	556	34.648	-1.975
33	2	556	34.648	-1.974
33	3	557	34.648	-1.975
33	4	557	34.648	-1.975
34	1	546	34.662	-1.956
34	2	354	34.476	-1.837
34	3	163	34.389	-1.819
34	4	22	34.106	-1.750
35	1	527	34.643	-2.018
35	2	385	34.464	-1.337
35	3	153	34.366	-1.844
36	1	501	34.528	-0.624
36	2	203	34.366	-1.840
36	3	22	34.162	-1.785
37	1	475	34.512	-0.757
37	2	153	34.363	-1.833
38	1	440	34.499	-0.929
38	2	153	34.363	-1.837
39	1	426	34.500	-1.515
39	2	305	34.429	-1.739
39	3	163	34.373	-1.822
40	1	404	34.476	-1.109
40	2	304	34.417	-1.502
40	3	153	34.355	-1.841
41	1	430	34.460	-1.329
41	2	254	34.373	-1.794
41	3	103	34.330	-1.820
42	1	469	34.525	-0.642
42	2	355	34.437	-1.385
43	1	496	34.537	-0.585
43	2	204	34.368	-1.838
44	1	526	34.633	-1.986
44	2	304	34.425	-1.742
44	3	103	34.365	-1.839
45	1	557	34.632	-1.988
45	2	104	34.367	-1.842
46	2	538	34.556	-1.030
46	3	493	34.460	-1.475
46	4	291	34.373	-1.825
47	1	1379	34.674	0.310
47	2	1062	34.662	0.438
94	1	2077	34.666	0.064
94	3	1417	34.674	0.368
94	5	254	34.374	-1.833
95	1	1920	34.672	0.244
95	3	1267	34.673	0.464
95	5	305	34.369	-1.832
96	1	1666	34.673	0.298
96	3	1014	34.659	0.510
96	5	306	34.370	-1.826
97	1	1469	34.673	0.321
97	3	1012	34.661	0.493
97	5	305	34.376	-1.823
98	1	1246	34.674	0.364
98	3	912	34.656	0.478
98	5	305	34.368	-1.838
99	1	1083	34.671	0.399
99	3	911	34.651	0.416
99	5	305	34.368	-1.835
100	1	876	34.668	0.336
100	3	795	34.610	0.038
100	5	305	34.369	-1.832
101	1	710	34.621	0.092
101	3	614	34.569	-0.273
101	4	302	34.368	-1.836
104	1	783	34.654	0.422
104	3	557	34.509	-0.622
104	5	304	34.370	-1.830
105	1	573	34.547	-0.303
105	2	304	34.366	-1.838
105	3	141	34.288	-1.907
106	1	448	34.420	-1.426
106	2	304	34.353	-1.894
106	3	163	34.301	-1.918
107	1	456	34.383	-1.777
107	2	304	34.355	-1.895
122	3	495	34.494	-0.910
122	4	365	34.379	-1.756
123	1	451	34.498	-1.588
123	2	406	34.482	-1.124
124	1	1388	34.673	0.381
124	2	1265	34.671	0.423
124	3	1114	34.667	0.508
124	4	962	34.648	0.458
124	5	809	34.625	0.371
124	6	457	34.383	-1.777
124	7	305	34.372	-1.828
124	8	153	34.363	-1.845
125	1	979	34.668	0.379
125	2	820	34.652	0.426
125	3	204	34.364	-1.838
128	1	509	34.616	0.051
128	2	440	34.510	-0.741
128	3	243	34.370	-1.776
128	4	143	34.355	-1.840
129	1	415	34.523	-0.805
129	2	351	34.472	-1.154
129	3	204	34.373	-1.797
137	1	578	34.534	-0.726
137	2	521	34.542	-0.609
137	3	465	34.534	-0.571
137	4	410	34.473	-1.037
137	5	354	34.420	-1.456
137	6	299	34.387	-1.667
137	7	243	34.366	-1.792
137	8	188	34.359	-1.829
137	9	132	34.351	-1.835
137	11	77	34.317	-1.798
137	12	22	33.926	-1.767
138	1	1021	34.667	0.349
138	2	910	34.661	0.392
138	3	860	34.662	0.468
138	4	809	34.659	0.497
138	5	708	34.635	0.399
138	6	607	34.550	-0.328
138	7	506	34.375	-1.694
138	8	405	34.350	-1.807
138	9	304	34.343	-1.816
138	10	203	34.326	-1.790
138	11	101	34.256	-1.641
138	12	52	33.976	-1.674
139	1	1493	34.669	0.250
139	2	1011	34.675	0.625
139	3	658	34.540	-0.375
139	4	405	34.364	-1.761
139	5	254	34.342	-1.819
139	6	153	34.317	-1.790
139	7	103	34.279	-1.694
139	8	53	34.111	-1.565
140	1	1761	34.668	0.177
140	2	859	34.653	0.551
140	3	627	34.490	-0.878
140	4	404	34.369	-1.720
140	5	253	34.342	-1.813
140	6	153	34.321	-1.777
140	7	102	34.272	-1.713
140	8	52	33.920	-1.741
141	1	2229	34.665	0.029
141	2	1315	34.668	0.358
141	3	859	34.651	0.487
141	4	556	34.468	-1.099
141	5	354	34.362	-1.774
141	6	253	34.348	-1.812
141	7	153	34.327	-1.786
141	8	102	34.291	-1.730
141	9	52	34.033	-1.617
142	1	1687	34.670	0.196
142	2	1015	34.680	0.504
142	4	522	34.631	0.419
142	5	204	34.399	-1.632
142	6	118	34.361	-1.772
143	1	925	34.672	0.412
143	2	435	34.668	0.775
143	3	238	34.517	-0.636
143	4	132	34.421	-1.629
144	1	773	34.677	0.507
144	2	405	34.673	0.770
144	3	233	34.585	0.054
144	4	133	34.445	-1.513
146	1	3075	34.639	-0.498
146	2	2972	34.640	-0.468
146	3	1715	34.663	-0.044
146	4	507	34.672	0.467
147	1	2755	34.656	-0.180
147	2	2534	34.658	-0.151
147	3	1514	34.669	0.187
147	4	750	34.655	0.290
148	1	2988	34.656	-0.170
148	2	2693	34.658	-0.126
148	3	2008	34.664	0.020
148	4	1502	34.668	0.145
149	1	3574	34.643	-0.399
149	2	2893	34.655	-0.207
149	3	2211	34.663	-0.039
149	4	1216	34.679	0.324
149	5	913	34.680	0.432
150	1	3862	34.643	-0.370
150	2	3297	34.645	-0.384
150	3	2584	34.657	-0.183
150	4	1772	34.671	0.114
150	5	1012	34.682	0.401
150	6	506	34.663	0.376
151	1	4075	34.643	-0.345
151	2	3551	34.645	-0.361
151	3	3039	34.650	-0.323
151	4	1720	34.672	0.133
151	5	708	34.672	0.398
152	1	4193	34.644	-0.326
152	2	3552	34.645	-0.355
152	3	3041	34.649	-0.320
152	4	2025	34.668	0.019
152	5	710	34.674	0.399
153	1	4136	34.645	-0.309
153	2	3504	34.646	-0.346

153	3	2482	34.659	-0.166	159	5	1315	34.672	0.194	168	6	200	34.547	0.993	172	2	501	34.711	1.373
153	4	2000	34.668	0.017	161	1	1329	34.662	-0.029	168	8	20	33.653	0.907	172	3	400	34.699	1.444
153	5	761	34.675	0.403	161	2	1257	34.663	-0.006	169	1	861	34.720	1.299	172	4	300	34.674	1.463
154	1	3825	34.647	-0.291	161	3	1012	34.666	0.193	169	2	701	34.715	1.336	172	5	202	34.613	1.317
154	2	3146	34.649	-0.299	161	4	651	34.675	0.350	169	3	500	34.702	1.383	172	6	100	34.273	-0.170
154	3	2500	34.659	-0.149	163	1	2623	34.658	-0.152	169	4	300	34.671	1.442	173	1	709	34.722	1.338
154	4	1715	34.671	0.085	163	2	2123	34.664	-0.011	169	5	101	34.110	-0.409	173	2	491	34.709	1.439
154	5	850	34.681	0.426	163	3	1617	34.668	0.120	169	6	20	33.736	1.051	173	3	301	34.675	1.501
156	1	3297	34.650	-0.273	163	4	902	34.663	0.362	170	1	943	34.722	1.302	173	4	200	34.598	1.262
156	2	2701	34.654	-0.225	164	1	2385	34.659	-0.126	170	2	788	34.719	1.317	173	5	101	34.315	0.071
156	3	2197	34.659	-0.154	164	2	2001	34.664	0.015	170	3	600	34.706	1.339	173	6	20	33.856	0.959
156	4	1500	34.674	0.169	164	3	1498	34.670	0.207	170	4	399	34.695	1.415	174	1	295	34.687	1.460
156	5	750	34.676	0.409	164	4	997	34.666	0.372	170	5	200	34.612	1.229	174	2	467	34.699	1.457
158	1	2512	34.656	-0.186	167	1	164	34.538	0.907	170	6	21	33.801	1.033	174	3	420	34.697	1.458
158	2	1507	34.663	-0.019	167	2	101	34.293	0.072	171	1	628	34.722	1.316	174	4	350	34.690	1.461
158	3	1013	34.680	0.327	167	3	48	33.827	0.964	171	2	452	34.703	1.424	175	1	285	34.672	1.426
158	4	505	34.666	0.388	168	1	707	34.714	1.348	171	3	302	34.665	1.399	175	2	230	34.631	1.307
159	1	1987	34.659	-0.104	168	2	600	34.706	1.378	171	4	199	34.578	1.105	175	3	170	34.479	0.742
159	2	1721	34.660	-0.088	168	3	500	34.697	1.400	171	5	100	34.227	-0.233	175	4	126	34.348	0.314
159	3	1315	34.672	0.195	168	4	401	34.686	1.427	171	6	21	33.823	0.984	175	5	70	33.861	1.121
159	4	1316	34.672	0.196	168	5	301	34.657	1.385	172	1	598	34.720	1.358	175	6	13	33.597	0.854

Table showing the CTD configuration, which remained constant throughout the cruise.

Channel	**Sensor**	**Serial number**
1 (F)	Temperature (primary)	4593
2 (F)	Conductivity (primary)	2165
3 (F)	Digiquartz pressure with TC	100898
4 (F)	Temperature (secondary)	4383
5 (F)	Conductivity (secondary)	2164
6 (A/D)	Free	
7 (A/D)	Altimeter	874

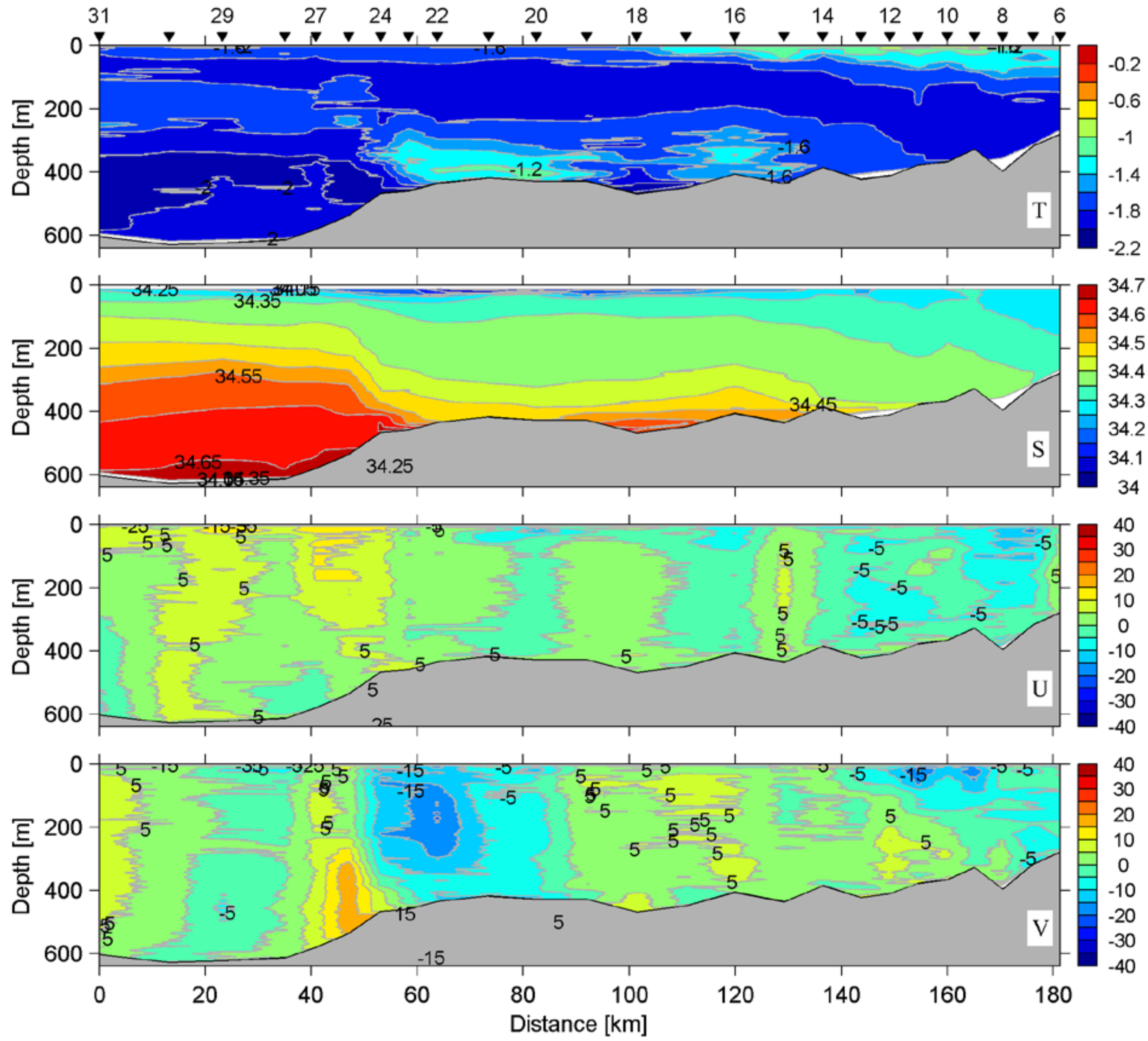
Appendix C. Selected preliminary sections

