CRUISE REPORT

Cruise ES060
with R.R.S ERNEST SHACKLETON

10 December 2012 – 28 January 2013

Working Areas:

Filchner Depression, Weddell Sea
Antarctica

Geophysical Institute, University of Bergen

Elin Darelius, Ilker Fer

1. Cruise participants

	Name	Institute	Primary responsibility
Scientists	Elin Darelius (cruise leader) darelius@gfi.uib.no	UIB	Moorings, CTD, LADCP and VMP
	Kjetil Våge	UIB	CTD, CTD and VMP winch
	Mari Fjellstad Jensen	UIB	CTD, LADCP and VMP
Technical personnel	Helge Thomas Bryhni	UIB	Moorings, CTD and VMP winch

Skipper: John Harper

Figure 1. Cruise participants: Kjetil Våge, Mari Jensen, Elin Darelius and Helge T. Bryhni (left to right).

2. Background

Funded by the Norwegian Research council, Norwegian Antarctic Research (NARE), a project entitled "WEDDELL" was started in 2011, with an objective to investigate mixing and plume dynamics of the dense outflow from the Filchner Depression. The cruise ES060 onboard the Royal Research Ship (RRS) Ernest Shackleton is the only dedicated field work planned in the project. The physical oceanography field work was carried out through a combination of conventional conductivity-temperature-depth (CTD) measurements, relatively densely instrumented moorings, current profile measurements using lowered acoustic Doppler Current Profiler (LADCP) and ocean microstructure measurements using a vertical microstructure profiler (VMP).

The observational program was initially designed to focus on the area close to the sill of the Filchner Depression, to improve transport estimates of the dense outflow and the warm inflow and the understanding of mechanisms leading to transport variability. Previous measurements recorded at the site show high mesoscale variability on timescales reaching from 1.5 to 14 days in the outflow and a seasonal variability in the warm inflow. Due to heavy ice conditions in the sill region the focus had to be shifted to the Filchner Depression proper, where a large coastal polynya allowed sampling in the vicinity of the Filchner front and on the eastern side of the Depression. The observational program carried out allows for estimates of the warm inflow and an increased understanding of the circulation within the Filchner Depression.

This report provides an overview of the methods employed and the data collected.

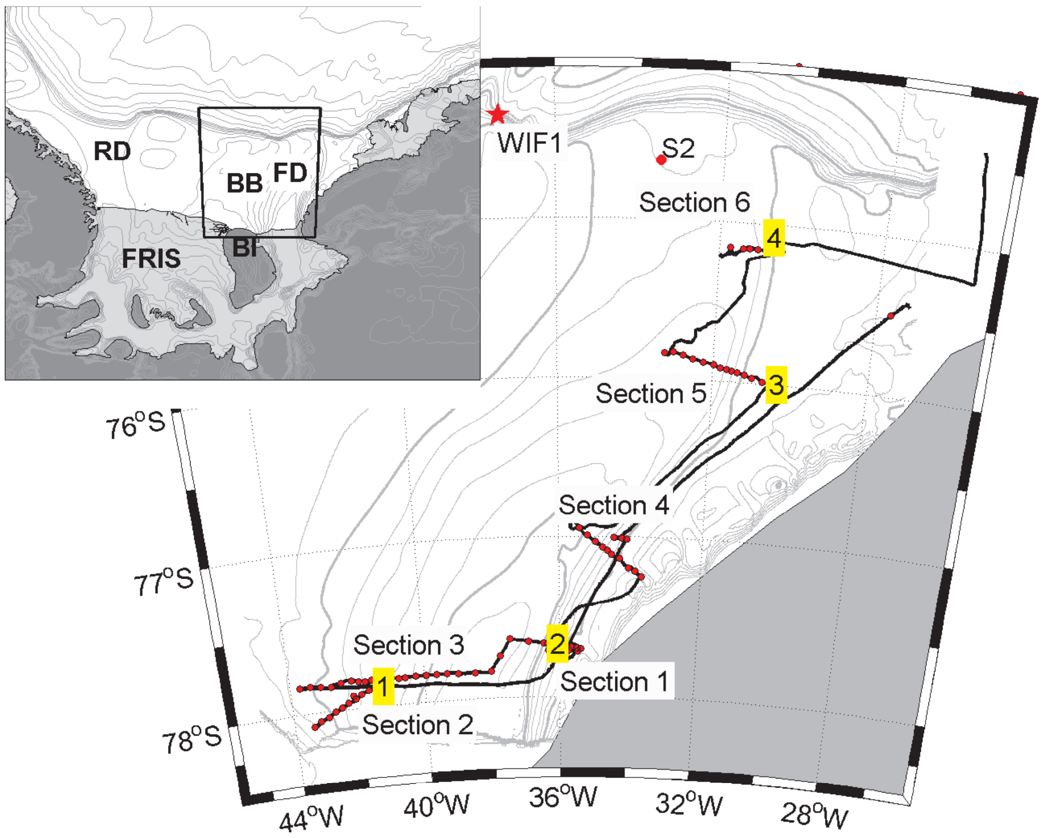

Figure 2. Cruise track, ES060 1-11 January, 2013. CTD stations are marked with red dots and time series locations with numbered yellow squares. Inset shows FRIS: Filchner Ronne Ice Shelves, BB: Berkner Bank, BI: Birkner Island, FD: Filchner Depression, RD: Ronne Depression and the study area (black rectangle). The position of the inaccessible moorings WIF1 and S2 are indicated with a red star (WIF1) and a red circle (S2).

3. Cruise Overview

A detailed cruise narrative is given in Appendix A. The cruise was conducted between 10 December 2012 and 28 January 2013 with two stops in Halley (26/12 2012 – 1/1 2013 and 11/1 2013) and one stop in Singy (19-22/1 2013). Scientific work was conducted during ten days, between the first and second call at Halley (1-11 January 2013).

The initial plans, including recovery (and redeployment) of WIF1, downloading of data from S2 (see Fig. 2 for location of WIF1 and S2) and deployment of four additional moorings across the sill had to be abandoned due to heavy ice conditions. Instead, scientific work was carried out in the Filchner Depression. The cruise track for the scientific part of the cruise is shown in Figure 2. In total 115 CTD/LADCP stations and 35 microstructure casts (VMP) were made. Five moorings were deployed and left to sample for a period of one year.

4. Hydrography

The hydrographic work was carried out using a CTD-water sampling package from SeaBird Inc., acquiring data during both down and upcast. The CTD package was kindly lent to us from (the Swedish ice breaker Oden by) A. Wåhlin at the University of Gothenburg. The package consisted of a SBE 911plus CTD with sensors for temperature (SN 4098 and 2852), conductivity (SN 2456 and 2401), and Oxygen (SBE43, SN 431928). Additionally an altimeter (Bentos PSA-916D, SN 850) was installed to allow profiling close to the bottom. The CTD was equipped with a 24 position SBE 32 Caroussel, fitted with two 10 liter sampling bottles. Water samples for salinity calibration were collected at 71 out of 115 stations (see Appendix B). Care was taken not to collect samples in super cooled water. We stopped taking water samples when we realized that we would run out of bottles, to save bottles for the end of the cruise. In total 115 CTD-stations were occupied, recorded in files sta001 to sta117. Due to communication problems, two casts were cut into two files (sta066-67 and sta116-117).