CTD stations for moorings and CTD sections

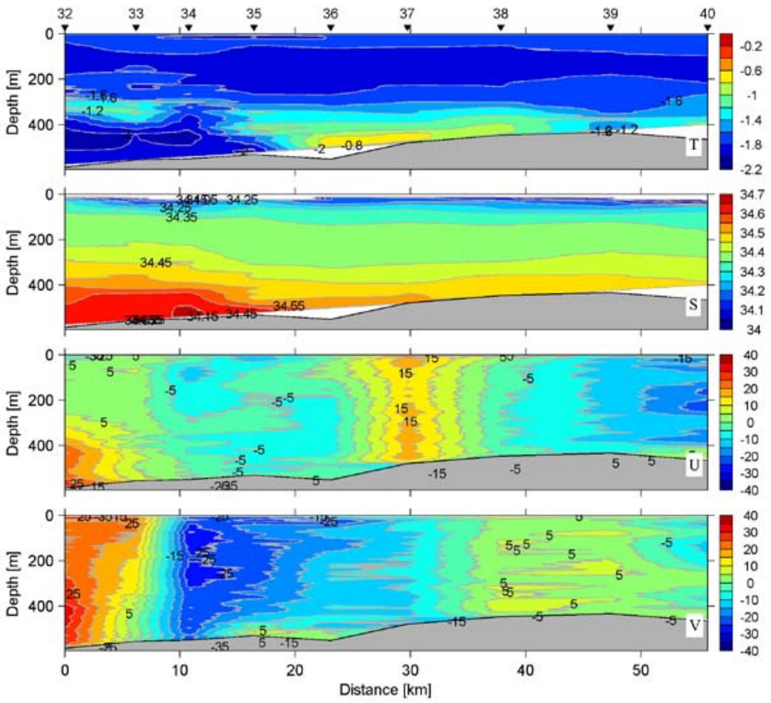
(The positions of Sections A to L are shown in Figure 2)

Section/mooring	Station numbers
M2 (recover)	1
SASSI section 1	2 – 5
SASSI 1600	2
SASSI 973	3
SASSI 487	4
SASSI 273	5
SASSI section 2	138 – 144
SASSI 2600	142
A	6 – 31
B	32 – 40, (50)
C	41 – 46
D	47 – 58
E	59 – 67
F	68 – 78
G	79 – 86
H	90, 91, 89, 92, 93, 87, 88
I	94 – 101
J	102 – 107
K	116 – 123
L	124 – 126, 135 – 137, 127, 128
M3 (deploy)	145
M2 (deploy)	146
Orkney Passage	162 – 147, 163 – 166
Marguerite Trough	167 - 175

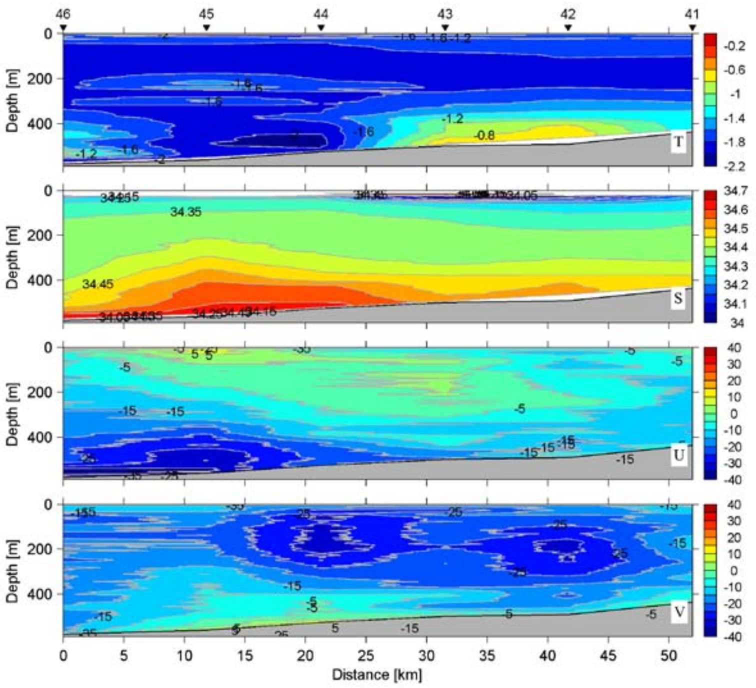
Section A



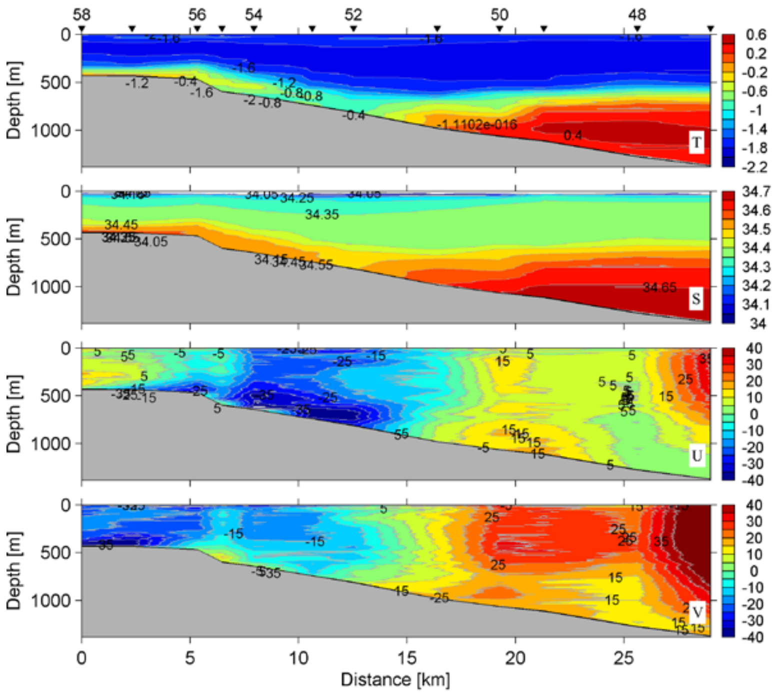
Section B



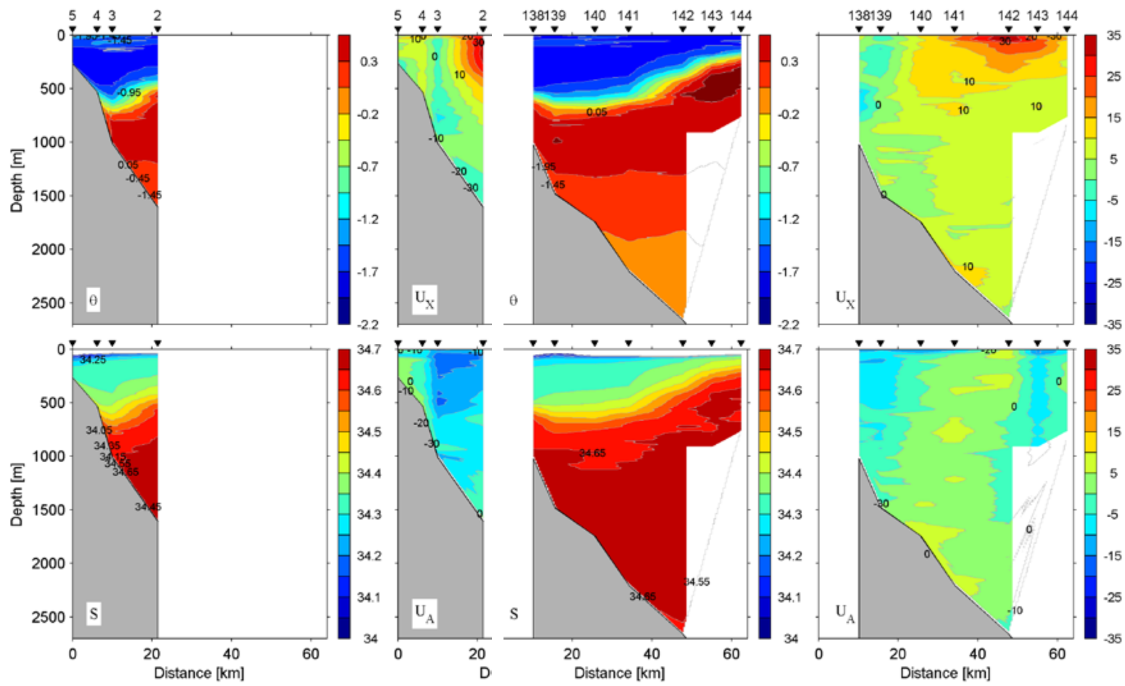
Section C



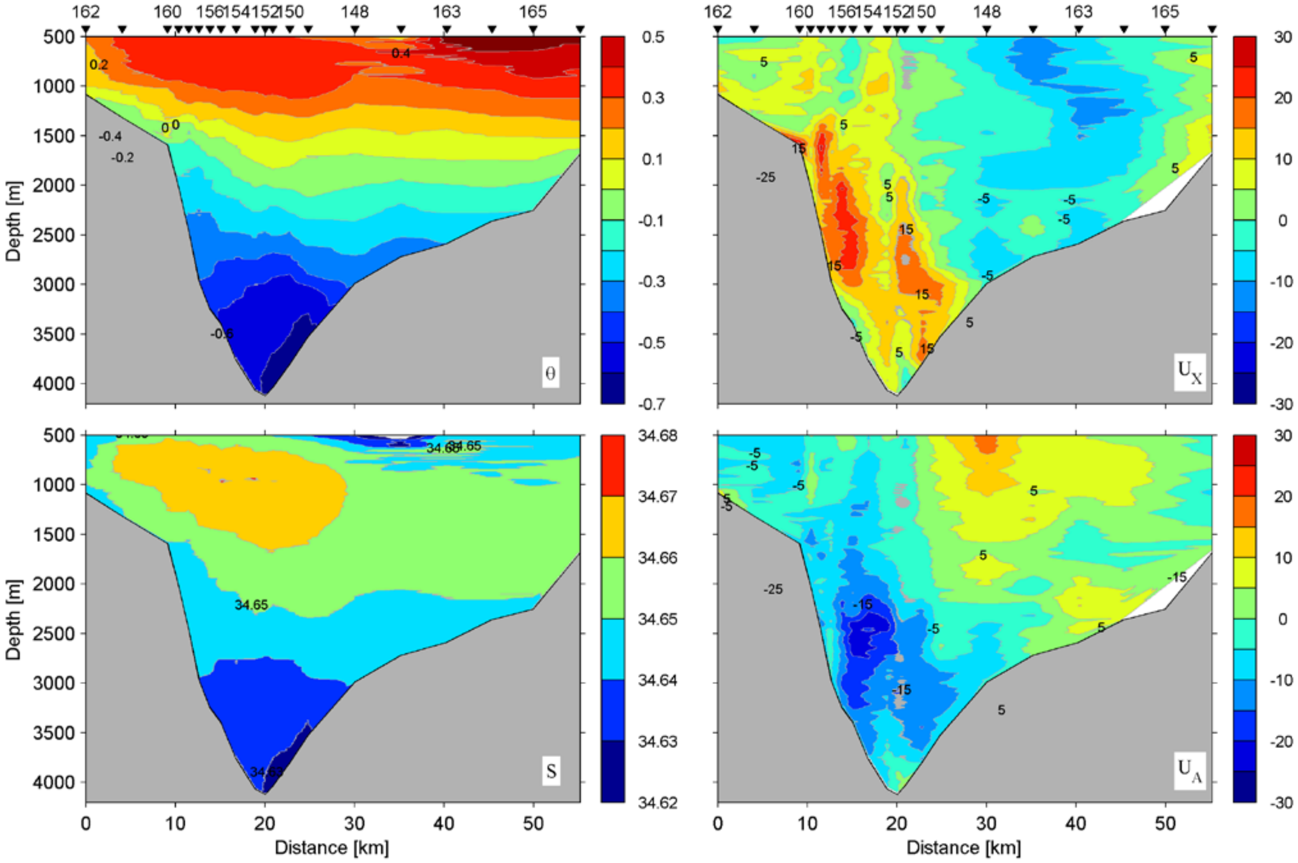
Section D



SASSI sections

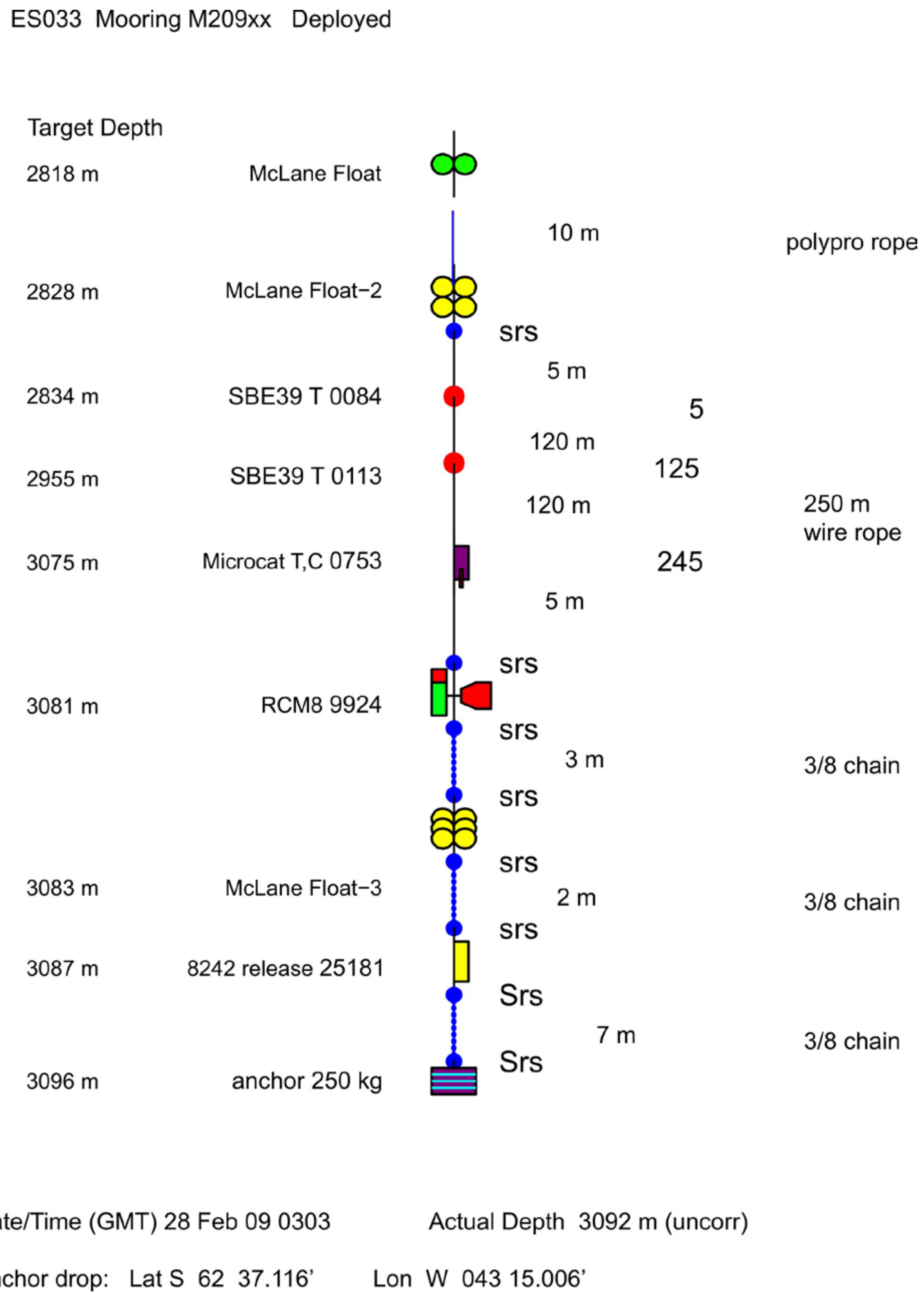


Orkney Passage Section



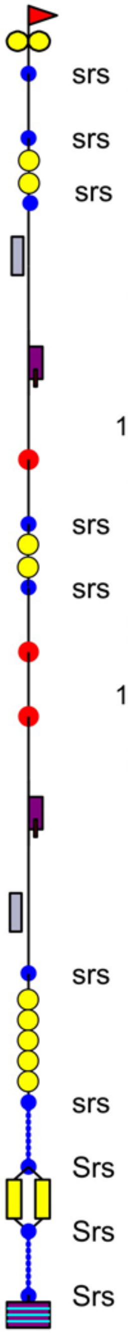
Appendix D. Instrument notes and mooring diagrams

M2 (as deployed)



M3 (as deployed)

ES033 Mooring M309xx Deployed



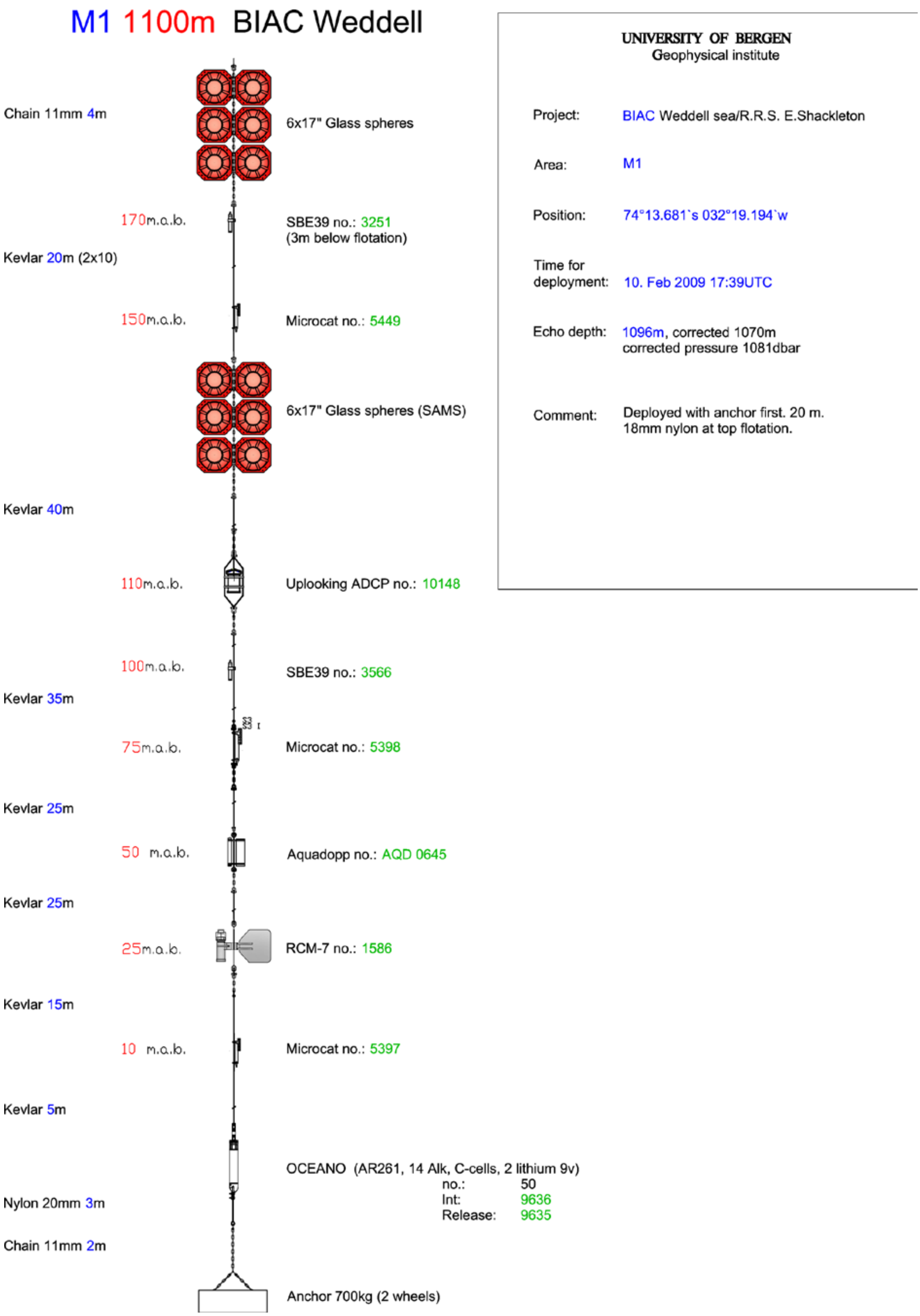
Depth	Element	Serial Number	Distance between elements	Wire marker	Line length/ type
4023 m	McLane Top w/ radio ch 71 156.575 MHz	J05-055	10 m		poly rope, 10 m
4034 m	17" glass x 2 on 2 m 3/8" chain		5 m		
4041 m	Aquadopp 6k	2317	45 m	**5**	
4087 m	Microcat T,C,P	1351	125 m	**50**	**3/16 wire, 250 m**
4213 m	SBE39 Trec	0083	75 m	**175**	
4288 m	17" glass x 2 on 2 m 3/8" chain		25 m		
4315 m	SBE39 T,P	1826	125 m	**25**	
4441 m	SBE39 Trec	0229	95 m	**150**	**3/16 wire, 250 m**
4536 m	Microcat T,C,P	4119	3 m	**245**	
4542 m	Aquadopp 6k	1752	2 m	**248**	
4545 m	17" glass x 5 on 4.7 m 1/2" chain		2 m		3/8" chain
4551 m	8242 release(2)	33147 33152	6 m		1/2" chain
4560 m	anchor 250 kg				

Date/Time (GMT) 27 Feb 09 1804 Depth 4583 m (uncorr)

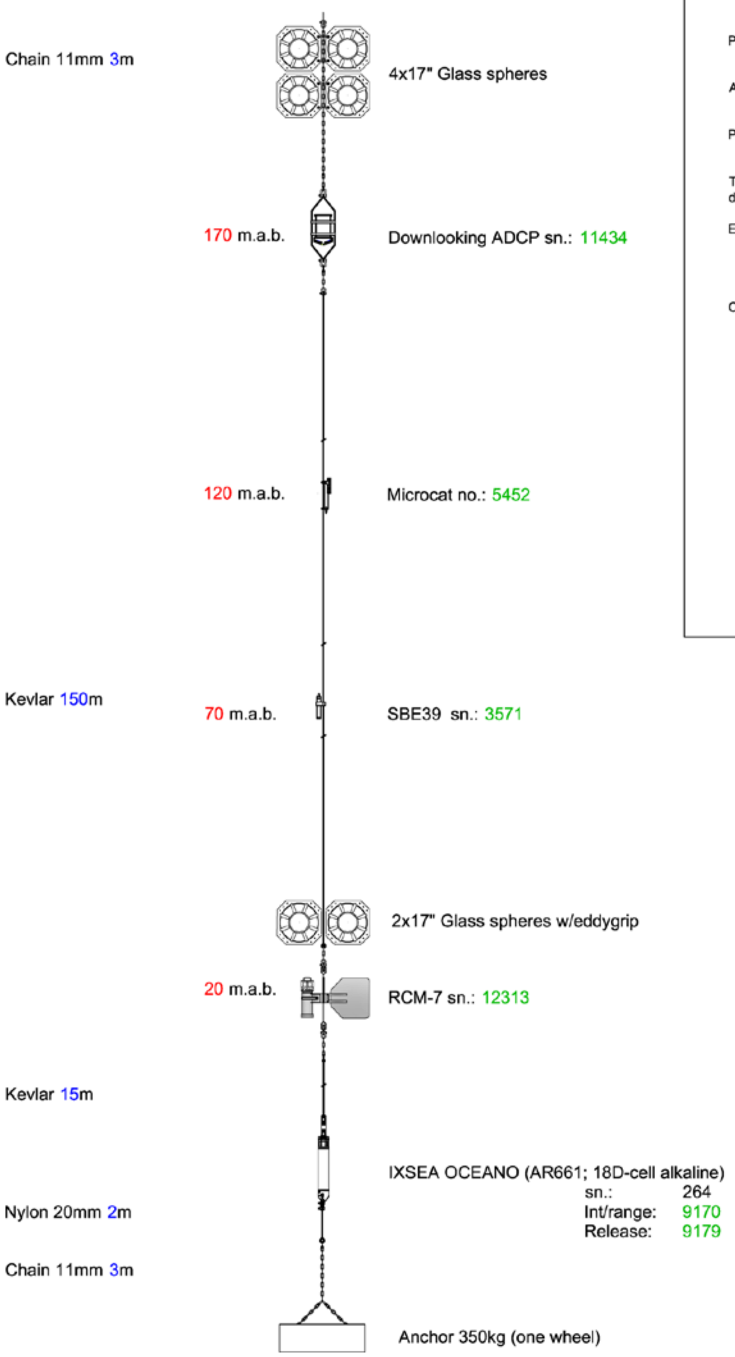
Anchor drop: Lat S 63 31.449' Lon W 041 46.115' (48.115'?)

notes: radio duty cycle: 2 s on, 4 off

BIAC Moorings (as deployed)



M2S 1900m BIAC Weddell



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Project:	BIAC Weddell sea 2009/R.R.S E.Shackleton
Area:	M2S (shortened), Weddell sea
Position	73°58.678`s 032°16.682`W
Time for deployment	11. Feb 2009 18:05UTC
Echo depth	1960m, corrected 1913m corrected pressure 1940dB
Comment:	Shortened version of the original (partly lost) M2 mooring. Releaser (from S. Østerhus), serviced with alkaline D-cells (18pz) and 9v batt. Deployed with anchor last.