Six sections and 4 time series (12-14 h long) were occupied during the cruise. The positions of the CTD stations, sections and time series are listed in Appendix B and shown in Figure 2. Positions were recorded using a Garmin GPS placed on the roof of the CTD-container and incorporated into the CTD-data stream. The position data in the CTD-files are compared with that collected using the ship system in Appendix D.

The records from the secondary conductivity sensor (SN 2401), show a high number of spikes and have an off-set of about 0.005-0.008 compared with the primary conductivity sensor and the conductivity sensor on the VMP (see Section 6).

The five sensors mounted on the rosette were shipped to Seabird for calibration directly from the Falklands, and data were reprocessed using the new calibration constants.

Echodepth is calculated using constant speed of sound (1500 m/s) and the depth obtained from the CTD (last depth reading + altimeter reading) was about 5% shallower. The depth given in the Pangea data set is the depth derived from the LADCP bottom tracking or, when no LADCP is available, from the CTD.

20140312: The data was reprocessed including the following steps: DatCNV, Filter, AlignCTD, CellTM, Loopedit, WildEdit, Derive, BinAvg,BottleSum. The conductivity had to be lagged 0.1s with respect to temperature to minimize spiking. The comparison with salinities from the bottles showed no drift during the cruise. The oxygen records however, showed a sudden jump of about 10 units (when plotted in SO-space) towards the end of the cruise. Since no in situ measurements were performed the data were discarded.

5. Current Profiling: Lowered-ADCP (LADCP)

Two LADCP-profilers (RD Instruments) were mounted on the CTD rosette in order to obtain current profiles (**Error! Reference source not found.**). The ADCPs are 6000 m-rated 300 kHz Sentinel Workhorses with internal batteries (SN 10151 and 10012). Each ADCP has the L-ADCP option installed and has the firmware v16.3. The ADCPs were configured to sample in master/slave mode to ensure synchronization. The master ADCP was the downlooker and the slave ADCP was the uplooker. Communication with the instruments, start & stop of data acquisition and data download were done using BBTalk software. PC time (UTC) was transferred to each instrument before each cast. The vertical bin size (and pulse length) was set to 8 m for each ADCP. Single ping data were recorded in narrow bandwidth (to increase range), in beam coordinates, with balk distance set to zero. The data from the first bin are discarded during post processing. In order to mitigate a possible influence of previous pinging, especially close to steep slopes, staggered pinging with alternating sampling intervals of 0.8 s and 1.2 s were used. The altimeter worked reliably and no sign of degradation of LADCP data quality was observed.

The initial test cast (001-002) gave poor data quality and warnings about weak beams on both instruments. Data quality improved and warnings disappeared, seemingly for no reason, on later casts. Throughout the cruise there were communication problems, most commonly with the Slave and occasionally with the Master, due to poor connectors on the connecting cables. Data recovering gave transfer errors and occasionally commands would not get through or we would be unable to talk to the instrument unless connecting directly to it. Communication problems were greatly reduced when the backend of SN 10151 was exchanged with that from SN 11434 (sta002) and the connecting cable at the Rosette was changed (sta012), but they persisted throughout the cruise. When transfer errors occurred, data recovery was restarted until download was successful. LADCP SN 10012 complained about a weak beam and, at after cast 057, about a broken beam. It did not pass the pre-deployment rubbing test, and its head was replaced by that from SN 11434, keeping the original electronics. This is not a standard procedure, since the electronics and the head are calibrated together by the manufacturer. A first inspection suggests useful data, see Appendix E. Details on LADCP instrumentation is given in Table 1.

The observed currents are shown in Appendix G.

Table 1: Details on instrument placement and changes during LADCP casts, M=Master, S=Slave. ^New backend. * Both instruments were started with the "one_LADCP" command file. ** New head, new battery.

cast	SN 10151	SN 10012
001	M	S
002	-	M

003	S^*	M*
004-036	S	M
037	-	M
038-057	S	M
058-061	M	-
062-116	M	S**

The LADCP data are processed using the LDEO software version IX.8. For each master/slave profile data, synchronized time series of CTD and navigation is used. For the purpose, NMEA GPS stream is added to each scan of the ship CTD and the data files are processed as 1 s bin averages, similar to the ADCP ping rate. LADCP-relevant processing of the CTD data included the following steps in the SBE-Data Processing software: DatCnv, WildEdit, CellTm, Filter, Binavg (1 s) and Derive.

6. Microstructure Profiling

Ocean microstructure measurements were made using the vertical microstructure profiler (VMP2000, VMP hereafter) manufactured by Rockland Scientific International (http://www.rocklandscientific.com). VMP is a loosely tethered microstructure profiler for the measurement of dissipation-scale turbulence to depths down to 2000 m. During the cruise VMP SN009 was deployed. It is equipped with high-accuracy conductivity temperature depth (CTD) sensors (P: Keller, T: SBE-3F SN 4788, C: SBE-4C SN 3440 with pump SBE-5T), two state-of-art microstructure velocity probes (shear probes), one high-resolution temperature sensor (FP07-38-1 thermistor), one high-resolution micro-conductivity sensor (SBE7-38-1 micro-C), and three accelerometers. Several sensors were damaged and had to be changed, see Table 2 for details. VMP samples signal-plus-signal-derivative on thermistor, micro-conductivity and pressure transducer, and derivative for shear signals, which is crucial for turbulence measurements, especially for the temperature microstructure. Data are transmitted in real time to a ship-board data acquisition system. VMP has an overall length of 2 m with 40/3.5 kg weight in air/water and with a nominal fall rate of ~ 0.6 m/s.

Table 2. VMP sensors. Note that cast 019 and 021 do not exist.

Cast	shear 1	shear 2	μ-cond.	temp 1	temp 2
000-006	M460	M461	-	T204	-
007-013*	M460	M462	C75	T204	-
014-025	M460	M462	C75	T457	-
026-029	M460	M462	C75	-	-
030-031	M555	M546	C75	-	-
032	M460	M456	C75	-	-
033-034	M460	M555	C75	-	-
035-036	M546	M555	C75	-	-

Deployments were made from the aft of the ship using a Sytech Research Ltd. CMK-2 Hydraulic winch with Linepuller (an active line payout system that makes it possible to perform rapid repeated profiles) and 2500 m deployment cable. The winch and line puller system was designed to feed cable over the side of the ship, allowing the profiler to free-fall through the water column. The cable was fed through an extra snatch block after the Linepuller, to secure distance between the ship and the cable.

During deployment, the main propeller of the ship was turned off to avoid the cable getting caught in the rotating shaft, and the azimuth was lowered to allow for forward propulsion. This turned out to be a time-consuming procedure, and the VMP was mainly used during time series. The captain did not allow use of the azimuth in ice.