M3 750m BIAC Weddell

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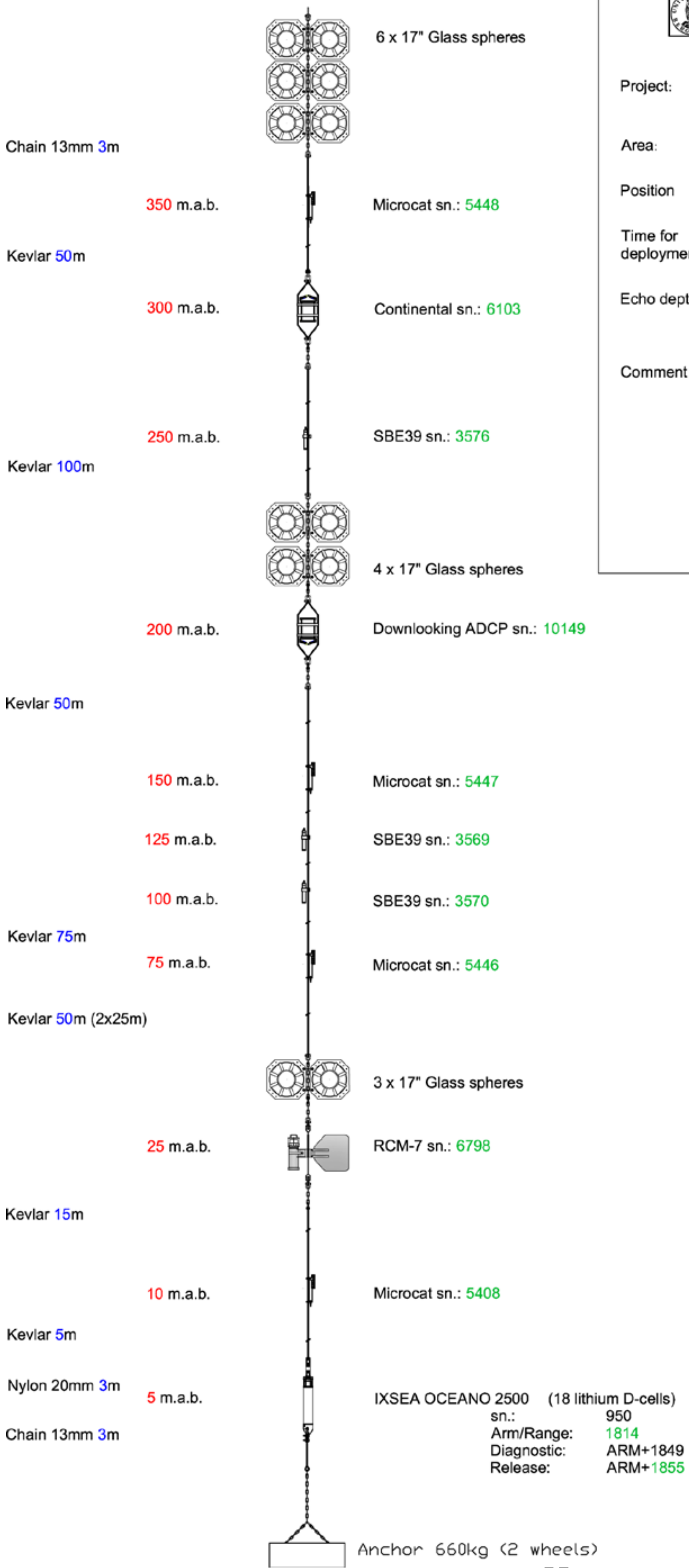
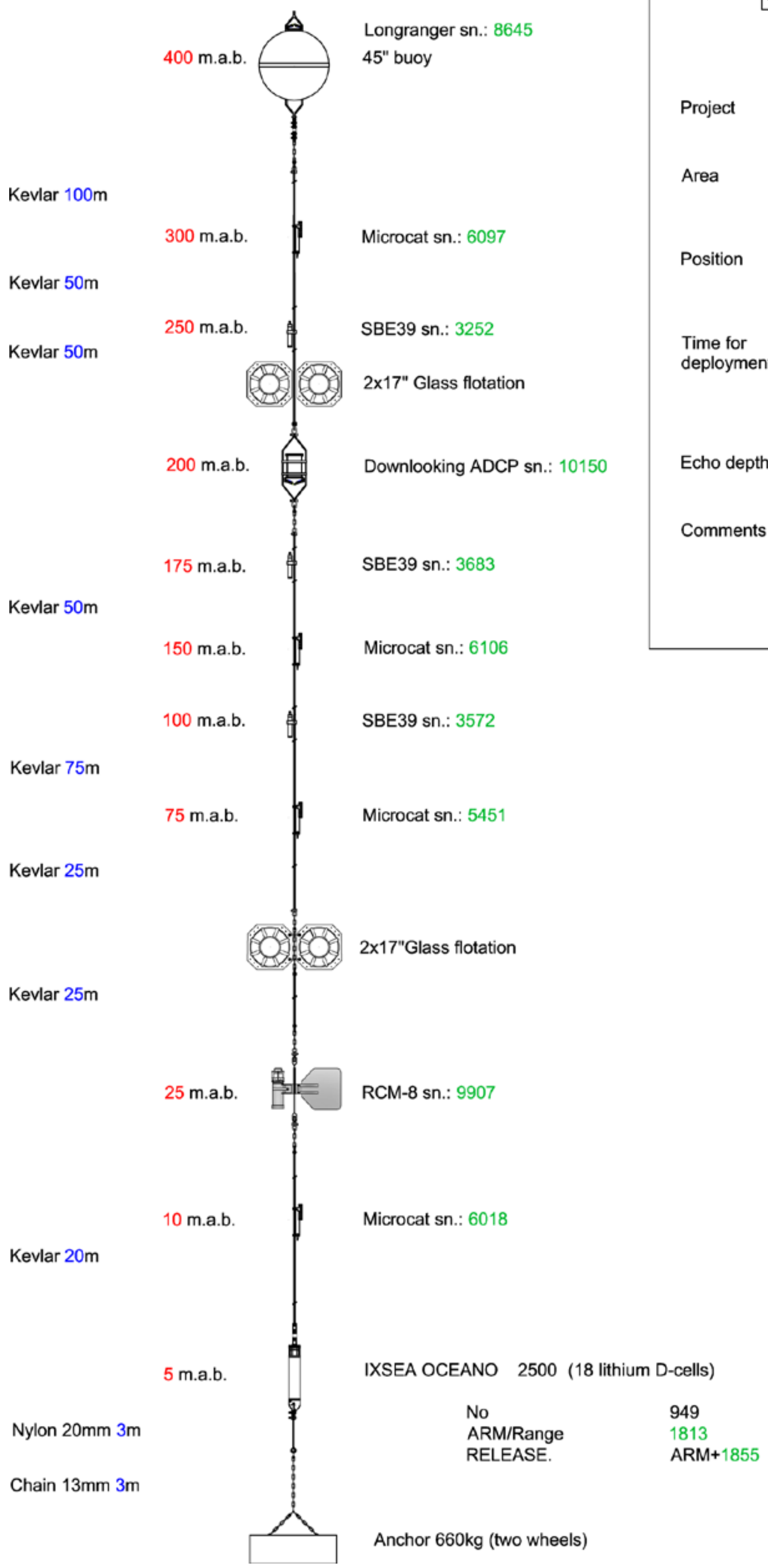
Project:	BIAC Weddell sea 2009/R.R.S. E.Shackleton
Area:	M3
Position	74°30.633`s 030°09.906`w
Time for deployment	13. Feb. 2009 16:26UTC
Echo depth	753m, corrected 728m, pressure 735dbar
Comment	Anchor last deployment. 5m nylon for recovery. Parts of flotation borrowed from SAMS/NERC.



M4 1100m BIAC Weddell



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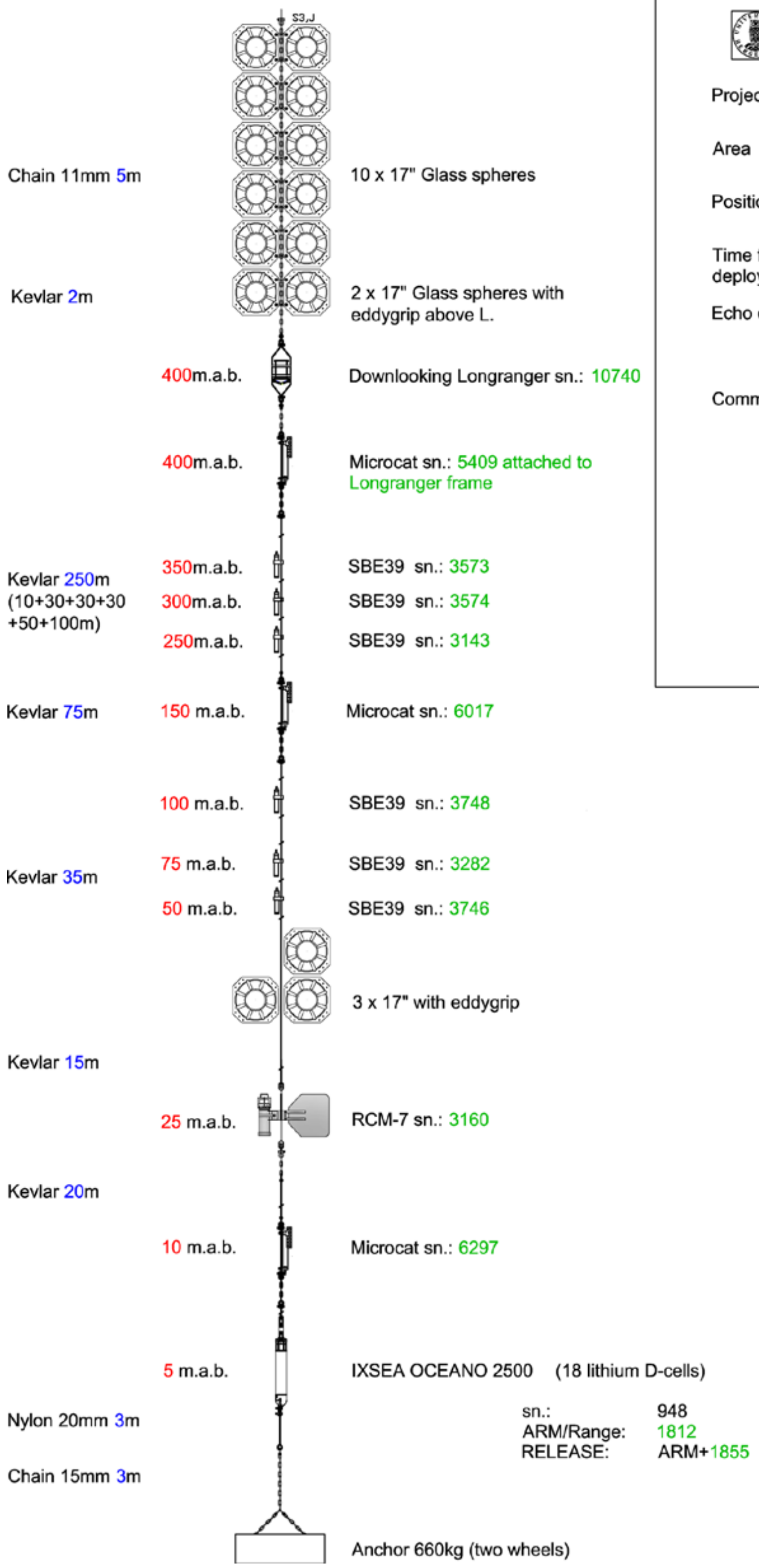
Project	BIAC Weddell sea 2009/R.R.S E.Shackleton
Area	M4
Position	74°26.278`s 030°02.639`w
Time for deployment	13. Feb. 2009 12:37UTC
Echo depth	1093m, corrected: 1059m corrected pressure 1071dbar
Comments	Deployed with anchor last in open water. Recovery rope attached.

M5 1900m BIAC Weddell



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Project	BIAC Weddell sea 2009/R.R.S. E.Shackleton
Area	M5
Position	74°10.15`s 029°32.60`w
Time for deployment	12.Feb 2009 22:43 UTC (Start 21:41UTC)
Echo depth	1976m, corrected 1928m
Comment	Deployed with anchor last in open water.

SASSI moorings as deployed

E/S Depth	Actual Depth	Lat S	Long W	Release S/N	Win.	Diag.	Rel.
2660	2600	72 15.2	018 37.9	369	14F9	1449	1455
1644	1600	72 25.0	018 01.1	321	14D1	1449	1455
1002.9	973	72 26.4	017 43.2	360	14F0	1449	1455
500	487	72 27.5	017 37.7	315	14CB	1449	1455
281	273	72 29.2	017 27.8	254	EC57	EC85	EC87

SASSI 273	Depth
ADCP 10689	256
RAS 12239-02	259
SBE37 1125	259
A/R 254	266
& Miniloggers:	
1083	246
1080	224
1086	202
1087	180
5594 (T/P)	158
1618	136
1617	114
1616	92
1615	70
1614	48

SASSI 487	Depth
LR-ADCP 5575	469
RAS 12239-01	473
SBE37 4609	473
SUBER (P)	473
A/R 315	480
& Miniloggers:	
1613	459
1612	439
1611	419
3021	399
1610	379
1609	359
1608	339
1607	319
1606	299
1605	279
1604	259
3022 (T/P)	239
1603	219
1082	199
1081	179
1079	159
1078	139
1070	119
1069	99
1064	79
1063	59
1062	39

SASSI 2600	Depth
LR-ADCP 5599	469
SBE37 4549	485
SBE37 3145	987
Nortek 1415	987
SBE37 3362	1950
Nortek 1420	1950
SBE37 3081	2585
Nortek 1430	2585
A/R 369	2588

SASSI 1600	Depth
LR-ADCP 5476	416
SBE37 3481	427
SBE37 3250	920
RCM11 527	936
SBE37 3083	1585
Nortek 1404	1585
A/R 321	1588

SASSI 973	Depth
LR-ADCP 10584	438
SBE37 3276	451
SBE37 3218	947
RCM11 522	959
A/R 360	961

The SASSI PIES (Inverted Echo Sounder with Paroscientific pressure sensor) was deployed near OP2 in Orkney Passage. The instrument was let go at 2146 on 2 March 2009 at 60°39'.2S, 042°06'.5W, in 3138 m water (corrected).

The following pages give mooring diagrams for the SASSI moorings, as deployed.

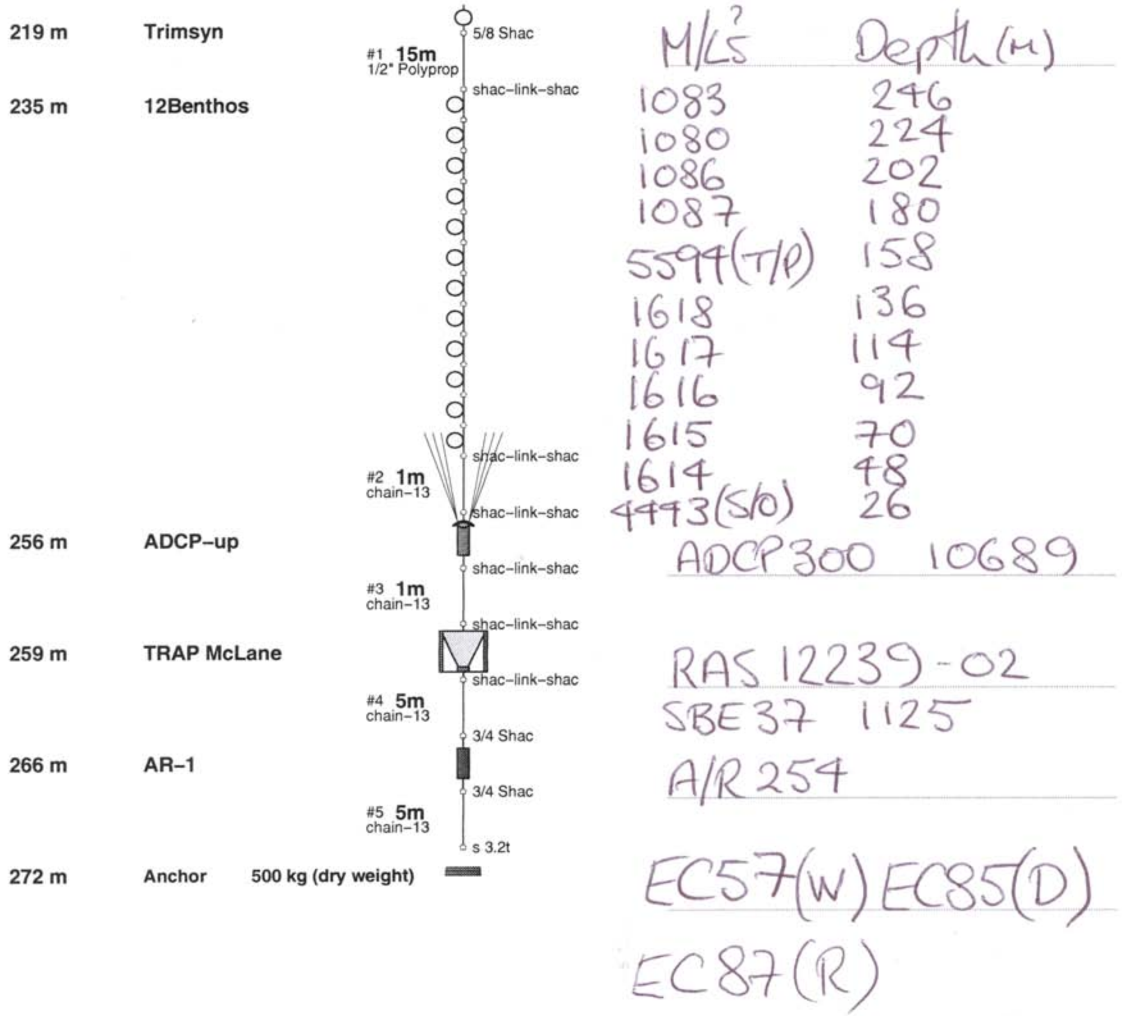
ESØ33 Deployed 31/1/2009

SASSI 273m 31/01/2009

S72°29.2' W017 27.8'

23-Mar-2009
12:52
Page # 1 / 2

depth (incl. stretch)	component	S/N	rope # & Length	Distance from lower rope end	in/out of water comment

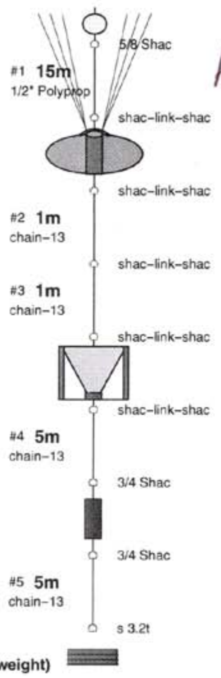


ESØ33 Deployed 31/1/2009

SASSI 487m 31/01/2009 S72°27.5' W017°37.7'

23-Mar-2009
12:54
Page # 1 / 2

depth (incl. stretch)	component	S/N	rope # & Length	Distance from lower rope end	in/out of water comment
453 m	Trimsyn				ARGOS 290/22458 + RADIO 156.625
469 m	ADCP+66"Streamline				LR-ADCP 5575
473 m	TRAP McLane				RAS 12239-01 SBE37 4609
480 m	AR-1 SUBER 473				A/R315 14CB(W)
486 m	Anchor 750 kg (dry weight)				1449(D) 1455(R)



M/L's	Depth(m)
1613	459
1612	439
3021	399
1611	419
1610	379
1609	359
1608	339
1607	319
1606	299
1605	279
1604	259
3022(T/P)	239
1603	219
1082	199
1081	179

contd

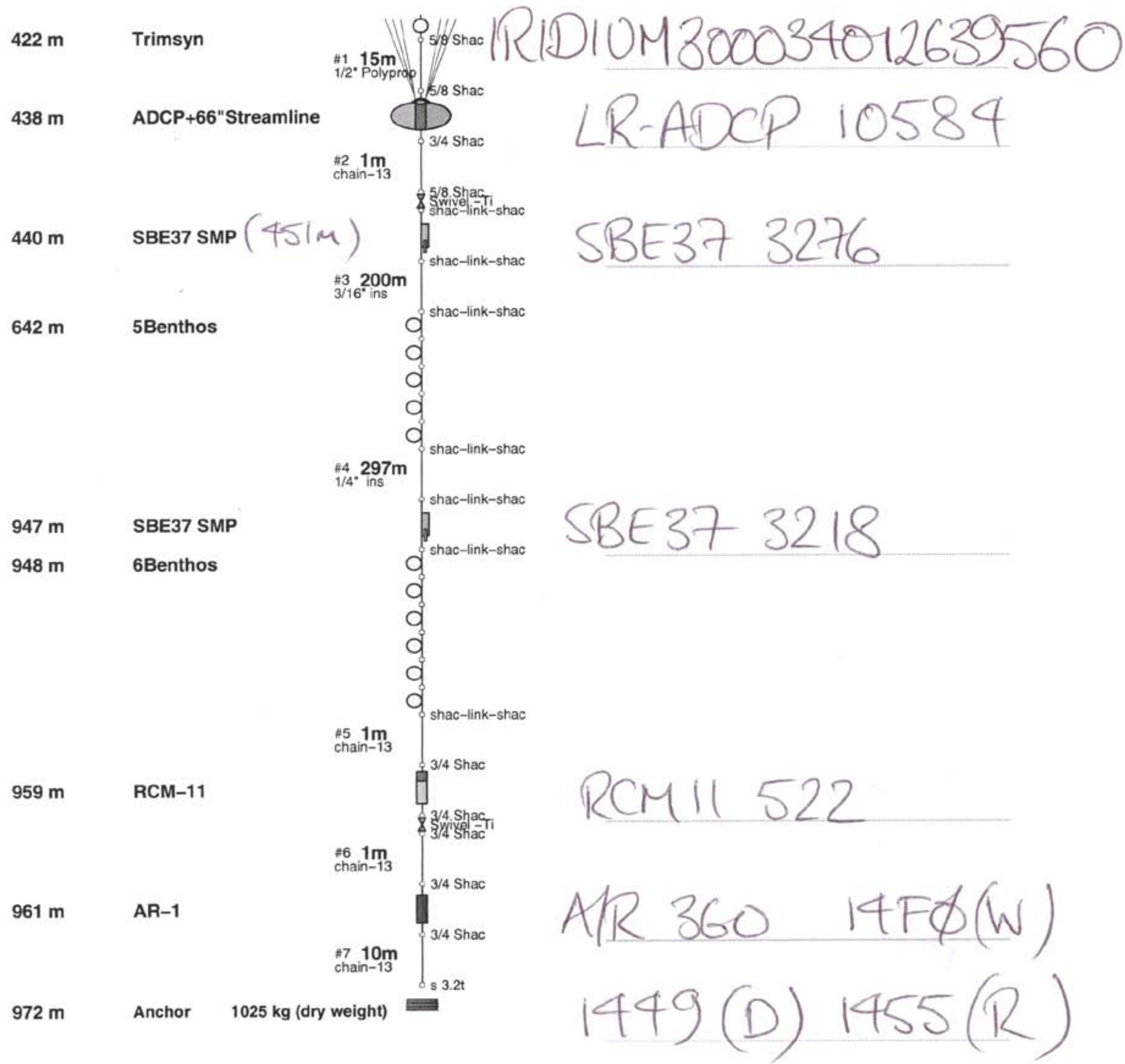
M/L's	Depth(m)
1079	159
1078	139
1070	119
1069	99
1064	79
1063	59
1062	39
4441(S/O)	19

ESØ33 Deployed 31/1/2009

SASSI 973m 31/01/2009 S 72° 26.4' W017° 43.2'

23–Mar–2009
13:15
Page # 1 / 2

depth (incl. stretch)	component S/N	rope # & Length	Distance from lower rope end	in/out of water comment



ES033 - Deployed 31/1/2009

SASSI 1600m 31/01/2009

(E/S 1644m) S 72° 25.0' W018° 01.1'

23–Mar–2009
12:27
Page # 1 / 3

depth (incl. stretch)	component	S/N	rope # & Length	Distance from lower rope end	in/out of water comment
400 m	Trimsyn			5/8 Shac	IRIDIUM 300034012638560 RADIOBEACON 156.625
			#1 15m 1/2" Polyprop	5/8 Shac	
416 m	ADCP+66"Streamline			3/4 Shac	LR-ADCP 5476 (SAS 2)
			#2 1m chain–13	5/8 Shac, Swivel –Ti, shac–link–shac	
418 m	SBE37 SMP			shac–link–shac	SBE37 SMP 3481
			#3 500m 3/16" ins	shac–link–shac	
920 m	SBE37 SMP			shac–link–shac	SBE37 SMP 3250
921 m	9Benthos			shac–link–shac	
			#4 1m chain–13	shac–link–shac	
936 m	RCM–11			3/4 Shac	RCM 11 - 527
			#5 1m chain–13	shac–link–shac	
			#6 600m 10mm Polyester	shac–link–shac	
1572 m	8Benthos			shac–link–shac	
			#7 1m chain–13	3/4 Shac	
1585 m	SBE37 SMP			shac–link–shac	SBE37 SMP 3083
1586 m	NORTEK			3/4 Shac, Swivel –Ti, 3/4 Shac	NORTEK 1404
			#8 1m chain–13	3/4 Shac	
1588 m	AR–1			3/4 Shac	A/R321 1401 (W)
			#9 10m chain–13	s 3.2t	
1599 m	Anchor	1500 kg (dry weight)			1449 (D) 1455 (R)

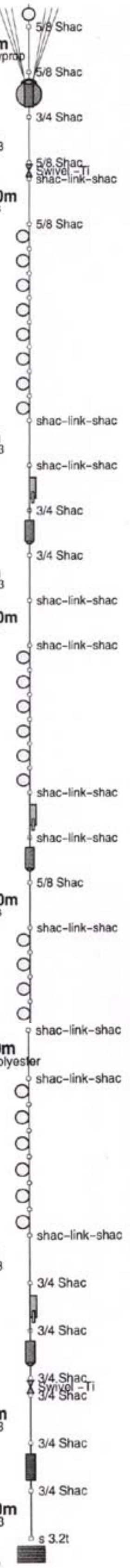
ESØ33 - Deployed 24/2/2009

sassi 2660m (actual depth 2600m) 24–02–2009 v01

S72° 15.1' W018° 37.9

06–Mar–2009
22:07
Page # 1 / 3

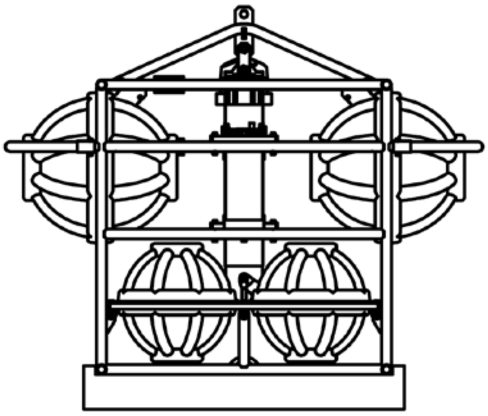
depth (incl. stretch)	component	S/N	rope # & Length	Distance from lower rope end	in/out of water comment
452 m	Trimsyn		#1 15m 1/2" Polyprop		Argos 23833 + Light + Radio 156.625
469 m	ADCP+F49		#2 1m chain–13		LR-ADCP 5599; SBE37 4549 (485m)
			#3 500m 3/16" ins		
973 m	8Benthos		#4 1m chain–13		
987 m	SBE37 SMP				SBE37 3145
987 m	NORTEK		#5 1m chain–13; #6 950m 1/4" ins		Nortek 1415
1941 m	6Benthos				
1950 m	SBE37 SMP				SBE37 3362
1951 m	NORTEK		#7 300m 3/16" ins		Nortek 1420
2253 m	4Benthos		#8 300m 10mm Polyester		
2575 m	6Benthos		#9 1m chain–13		
2585 m	SBE37 SMP				SBE37 3081
2586 m	NORTEK		#10 1m chain–13		Nortek 1430
2588 m	AR–1		#11 10m chain–13		A/R 369 14F9 (W) 1449 (D) 1455 (R).
2599 m	Anchor		1600 kg (dry weight)		



S2 mooring, as deployed

S2 600m

RDCP Acoustic Modem frame



Side view

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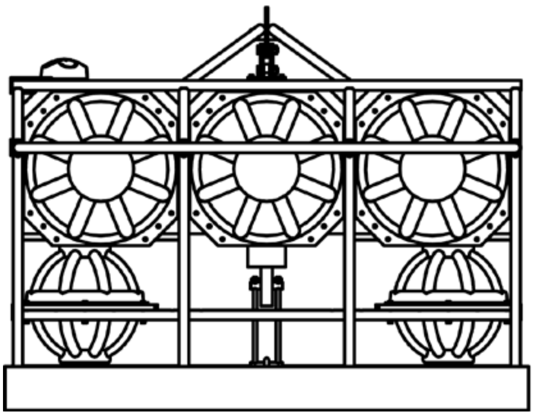
Project	Weddell sea 2009/R.R.S. E.Shackleton
Area	S2
Position	74°39.05`s 033°32.97`w
Time for deployment	4. Feb. 2009 14:00UTC
Echo depth	602m
Comment	Lowered and released to free fall the last 20 meters. Diagnostic: upright position. Communication tested ok. Alternative position: 74°38.882`s 033°32.999`n (CTD shack) Rope attached for recovery. Argos installed with lithium D-cells.