Figure 2. The set-up, on deck, of the VMP microstructure profiling system. The hydraulic winch is on the back; the cable is fed through the Linepuller, fastened to the ship's railing and then through a snatch block supported by the crane. The gate had to be opened during deployment and recovery, and involved personnel wore life jackets and safety harnesses. In addition to the winch operator, a second person observes the cable in water during the cast. During deployment and recovery, four persons were needed: one to operate the winch, one to operate the crane and two to handle the instrument. Due to the low height of the ceiling, the recovery line could not be used.

The dissipation rate of TKE was calculated using the isotropic relation $\varepsilon = 7.5\nu \left\langle u_z'^2 \right\rangle$, where ν is the viscosity of seawater. Small scale shear variance $\left\langle u_z'^2 \right\rangle$ was obtained by iteratively integrating the low wavenumber portion of the shear spectrum of half-overlapping 2-second segments (Fer 2006). Unresolved shear variance in the noise-affected high wavenumber portions was corrected using the empirical theoretical shape (Oakey 1982). The profiles of ε were produced as 1 m vertical averages to a noise level of of 10^{-10} W kg^{-1}.

7. Moorings

The WIF1 mooring, see Fig. 2 for location, was deployed in 2009 and planned to be recovered and redeployed in a new location during the cruise. Ice conditions, however, were not favorable and the mooring location could not be reached.

Prior to the cruise, four moorings (SA-D) were designed to be deployed across the Filchner sill, giving temperature, salinity and current measurements from 275 m depth to the bottom. Due to heavy ice conditions these plans had to be abandoned; the locations thus changed and the moorings were slightly modified. Instruments and buoyancy from mooring SA-D were combined with the anchor meant for redeployment of WIF1, extra line and a spare release to a fifth mooring, SE. Moorings were designed, i.e. the amount and placement of buoyancy and anchor weight needed were decided using the Matlab program “Mooring design and dynamics” (MDD) and buoyancy was distributed to allow for 50 cm/s currents without exceeding the instruments tilt thresholds. To avoid iceberg collision, moorings at 77S were allowed to reach 300 m depth while moorings at the Filchner front were kept below 400 m depth.

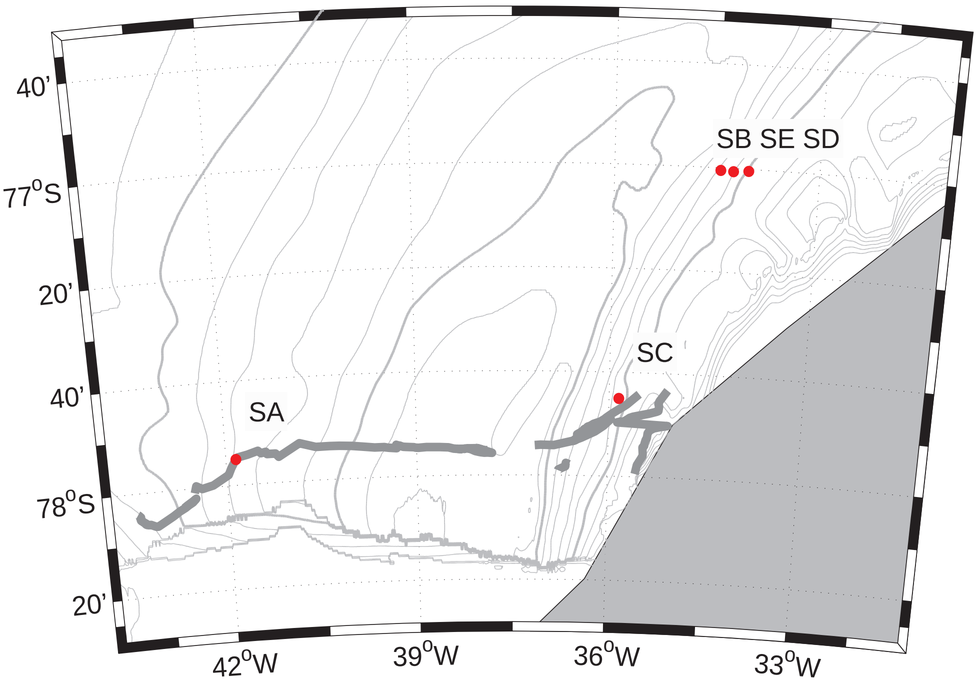

Figure 3. Map showing bathymetry (GEBCO) and the location of mooring SA-E. The thick grey line show the position of the ice shelf front (in the west) / extent of fast ice in front of the shelf (in the east) as marked be the deck officers. SA is located roughly 2 nm north of the front.

A total of five moorings were deployed anchor last during the cruise, see Appendix C for mooring details and drawings and Table 3 for location and deployment times. Mooring positions obtained from the ship are compared with those obtained by H. T. Bryhni in Appendix D. All moorings, including WIF1, are planned to be recovered during a Polarstern cruise in 2014.

Table 3. Mooring position, depth and release time.

Mooring	Longitude	Latitude	Time released	Echo depth	CTD	Release

SA	042º 09.4559' W	77º 55.0612' S	4/1 2012 10:45 UTC	715 m	022	SN 950
SB	034º 27.5882' W	77º 00.3684' S	2/1 2012 12:10 UTC	705 m	003	SN 1133
SC	036º 09.0162' W	77º 45.0444' S	3/1 2012 11:54 UTC	728 m	011	SN 1225
SD	034º 03.0488' W	77º 00.4897' S	2/1 2012 17:42 UTC	505 m	005	SN 1091
SE	034º 14.2472' W	77º 00.6141' S	2/1 2012 15:48 UTC	612 m	004	SN 48

7.1. Mooring components

Line: All moorings consist of yellow 8 mm Dynema line. Seabird sensors and Aqualoggers were all attached as "clamp-on" (except for SN 4446, which was inline and SN 6149 and 400 which were attached to the ADCP frames), and the line were covered with tape for protection and, when the line was to thin, with plastic housing (i.e. pieces of plastic tubing cut open and thread onto the line) at attachment points.

Seabird sensors: The moorings were equipped with a total of 11 SBE37 and 9 SBE39 with a sampling interval of 300s and 20 SBE56 with a sampling interval of 15 s. SN 4446 carried an old battery holder for which we did not have new batteries. Instead, old batteries (having sampled 114.000 times) were used and the sampling interval was increased to 1800 s. According to the manual batteries will last for 300.000 samples.

Five of the SBE39 (SN 3574, 3751, 3566, 3572, 3573) showed erroneous dates, as date entered did not correspond to date printed. The problem is probably connected to 2012 being a leap year. Dates were entered wrongly so that printed dates were right, but dates should be verified when recovering data. All Seabird instruments were set to start sampling on January 3rd at 12:00 UTC.