Front view

RDCP 600	sn:	240
RCM-9	sn:	1437
Argos	sn/id:	266/46244
IXSEA OCEANO		
	sn:	982
	Arm/range:	18C5
	Diagnostic:	Arm+1849
	Pinger off:	Arm+1848
	Release:	Arm+1855

FOCAS Coast mooring recovery

The Coast mooring consisted of a single upward-looking 300kHz RDI Workhorse ADCP. The data files recovered were badly fragmented, and one of the memory cards was unreadable/empty. The result was an intact times series from 11 August 2007 to 20 March 2008. Typically 40 of the 2-m bins contained useful data.

Orkney Passage Moorings

OP2 recovery 28/2/2009

1742 Release code sent

1759 First buoy spotted at surface

1829 Top float grappled

1830 Top floats on deck

1838 SBE39 s/n 1586 recovered

1849 SBE39 s/n 1311 recovered

1854 Buoy package recovered

1903 SBE39 s/n 1310 recovered

1918 Six-buoy package recovered

1921 RCM s/n 592 recovered

1933 SBE39 s/n 1247 recovered, bundled with two-buoy package

1951 RCM s/n 532 recovered, bundled with four-buoy package

1954 SBE38 s/n 0110 recovered

1957 Release recovered, with two buoys.

OP3 recovery 28/2/2009

1600 First buoy grappled

1606 First buoy package recovered

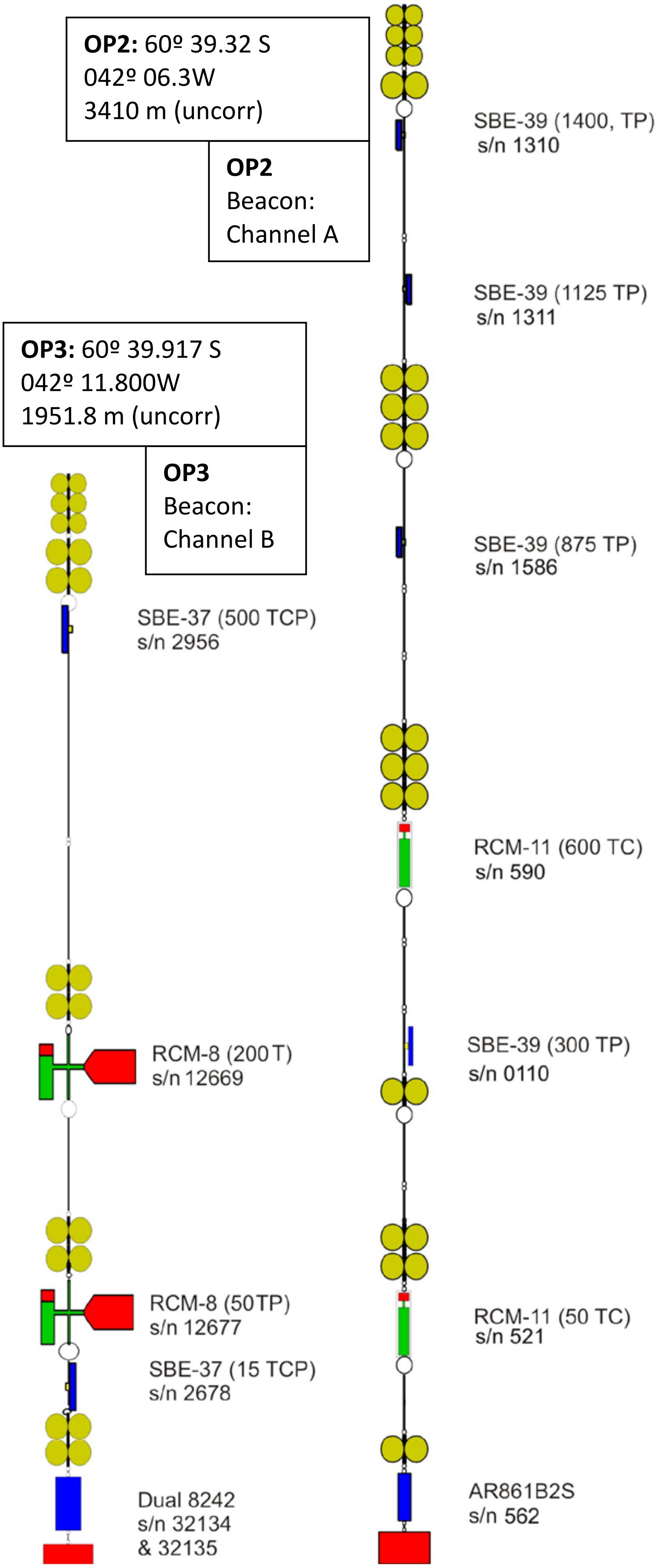
1609 SBE37 s/n 2956 recovered

1628 RCM8 s/n 12677 recovered, tangled with buoys

1645 RCM8 s/n 12669 recovered, tangled with buoys

1654 SBE37 s/n 2678 recovered

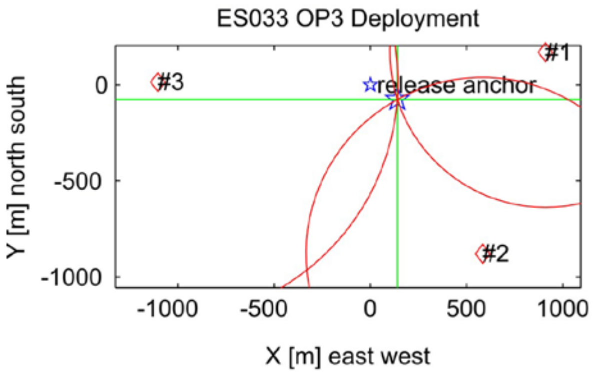
1657 Releases recovered

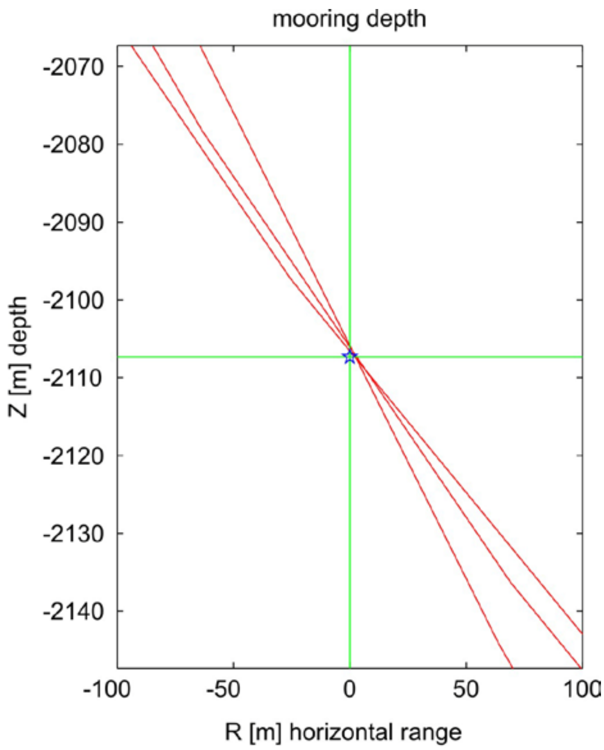


OP moorings as deployed during ES033. Note that the diagrams do not show beacons mounted on masts in 17-inch CRP buoys. The masts are connected to half-inch chain to ballast the buoy, and the chain is connected via a length of rope to the uppermost buoy on the moorings. The beacons consist of a flasher and a VHF beacon.

An improved location for OP3 was found by triangulation, shown below.

__Triangulation for OP3 location__





3D mooring position 60°S 39.958' 42°W 11.646'
mooring depth: 2107 [m]
slant error:0 [m] horizontal error:0 [m] vertical error:0 [m]
2D mooring position 60°S 39.927' 42°W 11.643'
horizontal error:25 [m]
anchor release position 60°S 39.917' 42°W 11.800' depth: 2075 [m]
drift: 159[m] heading: 118 [o]
sound speed at site 1466 [m/s]

#1 pos: 60°S 39.825' 42°W 10.797' range: 2243[m] range soundspeed 1500
#2 pos: 60°S 40.392' 42°W 11.157' range: 2285[m] range soundspeed 1500
#3 pos: 60°S 39.909' 42°W 13.018' range: 2436[m] range soundspeed 1500

Appendix E. Seal capture data, and calibration data from tags

Weddell Seal tagging protocol

Team member responsibilities:

1. Note-taker
   a. Ensure all fields of datasheet are completed and all samples are collected
   b. When recording data, always repeat the measurement value aloud
2. Morphometrics
   a. Measure girth at pre-defined locations
   b. Measure length at each pre-defined location (starting at tip of tail)
   c. Measure total curvilinear length and total straight line length
3. Breathing/condition
   a. Continuously monitor breathing and state of alertness. At any point during the procedure I may ask how long it has been since the last breath
   b. Continuously monitor the overall procedure for general safety concerns
4. Tag attachment
   a. Wash fur with acetone and mark attachment location
   b. Dispense epoxy on fur and on bottom of tag
   c. Surround tag with heat packs and hold in place until epoxy is firm
   d. Remove plastic CTD covering and check saltwater switch contacts
5. Drugger / Ultrasound
   a. Oversee entire procedure
   b. Initiate and maintain sedation
   c. Collect ultrasound measurements at predefined locations

Order of events:

1. Assess condition/health of seal and the safety of the ice
2. Dart / inject initial dose of drug. Wait 10-20 minutes to take effect.
3. Set spinal needle and assess level of sedation
4. Mark morphometric locations and begin measurements (starting at ears)
5. Begin tag attachment
6. Begin ultrasound measurements
7. Take photo
8. Ensure all data have been collected
9. Allow seal to recover and monitor until normal behaviour resumes

General guidelines:

1. Always assess the seal before approaching the head and minimize time there.
2. If the seal becomes mobile, ready the net and head bag and await instructions.
3. If you hear the ice crack, tell everyone immediately.
4. Please exercise extreme caution when walking on ice.
5. Please do not distribute photographs or allow them to become publicly available.
6. If you have any questions or are uncomfortable, please let me [PR] know.

Lessons learned from seal tagging activities

Weddell seal tagging in the Weddell Sea, February 2009

1. How to differentiate Weddell seals from crabeater seals (at a distance)
    a. Shape of face (flatter)
    b. Movement style (undulation rather than slithering)
    c. Reaction to ship (docile)
    d. Coloration (darker and spotted on the belly)
    e. Shape and posture of fore-flipper

2. How to find Weddell seals during late summer in the Weddell sea
    a. Thick pack ice generally away from expanses of open water
    b. 350 to 650m bottom depth
    c. Most dense west of 29-degrees, especially near Helmert Bank
    d. Seals typically haul out for several hours in the middle of the day (and feed during the "night")
    e. Weddell seals are not remarkably dense (crabeater seals are much more abundant)

3. Animal handling
    a. Sea lion net with hoop and block worked perfectly to control the animal and as a head bag
    b. Seals have almost no desire to bite, but need to minimize opportunities
    c. Common to find seal holes close to seals… need to inspect area for holes and cracks prior to drugging
    d. Check moult status… moult on head and along spine first (dark stripe). Possible to pluck old fur.

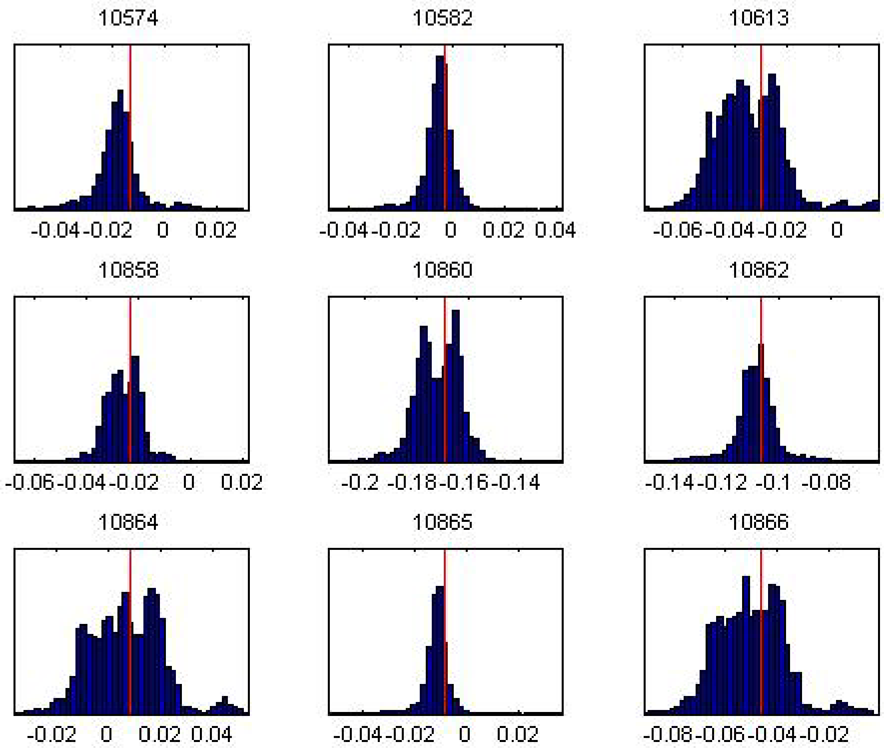
4. Sedation notes/recommendations
    a. Dart gun is not necessary.
    b. Remarkable variation in response to drugs. Recommend conservative dosing; physical restraint is relatively easy when necessary.
    c. 2.7cc Zoletil worked well as a standard dose.
    d. Traditional elephant seal approach works well (Zoletil and Ketamine)
    e. Diazepam was never used, although it would have been helpful for a couple of seals
    f. Attach heat pack to spinal needle with Velcro ring to prevent freezing
    g. Need to bring drugs in vials appropriate for drawing in the field (e.g. rubber stoppered bottles instead of 'ampoules')
    h. Seals respired remarkably well and breaths were easily prompted.
    i. Need to bring 4.5" 18G needles. 3.5" needles were often not long enough and 20G spinal needles bent easily.

5. How to improve overall efficiency
    a. Bring a backpack for gear (instead of a plastic bin)
    b. Bring a larger cooler to store saline, drugs, oil,
    c. Need to find ultrasound oil that remains liquid at cold temperatures
    d. Draw up all drugs (except Zoletil) prior to leaving the ship
    e. Use microwave to heat saline and oil prior to departing ship
    f. Need to find better heat packs to keep epoxy warm and perhaps a 'hat' for the tag to block wind.
    g. Essential to have (and use!) probing poles to find cracks/holes in ice
    h. Perhaps consider bringing an emergency clothing kit?
    i. Perhaps bring 'kneeling pads'
    j. Take photos of animals and tags
    k. Bring Zip-top plastic bags
    l. Glue gun worked well. Pre-warm epoxy on ship.

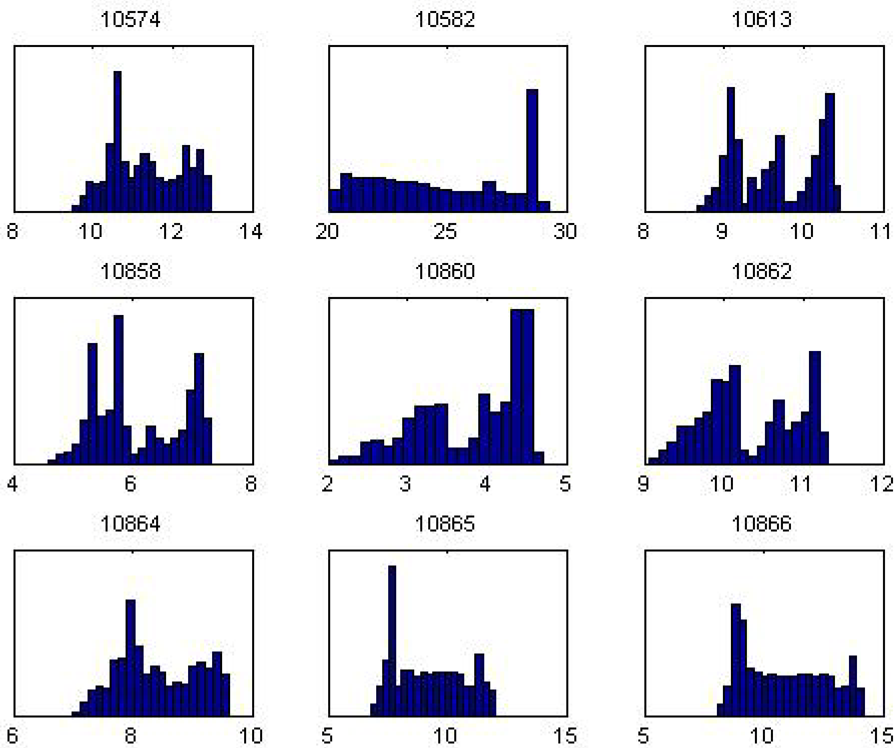
Tag calibration check

The following histograms show the difference between the tag data and data from the calibration yo-yo sequence of four casts (CTD 026).

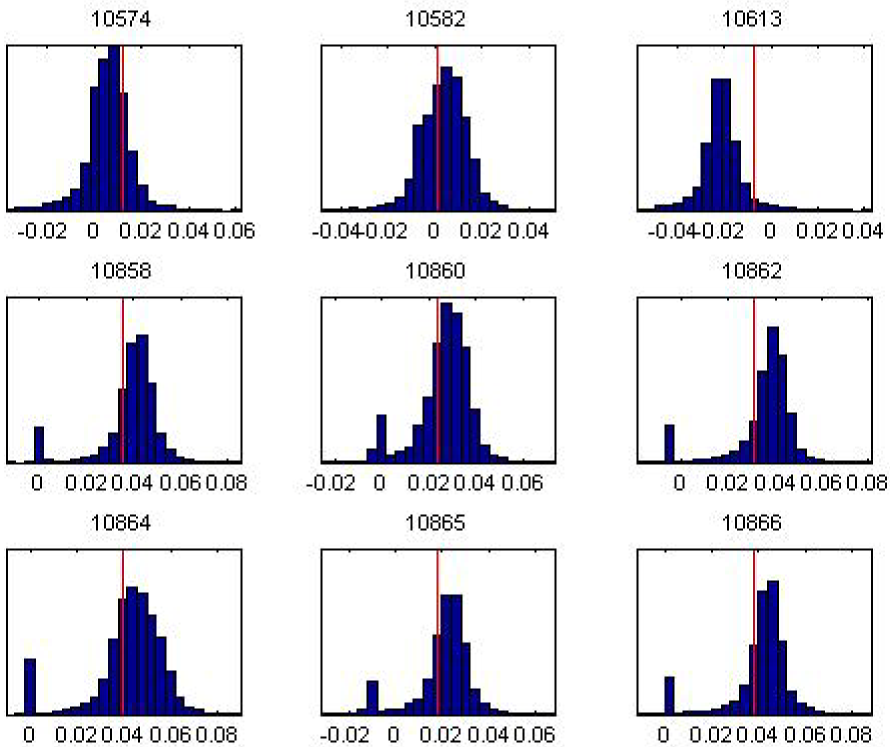
Mismatch between tag temperature data and CTD 026



Mismatch between tag pressure data and CTD 026 (dbar)



Mismatch between tag conductivity data and CTD 026 (mS cm^{-1})



Seal capture data

Date	Seal I/D	Tag Body #	PTT #	Length (cm)	Girth (cm)	Sex
4/2/2009	WED200901	10866	43839	240	181	Female
4/2/2009	WED200902	10858	48929	236	171	Male
5/2/2009	WED200903	10862	43844	240	169	Male
5/2/2009	WED200904	10865	43840	234	162	Male
5/2/2009	WED200905	10860	48928	207	130	Female
5/2/2009	WED200906	10864	43841	255	173	Female
7/2/2009	WED200907	10613	92136	153	166	Female
7/2/2009	WED200908	10574	92144	213	147	Female
7/2/2009	WED200909	10582	92138	252	166	Female
13/2/2009	WED200910	10059	92137	159	166	Female