Aqualoggers: 12 Aqualoggers (two with pressure sensors) were kindly lent to us by K. Nicholls at the British Antarctic Survey. The instruments were started and left in water over night, and one of them (SN 376) did not agree with the others and were excluded. Sampling interval was set to 300 s and instruments started logging 30/12 2012 at 23:00 UTC.

RCM: 3 RCM's were used, 1 RCM7, 1 RCM 8 and 1 RCM 9. Instruments were started 30/12 2012 at 22:00 UTC and set to a sampling interval of 3600 s and temperature range "low" (RCM 7 and 8) or "arctic" (RCM9). The cases were left open until it was assured that the instrument was logging and numbers on DSU display increased.

Seaguard: The seaguard was programmed 18/12 and set to start sample 7/1 2013 at 12:00 UTC using burstmode, 450 pings and hourly sampling interval. The instrument was "allowed to sleep", as recommended by the manual.

ADCPs: Three ADCPs were used in the moorings, 1 Longranger (75 kHz, new, SN 18447), 1 Quartermaster (150 kHz, new, SN 18595) and 1 Sentinel (300 kHz, 8026). The sentinel and its buoy were kindly lent to us by K. Nicholls at British Antarctic Survey. The ADCP setup files are included in Appendix F. The Sentinel compass was calibrated 26/12 2012, away from the ship on the ice shelf at N9 following the instructions in the manual. Total error after calibration was 0.7º. The 2 larger ADCPs were set to start sampling 1/1 2013 12:00 UTC and were observed to ping before deployment. The

Sentinel was set to start sampling on 3/1 2012 12:00 UTC. PC-time (UTC) was transferred to the instruments and memory on the old instrument was cleared.

A fourth ADCP (300 kHz, SN 11434) was intended to be used in the moorings, but it did not respond despite much effort. On two occasions it blew a fuse and a burnt electrical component on one of the boards were later found.

Bouyancy: A total of 36 Vitrovex glass spheres, 1 larger and 1 small spherical buoy and 1 elliptical buoy were used to provide buoyancy for the moorings. The glass spheres were attached in pairs to the chain, leaving six links between pairs. Each sphere were attached with two shackles, one of them secured using a piece of stainless welding rod and the other using a standard galvanized securing pin.

Acoustic release: Three of the acoustic releases were equipped with Lithium batteries (SN 950, 1133, 1225) and one with alkaline batteries (SN 1091). The old release (SN 48) was equipped 14 Alkaline Duracell procell 1.5 volt C-cell batteries, expiring in March 2013. The capacity of one old battery were checked and compared with one new battery of the same brand (expiring 2019) and the number of Ah contained in the old battery was shown to be reduced with only 14% compared with the new one (3.75 Ah versus 4.35 Ah when drained with 200 mA). In addition, 2 new 9 volt Lithium batteries (Energizer Longlife) were installed. Batteries are expected to last for a year, but probably not for two.

Serial numbers and codes of the acoustic releasers used in mooring SA-E are given in Table 4.

Table 4: Serial numbers and codes for acoustic releasers on mooring SA-E. * see text for details on SE batteries.

Release	SA	SB	SC	SD	SE
SN	950	1133	1225	1091	48
Arm	1814	0821	089C	180D	-
Release	Arm+1855	Arm+0855	Arm+0855	Arm+1855	9627
Diagnostic	Arm+1849	Arm+0849	Arm+0849	Arm+1849	9628
Batteries	Lithium	Lithium	Lithium	Alkaline	C-cell*

Appendix A: Cruise narrative

A1: Preparations

8/12   2012

H and K arrived on ship. The crew was busy with cargo and work was not possible. The winch had been welded on deck in Immingham, UK.

9/12 2012

E and M arrived on ship. Moved equipment from container down to wetlab.

10/12 2012

Tried starting up winch – and got error message. The remote control had leaked and there were traces of damage.

11/12 2012

Two local technicians were onboard and found a damaged cable where the protecting plastic had worn off around a corner. When replaced, the winch worked.

12/12 2012

Measured and marked all ropes.

Mikrocat SN 446 has an old batteryholder, for which we did not bring new batteries. The instrument had logged 114000 samples. Manual said new batteries will do 300000 samples. We decided to go with old batteries and increase sampling interval to 30 min (=18000 samples).

Set up CTD system: software, computers, cables, sensors etc. in CTD shack.

Service and new batteries in ADCPs and Seabird 37 /39.

16/12 2012

Connected LADCPs (Master SN 10151 and slave SN 10012) and started them up. Both units started pinging. Made pre-deployment tests (only PC1) – all OK.

17/12 2012

Programmed SBE39. H had previously checked O-rings and changed batteries. Instrument were set to start sampling January 3rd 12.00 UTC with a sampling interval of 300s. There appears to be a problem with the firmware related to leap years: When entering dates

ddmmyy=171212

a few instruments (see below) displayed 19 december 2012. When entering dates prior to February 2012 or in 2013 there was no error. “Wrong dates” were entered in the following instruments so that the dates displayed were right:

SN: 3574, 3566, 3572, 3573 (15/12)

SN: 3751 (16/12)

SN: 3746, 3571, 6143, 6149 (17/12 – no error)

17/12 2012

SBE56 were programmed using Toughbook to start sampling January 3rd at 12.00 UTC, with a sampling interval of 15 s. PC time was transferred, memory and events were cleared. O-rings were greased and the secant pill was put in plastic bag while instrument was open. SN: 1946-1965.

18/12 2012

Programmed Seaguard to start sampling 7/1 2013 at 12:00 UTC: 450 pings in burst mode, time interval 1h. The instrument was allowed to sleep.

19/12 2012

Changed – with some difficulties - batteries in Aqualoggers. One of the pins that were meant to hold the batteries came lose and had to be soldered back. We had to recycle shrinking hose since no there were no new included in the repair-kits provided. O-rings were greased but not changed. The driver for Aquareaders will only install on 32bits computers. Instruments were set to start at 18h UTC (only time, not date, for start can be set) and to log 15 times with a sampling interval of 5 minutes and left in the wet-lab sink overnight.

19/12 2012

M read data from Aqualogger. They had all started as programmed but SN 376 were giving bad data. Tested CTD setup in CTD-container.

20/12 2012

Mounted CTD on rosette: T1 SN 4098, T2 SN 2852, C1 SN 2456, C2 SN 2401, O2 SN 431928 Altimeter SN 55927. Offset of about 0.05 C between T-sensors in air. Two water bottles were left on Rosette. When starting up the winch we got a similar error message as in Capetown: Profibus error. Please check connections. One component had leaked and there was water inside. When dried up and sealed the winch worked fine. Attached block and cable mounting bracket from HI.

21/12 2012

Mounted LADCP on rosette using existing placements (which had previously been modified slightly to fit the instruments). Distance from Master SN 10151 to ground is only 1.5-2 cm. When starting test cast it was discovered that the winch was too close to the rosette so that the angle of the wire did not match the steering rods. Attempts were made to keep wire down with a snatch block attached to the steering rods – while doing so the Rosettes was lifted and sat down halfway outside the wooden pallet on which it had been standing. When placed correctly on the pallet the LADCP was touching ground. No sign of external damage, but the master did not seem to respond when sent the master.txt file – possibly due to connection problems and loose cables. When trying again later master.txt could be sent and the instrument started pinging. However, pre-deployment test PA gave error message: Sensor test H/W operation FAIL. This error message was most likely due to the ships magnetic field. No external/internal sign of damage. Test PC1 was performed without errors.