The following text is the description for the program used in the six BAS tags. The tags from UC Santa Cruz used different programs.

```
Software specification for CTD_BAS_07A deployment
 (BAS Weddell seal CTD)


Transmitting via ARGOS
Page transmission sequences:

        Until day 1464:  0 1 2 3 1 2 3 2 3 using 1 PTT numbers


Satellite availability (UTC):
        00:  --  on --
        01:  --  on --
        02:  --  on --
        03:  --  on --
        04:  --  on --
        05:  --  on --
        06:  --  on --
        07:  --  on --
        08:  --  on --
        09:  --  on --
        10:  --  on --
        11:  --  on --
        12:  --  on --
        13:  --  on --
        14:  --  on --
        15:  --  on --
        16:  --  on --
        17:  --  on --
        18:  --  on --
        19:  --  on --
        20:  --  on --
        21:  --  on --
        22:  --  on --
        23:  --  on --

Transmission targets:

  20000 transmissions after 100 days
  50000 transmissions after 280 days


   In Haulouts: ON (one tx every 1 min 20 secs) for first 5 hours  then cycling OFF for 6 hours, ON for 1
hour

Check sensors every 4 secs
When near surface (shallower than 10m), check wet/dry every 1 sec
Consider wet/dry sensor failed if wet for 7 days or dry for 99 days
Dives start when wet and below 6m for 8 secs  and end when above 6m for 0, or dry at any time
No separation of 'Deep' dives
A cruise begins if there has been no dive for 9 mins
A haulout begins when dry for 10 mins  and ends when wet for 40 secs

Dive shape (normal dives):  4 points per dive using broken-stick algorithm

Dive shape (deep dives):  none

CTD upcasts: max 1000 dbar up to 8 dbar in 1 dbar bins.
        20 cut points per profile
         Send the deepest 1 upcasts in each 2-hour period.
         Minimum depth to trigger collection of cast:
                400m in hour 1
                50m in hour 2
        or 20% greater than current maximum.

        Sample CTD sensor every 1 seconds.
        Temperature: Collected, Stored. Valid range: -2.75 to 2.25 degC
        Conductivity: Collected, Not stored.
        Salinity: Calculated, Stored. Valid range: 32.8 to 35.4

TRANSMISSION BUFFERS (in RAM):
Dive in groups of 3 (6.25 days @ 10mins/dive): 300  = 1200 bytes
No 'deep' dives
Haulout: 30  = 120 bytes
4-hour summaries in groups of 3 (8 days): 16  = 64 bytes
No berniegrams
No timelines
Cruise: 30 = 120 bytes
No diving periods
No spot depths
```

```
No emergence records
No Duration histograms
No Max depth histograms
CTD casts (6.66667 days): 80 = 320 bytes
No GPS fixes

 TOTAL 1824 bytes (of about 21000 available)



MAIN BUFFERS (in 6.2 Mb Flash):
Dive in groups of 3 (416.667 days @ 10mins/dive): 20000 x 100 bytes = 2000000 bytes
No 'deep' dives
Haulout: 3000 x 16 bytes = 48000 bytes
4-hour summaries in groups of 3 (500 days): 1000 x 68 bytes = 68000 bytes
No berniegrams
No timelines
Cruise: 3000 x 16 bytes = 48000 bytes
No diving periods
No spot depths
No emergence records
No Duration histograms
No Max depth histograms
CTD casts (500 days): 6000 x 188 bytes = 1128000 bytes
No GPS fixes

 TOTAL 3214 kb (from 6333 kb available)

PAGE CONTENTS (256 bits - 9 overhead):

PAGE 0:
        PTT NUMBER OVERHEAD (28-bit code)
        -----------[8 bits: 0 - 7]

        PAGE NUMBER
        -----------[2 bits: 8 - 9]

        DIAGNOSTICS in format 0:

         TX number:  wraparound 11 bits in units of 32  (range: 0 to 65504 )
         Number of resets:  wraparound 1 bits in units of 1  (range: 0 to 1 )
        -----------[12 bits: 10 - 21]

        DIVE group in format 0:
        Normal dives transmitted in groups of 3
         Time of start of last dive:  max 5 days 12 hours @ 30 secs= 15840
                tx as raw 14 bits in units of 1  (range: 0 to 16383 )
                (recommended sell-by 5 days 11 hours)
         Sell-by range:  5 days
         Number of records:  raw 2 bits in units of 1  (range: 0 to 3 )
         Reason for end:  -- not transmitted --
         Group number:  wraparound 8 bits in units of 1  (range: 0 to 255 )
         Max depth:  -- not transmitted --
         Dive duration:  odlog 1/6 in units of 30 s (range: 0 to 5715 s)
         Mean speed:  -- not transmitted --
                 Profile data (4 depths/times, 0 speeds):
                  Depth profile:  odlog 2/6 in units of 25 dm (range: 0 to 23887.5 dm)
                  Profile times:  raw 5 bits in units of 32.2581 permille (range: 0 to 1000 permille)
                  Speed profile:  -- not transmitted --
                 Residual:  raw 2 bits in units of 60  (range: 0 to 180 )
                 Calculation time:  -- not transmitted --
         Surface duration:  odlog 2/4 in units of 2.5 s (range: 0 to 588.75 s)
                 cf. cruise starts after 9 mins (540 secs)
         Dive area:  -- not transmitted --
        -----------[225 bits: 22 - 246]

        Available bits used exactly
 === End of page 0 ===


PAGE 1:
        PTT NUMBER OVERHEAD (28-bit code)
        -----------[8 bits: 0 - 7]

        PAGE NUMBER
        -----------[2 bits: 8 - 9]

        CRUISE group in format 0:
         Number of records:  raw 1 bits in units of 1  (range: 0 to 1 )
         Cruise number:  wraparound 6 bits in units of 1  (range: 0 to 63 )
         Start time:  -- not transmitted --
         End time:  max 5 days 12 hours @ 2 mins= 3960
                tx as raw 12 bits in units of 1  (range: 0 to 4095 )
                (recommended sell-by 5 days 11 hours)
         Sell-by range:  5 days 4 hours
         Duration:  raw 9 bits in units of 120 s (range: 0 to 61320 s)
                cf. Max duration is 16 hours
```

```
         Speed:  -- not transmitted --
         Reason for end:  -- not transmitted --
        -----------[28 bits: 10 - 37]

        HAULOUT in format 0:
         Number of records:  raw 1 bits in units of 1  (range: 0 to 1 )
         Haulout number:  wraparound 6 bits in units of 1  (range: 0 to 63 )
         Start time:  -- not transmitted --
         End time:  max 5 days 12 hours @ 2 mins= 3960
                tx as raw 12 bits in units of 1  (range: 0 to 4095 )
                (recommended sell-by 5 days 11 hours)
         Sell-by range:  5 days 4 hours
         Duration:  raw 9 bits in units of 120 s (range: 0 to 61320 s)
                cf. Max duration is 16 hours
         Reason for end:  -- not transmitted --
         Contiguous:  -- not transmitted --
        -----------[28 bits: 38 - 65]

        SUMMARY group in format 0:
        Transmitted in groups of 3
        Record could be in buffer for 8 days
         End time:  max 7 days @ 4 hours= 42
                tx as raw 6 bits in units of 1  (range: 0 to 63 )
                (recommended sell-by 6 days 19 hours)
         Sell-by range:  7 days
         Number of records:  raw 1 bits in units of 1  (range: 0 to 1 )
         Cruising time:  -- not transmitted --
         Haulout time:  raw 6 bits in units of 15.873 permille (range: 0 to 1000 permille)
         Dive time:  raw 6 bits in units of 15.873 permille (range: 0 to 1000 permille)
         Deep Dive time:  -- not transmitted --
        Normal dives:
                 Avg max dive depth:  odlog 2/6 in units of 25 dm (range: 0 to 23887.5 dm)
                 SD max dive depth:  odlog 2/4 in units of 50 dm (range: 0 to 11775 dm)
                 Max max dive depth:  odlog 2/6 in units of 25 dm (range: 0 to 23887.5 dm)
                 Avg dive duration:  odlog 1/6 in units of 30 s (range: 0 to 5715 s)
                 SD dive duration:  odlog 1/4 in units of 60 s (range: 0 to 2790 s)
                 Max dive duration:  odlog 1/6 in units of 30 s (range: 0 to 5715 s)
                 Avg speed in dive:  -- not transmitted --
                 Number of dives:  odlog 1/4 in units of 2  (range: 0 to 93 )
        Deep dives:
                 Avg max dive depth:  -- not transmitted --
                 SD max dive depth:  -- not transmitted --
                 Max max dive depth:  -- not transmitted --
                 Avg dive duration:  -- not transmitted --
                 SD dive duration:  -- not transmitted --
                 Max dive duration:  -- not transmitted --
                 Avg speed in dive:  -- not transmitted --
                 Number of dives:  -- not transmitted --
         Avg SST:  -- not transmitted --
        -----------[181 bits: 66 - 246]

        Available bits used exactly
 === End of page 1 ===


PAGE 2:
        PTT NUMBER OVERHEAD (28-bit code)
        -----------[8 bits: 0 - 7]

        PAGE NUMBER
        -----------[2 bits: 8 - 9]

        CTD in format 0:

         End time:  max 5 days 12 hours @ 2 mins= 3960
                tx as raw 12 bits in units of 1  (range: 0 to 4095 )
                (recommended sell-by 5 days 11 hours)
         Sell-by range:  5 days
         CTD cast number:  -- not transmitted --
         Min pressure:  -- not transmitted --
         Max pressure:  raw 10 bits in units of 1 dbar (range: 8 to 1031 dbar)
         Min temperature:  raw 13 bits in units of 1  (range: 1800 to 9991  = -3.2 to 4.991 °C in steps of
0.001 °C)
         Max temperature:  raw 13 bits in units of 1  (range: 1800 to 9991  = -3.2 to 4.991 °C in steps of
0.001 °C)
                cf. Valid temperatures: -2.75 to 2.25 degC
         Number of samples:  -- not transmitted --
         20 profile points 0 to 19 (from total of 20 cut points):
                 First 18 pressures are fixed
                 Min pressure is fixed
                 Max pressure is sent separately
                 Temperature:  raw 9 bits in units of 1.95695 permille (range: 0 to 1000 permille)
         Temperature residual:  raw 7 bits in units of 5 mdegC per sample (range: 0 to 635 mdegC per
sample)
         Temperature bounds :  raw 2 bits in units of 1 lo/hi (range: 0 to 3 lo/hi)
         Conductivity bounds :  -- not transmitted --
         Salinity bounds :  -- not transmitted --
```

```
        -----------[237 bits: 10 - 246]

        Available bits used exactly
 === End of page 2 ===


PAGE 3:
        PTT NUMBER OVERHEAD (28-bit code)
        -----------[8 bits: 0 - 7]

        PAGE NUMBER
        -----------[2 bits: 8 - 9]

        DIAGNOSTICS in format 1:

         Max depth ever:  odlog 1/5 in units of 250 dm (range: 0 to 23625 dm)
         Dry conductivity:  raw 6 bits in units of 4  (range: 0 to 252 )
        -----------[12 bits: 10 - 21]

        CTD in format 1:

         End time:  max 5 days 12 hours @ 2 mins= 3960
                tx as raw 12 bits in units of 1  (range: 0 to 4095 )
                (recommended sell-by 5 days 11 hours)
         Sell-by range:  5 days
         CTD cast number:  -- not transmitted --
         Min pressure:  -- not transmitted --
         Max pressure:  -- not transmitted --
         Min salinity:  raw 12 bits in units of 1 mPSU (range: 32000 to 36095 mPSU)
         Max salinity:  raw 12 bits in units of 1 mPSU (range: 32000 to 36095 mPSU)
                cf. Valid salinity: 32.8 to 35.4
         Number of samples:  -- not transmitted --
         20 profile points 0 to 19 (from total of 20 cut points):
                 Salinity:  raw 9 bits in units of 1.95695 permille (range: 0 to 1000 permille)
         Salinity residual:  raw 7 bits in units of 5 mPSU per sample (range: 0 to 635 mPSU per sample)
         Temperature bounds :  -- not transmitted --
         Conductivity bounds :  -- not transmitted --
         Salinity bounds :  raw 2 bits in units of 1 lo/hi (range: 0 to 3 lo/hi)
        -----------[225 bits: 22 - 246]

        Available bits used exactly
 === End of page 3 ===
```

Appendix F. Setup files for Vertical Microstructure Profiler (VMP)

```
# This is the setup file for VMP SN009 made for the University of Bergen
# Any line that begins with "#", pound symbol, is a comment and is ignored by all programs
# that read this file. Use it to explain what the various itmes mean.
# Programs such as ODAS and plot_VMP will parse this file and look for key line identifiers.
# an identifier is a word followed by a colon and then a number of parameter values. The identifier is
# the first item on a line.
# For example, the line "prefix: ESR_122_" indicates the prefix or base name of the data
# files created by ODAS will be "ESR_122_XXX.p" where XXX starts from 000 and
# is automatically incremented for subsequent files created by ODAS. The extension ".p"
# is historical and idicates data collected with a parallel interface. Nowadays, most
# data will be collected with a USB interface but the extension ".p" remains.
# this setup file was created on 2005-04-08
#
# Modified by RSI on 2007-09-11
#
# When entering parameters values please note that you can uses tabs and spaces
# freely for visual effects. You can also use commas to separate values but, if you do use commas,
# you CANNOT use spaces or tabs.
##########################################################
# This is a list of channels (addresses) and their signals
# 0     Reference ground
# 1     Ax or tilt - horizontal acceleration in the direction of the pressure port
# 2     Ay or roll - horizontal acceleration orthogonal to the direction of the pressure port
# 3     Az vertical acceleration
# 4     T1 - Temperature from Thermistor 1 without pre-emphasis
# 5     T1_dT1 - Temperature from Thermistor 1 with pre-emphasis
# 6     T2 - Temperature from Thermistor 2 without pre-emphasis
# 7     T2_dT2 - Temperature from Thermistor 2 with pre-emphasis
# 8     Sh1 - velocity derivative from shear probe 1
# 9     Sh2 - velocity derivative from shear probe 2
#10     P - pressure signal without pre-emphasis
#11     P_dP - pressure signal with pre-emphasis
#12     C_dC - micro-conductivity with pre-emphasis from SBE7
#16     SBT1E - The even address of the SBE3 thermometer that returns the least significant
#               half of the 32-bit data word
#17     SBT1O - The odd address of the SBE3 thermometer that returns the most significant
#               half of the 32-bit data word
#18     SBC1E - The even address of the SBE4 conductivity sensor that returns the least significant
#               half of the 32-bit data word
#19     SBC1O - The odd address of the SBE4 conductivity sensor that returns the most significant
#               half of the 32-bit data word
#255    Special Character that always returns 32753 (Decimal) or 7FF0 (Hex) and is used to test the
#               integrity of communication.
#############################################################

prefix: ES033d_
# Change this to make sense, such as a crusie ID, for example

disk:   D:\ES033\VMP\
# This is the directory where the data files will be written

rate:   512
# This is the sampling rate (in Hz) for fast channels, 512 is recommended for compatibility with the
# anti-aliasing low-pass filters set for 165 Hz.

recsize: 1
# This is the size of a data record in seconds. We recommend 1 second.

no-fast: 8
no-slow: 2
# These are the number of columns representing fast channels and slow channels in
# the address matrix given below.

man_com_rate:   3
# This sets the Man-II commuincation rate in UTRANS. It must match the jumper settings in RTRANS.
# For example, if RTRANS has jumpers on positions 1 and 2 (= 11Binary = 3Decimal), then set this to 3.

profile: vertical
# just a flag in the header to identifiy the direction of profiling. Some plotting programs may use this.

############################################################
# Here we identify certain channels for which ODAS calculates record average values and converts
# them to physical units. We identify the channel and give its calibration coefficients.
# Do not enter a channel if its is not available on your instrument or if you
# have chosen not to sample it by excluding it from the address matrix.

# SBE3
channel: 16,SBT1E,4.39844087e-3,6.43402974e-4,2.21418841e-5,1.90305867e-6,1000.0,24e6,128
channel: 17,SBT1O,4.39844087e-3,6.43402974e-4,2.21418841e-5,1.90305867e-6,1000.0,24e6,128
# For the SBE3 SN-4788. We give the g-h-i-j-f0 calibration coefficients (ITS-90). calibrated 2007-06-05
# These values are followed by the reference frequency of the SCOUNT (usually 24e6) and
# the number of periods for the averaging. Repeat the values for both channels
```

```
# SBE4
channel: 18,SBC1E,-1.01101980e1,0,1.56625229e0,-2.19478852e-3,2.60910995e-4,24e6,128
channel: 19,SBC1O,-1.01101980e1,0,1.56625229e0,-2.19478852e-3,2.60910995e-4,24e6,128
# For the SBE4 SN-3340. We give the g-zero-h-i-j calibration coefficients. Calibrated 2007-06-01
# These values are followed by the reference frequency of the SCOUNT (usually 24e6) and
# the number of periods for the averaging. Repeat the values for both channels


channel: 0,Gnd1,0,0,0,0,0,0,0,0,0
# No conversion to physical units for reference ground channel number 1 (up to 2 allowed)

channel: 1,Pitch,297,12953,0,0,0,0,0,0,0
channel: 2,Roll,-123,-13084,0,0,0,0,0,0
channel: 3,az,257,13172,0,0,0,0,0,0
# Linear coefficients for computing the angle in degrees


channel: 10,Pres,-2.3,0.10381,-3.432e-8,0,0,0,0,0,0
# Convert pressure to dBars

channel: 32,Mz,-27.5,60.14,0,0,0,0,0,0
channel: 33,My,-151.5,62.72,0,0,0,0,0,0
channel: 34,Mx,12.5,-55.42,0,0,0,0,0,0
# For PNI MicroMag3, 3-axis magnetometer


#################################################################
# This is the address matrix and shows the order of sampling proceeding across the rows and
# then down the columns.
# Use tabs only to separate the entries otherwise funny things happen. Something to do with
# the way C++ reads values.
# The first 2 columns are slow channels the remaining 8 columns are fast channels
# There are 8 rows, so the slow channels are sampled 8 time slower than the fast channels
#
# Warning, only use "tabs" to separate the channels. Do not use spaces or commas.


matrix:  255     0       1       2       3       5       7       8       9       12
matrix:  4       6       1       2       3       5       7       8       9       12
matrix:  10      11      1       2       3       5       7       8       9       12
matrix:  16      17      1       2       3       5       7       8       9       12
matrix:  18      19      1       2       3       5       7       8       9       12
matrix:  4       6       1       2       3       5       7       8       9       12
matrix:  32      33      1       2       3       5       7       8       9       12
matrix:  34      0       1       2       3       5       7       8       9       12

##########################################
# Parameters for real-time plotting
#################################################################
# Plotting parameters for plot_tomi
# Keywords:
#    plotting:         list of channels to be plotted (should be in order, list both channels of even/odd
pairs)
#   plotaverages:   list of channels used to calculate average, calibrated values (as with plotaverages)
#   plotnames:      names of the channels being plotted (can be different from those used above,
#                       but even/odd channel pairs must be identified by E/O suffix
#   averagenames:   names of the channels used to calculate average, calibrated values (routines
#                       look for the following names: SBT2(E/O),U1(E/O),U2(E/O),Pres,Cref,Ccos,Csin)

plotting:         1,2,3,4,5,6,7,8,9,10,11,12,16,17,18,19
plotaverages:   16,17,10
plotnames:      Ax,Ay,Az,T1,T1\_dT1,T2,T2\_dT2,Sh1,Sh2,P,P\_dP,C\_dC,SBT2E,SBT2O,SBC2E,SBC2O
averagenames:   SBT2E,SBT2O,Pres
#################################################################
```