22/12 2012

No sign of damage when opening the master LADCP. After refitting master and slave, removing the soft material used yesterday, on the rosette the master LADCP passed pre-deployment test without errors. Transmit error on slave. The snatch-block was removed from the winch since we were afraid that a) electronics would get damaged when moving close to the edge of the drum and b) the wire would get damaged due to the small diameter of the block. Instead the rosette will be lifted over the side using the crane, putting tension on the CTD-winch only as the rosette has been lowered sufficiently to have a correct angle on the outgoing wire.

Clamp on attachments for SBE39 have been drilled on and was re-attached.

Remaining cargo in container – buoys, glass spheres and VMP-winch – was moved down to the poop deck.

A new attempt to make a CTD test station (sta001) was made 14:00 UTC after considerable problems with finding a winch arrangement. The solution suggested yesterday did not work – instead a second large block was attached to the deck to hold the wire down and decrease the angle. The CTD was sent down to 300m where two bottles were fired successfully. An alarm on the CTD deck unit was set off – it was later found out that this is related to the bottom switch which we don't use. The alarm continued to go off during the remainder of the cruise. When recovering data from the LADCPs the slave responded to break, but did not communicate further. When opened, the battery voltage was low (but not critically low). Data from the cast was recovered without problem using a second battery, and a new battery was installed. LADCP data quality was poor. Altimeter (GFI) readings were jumping, and was later replaced with altimeter from GU.

24/12 2012

Cut chain (1 m per sphere-pair + 0.5 m) and attached spheres with 6 bolts in between pairs.

25/12 2012

Visit of penguin colony at Windy peak. Christmas dinner and transfer to "N9".

26/12 2012

Mooring ADCPs were programmed (see Appendix F for set up files) to start pinging 3/1 2013 12:00 UTC.

WH300 11434 did not respond to a break in BB-talk. We changed the fuse which was broken, tried a new top cap connector, new cable. The instrument will be omitted from SA and the elliptical buoy replaced with 1 extra sphere. WH 18595 was mounted in frame.

WH300 8026 was calibrated on the ice and compass error after calibration was 0.7 degrees. Memory was erased and the instrument programmed to start 3/1 2013 12:00 UTC.

27/12 2012

WH300 8026 and WH75 18477 were mounted in their buoys. Microcat attachments were drilled to fit thicker Kevlar and re-placed. S2 modem was connected to computer – contact was established only once connectors were cleaned. Before that, red commands on the screen and no loading of parameters from local unit.

28/12 2012

VMP winch connector repaired – pin was simply bent back. Still lots of ice in deployment area.

30/12 VMP winch blow 220 V / 16 amp fuse. (Only worked in the wrong direction). Worked fine with 32 amp. Mounted and tested calibration with sea cable: all green. Line puller hydraulic switch was stuck – is hard to use.

RCM 7, 8, 9 was started at 22h UTC. RCM9: 60 min, Arctic, Burst mode. RCM7: 60 min, T: low, RCM8 60 min, T: low.

Aqualoggers were set to start logging at 23h, every five minutes.

Discussion on new mooring positions.

29/12 2012

Weighed railway roads for anchors – if they had been marked the marks had been washed off during transit. Battery investigations for spare release.

30/12 2012

Decided to create new mooring (SE) using spare release, WIF anchor and instruments/buoyancy from other moorings. MDD calculations on new moorings.

31/12 2012

Captain agreed to turn off propeller and a VMP test cast (cast000) was made. Everything worked fine and data looked good. Transfer to Halley VI and New year's eve party. Back-end of SN 10151 was changed and instrument was moved to slave position. RDI 150 kHz and RDI 75 kHz was re-programmed to start pinging 1/1 2013 at 12:00 UTC. A new set up file (written by I. Fer) was used for RDI 75 kHz since it was moved 50 m higher up from the bottom. It was not possible to access the RDI 300 kHz (mounted in its buoy) to change start up time.

A2: Scientific Work

1/1 2013

13:00 Departure towards Filchner Depression, 77 S for mooring deployment. A second CTD test station (sta002) was occupied at 15:00 UTC after adding weight to balance Rosette. Slave did not respond and Master was started with "oneLADCP". Data quality was poor and it was indicated that beams 1 and 2 were weak and that beam 4 was broken. Finalized moorings and MDD calculations.

Altimeter worked. Conductivity sensor 2 gave spiky profiles and (unsuccessful) attempts were later made to flush through the conductivity cell.

2/1 2013

09:00 UTC: CTD cast (sta003) at first mooring location (SB). Both Master and Slave were started with "oneLADCP".

12:10 UTC: Deployed **mooring SB** at 77^o 00.3684' S, 034^o 27.5882' W, 705 m depth.

13:50 UTC: CTD cast (sta004) at second mooring location (SE).

15:50 UTC: Deployed **mooring SE** at 77^o 00.6141' S, 034^o 14.2472' W, and 612 m depth.

17:45 UTC: Deployed **mooring SD** at 77^o 00.4897' S, 034^o 03.0488' W, and 505 m depth.

18:25 UTC: CTD cast (sta005) in the vicinity of mooring SD.

Steamed towards the Filchner front. During night section 1 (sta006-010) was occupied, CTD/LADCP only. LADCP data from sta008 was overwritten – we then changed the downloading procedure made one LADCP-folder per station.

3/1 2013

09:10 UTC CTD cast (sta011) at mooring location (SC).

11:55 UTC: Deployed **mooring SC** at 77^o 45.0444' S, 036^o 09.0162' W, and 728 m depth.

Steamed towards eastern side of Filchner Depression. Repaired and replaced LADCP connecting cable on rosette. Section 2 (sta012-021) was occupied during the night.

4/1 2013

08:40 UTC: CTD cast (sta022) at mooring location (SA).

10:45 UTC: Deployed **mooring SA** at 77^o 55.0612' S 042^o 09.4559' W, and 715 m depth.

13:45 UTC: Started **time series 1** (sta023-028), CTD + VMP every second hour at 845 m depth.

23:30 UTC: Started last cast in TS1.

5/1 2013

Steamed eastward to shallow water.

04:00 UTC: Started **Section 3** (sta029-sta061) along the Filchner front. Due to ice we had to “turn” north at the western side of the Depression. VMP was included eastern side of the Depression (sta054-058). The ship had to move during up-cast due to an approaching ice floe on sta034. No LADCP slave on sta037. Master gave warning “Broken beam 1” (had been weak on and off before) and failed rub test on all beams (sta057). SN 10151 was moved down to Master position and run with “oneLADCP” for the rest of the section. Weight was added to Rosette to balance the removal of the slave (it was left on for the remainder of the cruise). SN 10012 was rebuilt using the head from SN 11434.

<u>6/1 2013</u>

23:20 UTC: Last cast in Section 3. Steamed back to deeper water for time series.

<u>7/1 2013</u>

02:00 UTC: Started **time series 2** (sta062-069), CTD + VMP every second hour at 850 m depth. The ship had to move slightly due to approaching ice floe during sta065 (down-cast 200 m). During the fifth CTD cast (sta066) the connection with the CTD was lost at 740 m depth (downcast). The system (computer, software and deck unit) was restarted and connection was re-established. The CTD was lifted 50 m and a “new” cast was started (sta067). The rebuilt SN 10012 passed all pre-deployment tests and was mounted on the Rosette as Slave before start of TS2 (cast062).

Realized we would run out of water sample bottles and stopped filling them to save bottles for the end of the cruise.

15:00 UTC: Last cast in TS2 was started.

Steamed north to 77^{o} S.

20:50 UTC: Started **Section 4** (sta070-080). During processing of sta078 there were warnings: “LADCP started at depth” and “GPS error?”.

<u>8/1 2013</u>

08:25 UTC: Last cast (sta080) in Section 4.

Steamed northeast.

17:30 UTC: Started **time series 3** (sta081-089), CTD + VMP every ninety minutes at 470 m depth.

<u>9/1 2013</u>

09:00 UTC: Started last cast in TS3 and first cast in **Section 5** (sta089-102)**.**

21:30 UTC: Started last cast in Section 5. Tried to continue eastward but was stopped by ice.

<u>10/1 2013</u>

04:00 UTC: Started **Section 6** (sta103:109).

09:30 UTC: Last cast (sta109) in Section 6. Tried to proceed eastward but was stopped by ice.

Steamed back along Section 6, but was stopped by moving ice and had to move **time series 4** north of section.

13:16 UTC: Started time series 4 (sta110-117), CTD + VMP every two hours at 550 m depth. Communication problem at 190 m (down cast) at the last station: CTD was lifted to surface and started over again (not LADCP). New communication at bottom: Software was restarted and up-cast is saved in sta117.

<u>11/1 2013</u>

01:00 UTC: Started last cast in TS4

Steamed back to Halley. During the day all scientific equipment was washed and packed away in container.

21:00 UTC: Left Halley and steamed towards Signy.

<u>19/1 2013</u>

Arrived in Signy

Appendix B: Station list

The stations occupied during the cruise are summarized in Table B1.

Table B1: Stations occupied during cruise ES060. CTD depth = Depth at which the CTD stopped + altimeter reading. VMP file names are given as cast_XXX.p where XXX is the number in the VMP column and LADCP file names as staYYY_LADCPM.000 (master) or staYYY_LADCPS (slave) where YYY is the last three digits in the CTD file name.

Station name	CTD File Name	Date		Time UTC	Lat. S	Lon. W	Bottle P (dbar)	Echo depth (m)	CTD depth (m)	VMP	LADCP	LADCP depth (m)
		mon	day									
001	ES060_001	12	22	14:06	69,526	18,740	-	-	-	-	M+S	-
Halley	-	12	31	10:30	75,219	25,687	-	557	-	000		-
002	ES060_002	1	1	15:07	75,487	27,644	-	313	-	-	M	-
003	ES060_003	1	2	09:00	77,004	34,460	200	703	-	-	M+S	-
004	ES060_004	1	2	13:48	77,007	34,240	150	613	-	-	M+S	589
005	ES060_005	1	2	18:25	77,015	34,094	125	506	-	-	M+S	499
006	ES060_006	1	3	01:35	77,715	35,465	300	424	-	-	M+S	406
007	ES060_007	1	3	03:18	77,712	35,718	203	512	-	-	M+S	490
008	ES060_008	1	3	04:27	77,712	35,960	125	584	-	-	-	-
009	ES060_009	1	3	05:38	77,711	36,131	176	705	-	-	M+S	678
010	ES060_010	1	3	06:50	77,711	36,317	200	849	-	-	M+S	817
011	ES060_011	1	3	09:08	77,750	36,134	180	710	-	-	M+S	683
012	ES060_012	1	3	20:40	78,083	43,410	18	499	-	-	M+S	479
013	ES060_013	1	3	21:33	78,056	43,200	20	523	503	-	M+S	501
014	ES060_014	1	3	22:26	78,034	42,959	120	538	518	-	M+S	517
015	ES060_015	1	3	23:20	78,006	42,739	37	556	536	-	M+S	534
016	ES060_016	1	4	00:13	77,985	42,518	92	656	626	-	M+S	631
017	ES060_017	1	4	01:49	77,962	42,311	18	688	668	-	M+S	662
018	ES060_018	1	4	02:47	77,941	42,096	20	735	710	-	M+S	709
019	ES060_019	1	4	03:52	77,914	41,901	28	772	742	-	M+S	743
020	ES060_020	1	4	04:50	77,892	41,684	7	812	780	-	M+S	780
021	ES060_021	1	4	05:46	77,871	41,468	56	844	811	-	M+S	811
022	ES060_022	1	4	08:41	77,917	42,143	177	715		-	M+S	687
TS1 (1)	ES060_023	1	4	13:42	77,872	41,467	110	845	812	001	M+S	814
TS1 (2)	ES060_024	1	4	15:48	77,871	41,465	100	845	811	002	M+S	811
TS1 (3)	ES060_025	1	4	17:35	77,872	41,466	50	845	810	003	M+S	810
TS1 (4)	ES060_026	1	4	19:31	77,872	41,465	71	843	810	004	M+S	810
TS1 (5)	ES060_027	1	4	21:32	77,872	41,465	30	843	810	005	M+S	810
TS1 (6)	ES060_028	1	4	23:36	77,872	41,465	120	843	811	006	M+S	811
29	ES060_029	1	5	03:54	77,832	43,724	51	436	419	-	M+S	420
30	ES060_030	1	5	04:54	77,832	43,406	62	491	470	-	M+S	470
31	ES060_031	1	5	05:50	77,840	43,090	18	518	497	-	M+S	496
32	ES060_032	1	5	06:44	77,850	42,780	40	546	525	-	M+S	524
33	ES060_033	1	5	07:40	77,829	42,480	254	632	607	-	M+S	605
34	ES060_034	1	5	08:40	77,824	42,178	40	680	nan	-	M+S	655
35	ES060_035	1	5	09:40	77,831	41,962	80	705	681	-	M+S	682
36	ES060_036	1	5	10:37	77,834	41,765	100	770	750	-	M+S	742
37	ES060_037	1	5	11:43	77,833	41,568	770	810	780	-	M+S	-

38	ES060_038	1	5	13:39	77,833	41,365	50	832	806	-	M+S	804
39	ES060_039	1	5	14:34	77,832	41,171	80	857	837	-	M+S	828
40	ES060_040	1	5	15:40	77,834	40,976	100?	880	849	-	M+S	849
41	ES060_041	1	5	16:40	77,835	40,777	130	911	886	-	M+S	875
42	ES060_042	1	5	17:30	77,834	40,580	80	926	900	-	M+S	891
43	ES060_043	1	5	18:37	77,833	40,274	152	956	921	-	M+S	921
44	ES060_044	1	5	19:49	77,832	39,961	69	1013	973	-	M+S	973
45	ES060_045	1	5	21:02	77,832	39,651	nan	1086	1039	-	M+S	1037
46	ES060_046	1	5	22:17	78,331	39,332	97	1136	1086	-	M+S	1085
47	ES060_047	1	5	23:24	77,836	39,001	120	1175	1123	-	M+S	-
48	ES060_048	1	6	01:30	77,833	38,500	96	1189	1147	-	M+S	1148
49	ES060_049	1	6	03:09	77,832	38,008	67	1200	1156	-	M+S	1156
50	ES060_050	1	6	04:43	77,736	37,726	51	1179	1135	-	M+S	1135
51	ES060_051	1	6	06:13	77,633	37,433	51	1143	1101	-	M+S	1102
52	ES060_052	1	6	07:45	77,649	36,900	54	1091	1048	-	M+S	1049
53	ES060_053	1	6	09:13	77,664	36,451	100	987	951	-	M+S	950
54	ES060_054	1	6	11:00	77,668	36,334	180	900	878	007	M+S	868
55	ES060_055	1	6	00:43	77,670	36,192	108	805	778	008	M+S	778
56	ES060_056	1	6	07:12	77,678	36,072	140	696	668	009	M+S	672
57	ES060_057	1	6	06:00	77,682	35,095	300	600	577	010	M+S	578
58	ES060_058	1	6	20:11	77,687	35,792	149	562	537	011	M	540
59	ES060_059	1	6	21:39	77,690	35,647	304	495	477	-	M	477
60	ES060_060	1	6	22:30	77,693	35,492	134	431	413	-	M	413
61	ES060_061	1	6	23:17	77,698	35,381	155	435	418	-	M	418
TS2 (1)	ES060_062	1	7	02:00	77,669	36,266	111	850	830	012	M	830
TS2 (2)	ES060_063	1	7	04:00	77,669	36,267	136	850	831	013	M+S	830
TS2 (3)	ES060_064	1	7	06:00	77,669	36,267	82	850	831	014	M+S	831
TS2 (4)	ES060_065	1	7	08:08	77,669	36,268	nan	850	831	015	M+S	831
TS2 (5)	ES060_066/67	1	7	10:04	77,669	36,267	nan	850	nan	016	M+S	796
TS2 (6)	ES060_068	1	7	13:03	77,669	36,267	nan	850	830	017	M+S	831
TS2 (7)	ES060_069	1	7	15:00	77,669	36,267	nan	850	831	018	M+S	831
70	ES060_070	1	7	20:53	77,246	33,664	nan	357	340	-	M+S	337
71	ES060_071	1	7	22:01	77,215	33,855	nan	527	505	-	M+S	503
72	ES060_072	1	7	23:15	77,192	34,046	nan	485	468	-	M+S	482
73	ES060_073	1	8	00:22	77,136	34,293	nan	500	485	-	M+S	484
74	ES060_074	1	8	01:47	77,109	34,511	nan	604	580	-	M+S	579
75	ES060_075	1	8	02:36	77,084	34,633	nan	695	670	-	M+S	669
76	ES060_076	1	8	03:27	77,064	34,769	nan	769	740	-	M+S	739
77	ES060_077	1	8	04:38	77,031	34,966	nan	899	870	-	M+S	869
78	ES060_078	1	8	05:49	76,993	35,203	nan	1002	966	-	M+S	965
79	ES060_079	1	8	07:00	76,945	35,420	990	1025	990	-	M+S	990
80	ES060_080	1	8	08:25	76,899	35,653	1040	1072	1040	-	M+S	1031
TS3 (1)	ES060_081	1	8	17:27	76,000	30,507	nan	470	446	020	M+S	454
TS3 (2)	ES060_082	1	8	19:02	76,001	30,504	nan	470	454	022	M+S	453
TS3 (3)	ES060_083	1	8	20:30	76,001	30,504	nan	470	453	023	M+S	454
TS3 (4)	ES060_084	1	8	00:00	76,001	30,504	nan	470	453	024	M+S	-
TS3 (5)	ES060_085	1	8	23:30	76,001	30,504	nan	470	453	025	M+S	457
TS3 (6)	ES060_086	1	9	01:30	76,001	30,506	nan	470	453	026	M+S	452
TS3 (7)	ES060_087	1	9	03:00	76,001	30,506	nan	470	454	027	M+S	453
TS3 (8)	ES060_088	1	9	04:30	76,001	30,506	nan	470	454	028	M+S	454
TS3 (9)	ES060_089	1	9	06:00	76,001	30,506	nan	470	454	029	M+S	455
90	ES060_090	1	9	09:17	75,988	30,700	nan	474	458	-	M+S	453

91	ES060_091	1	9	10:10	75,971	30,986	nan	470	453	-	M+S	450
92	ES060_092	1	9	11:02	75,954	31,184	nan	496	474	-	M+S	475
93	ES060_093	1	9	11:55	75,942	31,375	nan	557	539	-	M+S	534
94	ES060_094	1	9	13:15	75,933	31,514	nan	627	604	-	M+S	450
95	ES060_095	1	9	14:15	75,924	31,652	nan	693	668	-	M+S	475
96	ES060_096	1	9	15:09	75,918	31,799	nan	732	713	-	M+S	703
97	ES060_097	1	9	16:01	75,901	31,982	nan	739	715	-	M+S	714
98	ES060_098	1	9	17:18	75,888	32,256	nan	765	735	-	M+S	737
99	ES060_099	1	9	18:20	75,871	32,527	727	757	727	-	M+S	727
100	ES060_100	1	9	19:23	75,848	32,766	nan	747	717	-	M+S	719
101	ES060_101	1	9	20:23	75,833	33,025	nan	750	722	-	M+S	721
102	ES060_102	1	9	21:29	75,838	33,258	nan	757	727	-	M+S	727
103	ES060_103	1	10	03:54	75,166	30,486	437	459	441	-	M+S	440
104	ES060_104	1	10	04:44	75,165	30,682	nan	499	479	-	M+S	478
105	ES060_105	1	10	05:33	75,164	30,873	nan	561	539	-	M+S	539
106	ES060_106	1	10	06:25	75,167	31,076	nan	621	597	-	M+S	595
107	ES060_107	1	10	07:22	75,164	31,263	nan	639	614	-	M+S	614
108	ES060_108	1	10	08:13	75,165	31,431	nan	649	623	-	M+S	625
109	ES060_109	1	10	09:33	75,163	31,737	nan	676	650	-	M+S	653
TS4 (1)	ES060_110	1	10	13:16	75,087	30,871	nan	550	541	030	M+S	543
TS4 (2)	ES060_111	1	10	15:00	75,087	30,871	160	550	545	031	M+S	540
TS4 (3)	ES060_112	1	10	17:00	75,087	30,871	318	550	541	032	M+S	541
TS4 (4)	ES060_113	1	10	19:00	75,087	30,871	150	550	541	033	M+S	549
TS4 (5)	ES060_114	1	10	21:00	75,087	30,871	197	550	543	034	M+S	539
TS4 (6)	ES060_115	1	10	23:00	75,087	30,871	256	550	540	035	M+S	540
TS4 (7)	ES060_116	1	11	01:00	75,087	30,871	nan	550	542	036	M+S	533

Appendix C: Moorings

Moorings SA-E are summarized in Table A1-5.

Table A1: Moorings SA.

Height (m)	T,C,P sensors / Release	Velocity	Buoyancy
300	(CTD)	Seaguard: SN 1050	5 x Vitrovex
275	AL: SN 380		
250	SBE56: SN 1950		
225	SBE56: SN 1946		
200	SBE37: SN 9945 (CT)		
175	SBE56: SN 1949		
150	SBE56: SN 1947		
125	SBE56: SN 1952		
100	SBE39: SN 3282 (TP)	RCM7: SN 9758	2 x Vitrovex
60	SBE37: SN 4445 (CT)		
25	AL: SN 362*	RCM8:SN16283/AR:SN 950	2 x Vitrovex
0	Anchor: 550 kg		

Table A2: Mooring SB. ADCP is down-looking. * instrument mounted on ADCP-frame. ** inline instrument

Height (m)	T,C,P sensors	Velocity/Release	Buoyancy
400	AL: SN 400* (TP)	RDI 75 kHz: SN 18447	Large buoy
375	SBE56: SN 1948		
350	SBE37: 4446** (CT)		
325	AL: SN 364		
300	AL: SN 363		
275	SBE56: SN 1956		
250	SBE56: SN 1957		
225	SBE37: SN 7224 (CTP)		
200	SBE56: SN 1958		
175	SBE56: SN 1959		
150	SBE56: SN 1960		
125	SBE56: SN 1961		
100	SBE37: SN 9943 (CT)		
75	SBE56: SN 1963		
50	SBE56: SN 1964		
25	SBE37: SN9944 (CT)	AR: SN 1133	2x vitrovex
0	Anchor: 800 kg		

Table A3: Mooring SC. ADCP is down-looking.*instrument is mounted on ADCP-frame.

Height (m)	T,C,P sensors	Velocity/Release	Buoyancy
300	SBE37: SN 8972 (CTP)		9 x Vitrovex
275	SBE39: SN 3566		
250	SBE39: SN 3571		
225	SBE56: SN 1953		
200	SBE39: SN 6149*	RDI 150 kHz: SN 18595	6 x Vitrovex
175	SBE39: SN 3572		
125	SBE37: SN 7223 (CTP)		
100	SBE39: SN 3574		
75	SBE39: SN 3746		
50	SBE39: SN 3573		
25	SBE37: SN 5251 (CT)	AR: SN 1225	
0	Anchor: 750 kg		

Table A4: Mooring SD. ADCP is down-looking.

Height (m)	T,C,P sensors	Velocity/Release	Buoyancy
175	AL: SN 375		2 x Vitrovex
150	AL: SN 367		
125	AL: SN 403 (TP)	RDI 300 kHz: SN 8026	Small sphere
100	SBE37: SN 5252 (CT)		
75	AL:SN 369		
50	AL: SN 1192		
25	SBE37: SN 5409*	AR: SN 1091	2 x Vitrovex
0	Anchor: 650 kg		

Table A5: Mooring SE. Batteries in RCM9 is expected to drain after 3-4 months.

Height (m)	T,C,P sensors	Velocity/Release	Buoyancy
300	SBE56: SN 1962		Elliptical buoy
250	AL: SN 377		
200	SBE56: SN 1965		
150	SBE39: SN 6143 (TP)	RCM9: SN 1238	2 x Vitrovex
125	SBE56: SN 1955		
75	SBE56: SN 1954		
25	SBE56: SN 1951	AR: 48	2 x Vitrovex
0	Anchor: 500 kg		

Appendix D: GPS positioning

The position of the ship was monitored using three different GPS-sytems

1) A Garmin GPS placed on the roof of the CTD-container and connected directly to the CTD-computer. Data from this GPS is logged in CTD-files during CTD-casts and used when processing ADCP-data to correct velocity profiles for ship drift.

2) The position obtained from the ship's GPS-system was logged continuously during the scientific part of the cruise.

3) H. Bryhni continuously logged the position of the ship using a handheld Garmin GPS positioned in the wet lab in the aft of the ship. Mooring positions were bookmarked roughly 30 s after the anchor was released.

D1. Comparison of ship and CTD GPS positions during CTD casts

Figure D1 shows cast mean positions from CTD GPS and ship GPS. They agree well, mean distance between ship and CTD positions are 24 m (range between 11 and 30 m. Standard deviation of positions during CTD casts are higher for CTD-GPS than for ship-GPS (see Figure D2) and are about 5e-5^{o} (or about 6 m) in Latitude and 5e-4^{o} (or about 10 m) for the CTD. During station 065 the ship had to move due to a large ice floe interfering with the CTD cable, causing increased values of standard deviation.

There is no ship GPS data for cast 23-28.

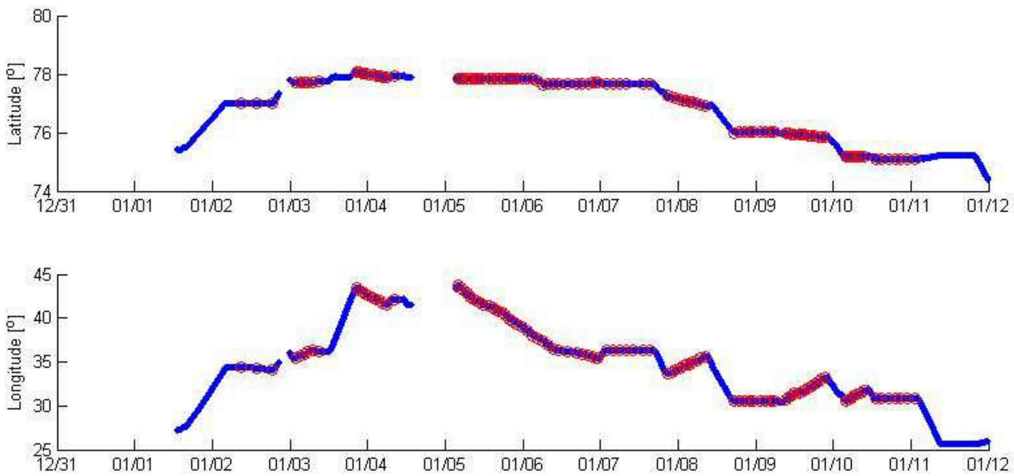

Figure D1: Positions a) latitude and b)longitude from ship GPS (blue) and CTD-GPS (red)

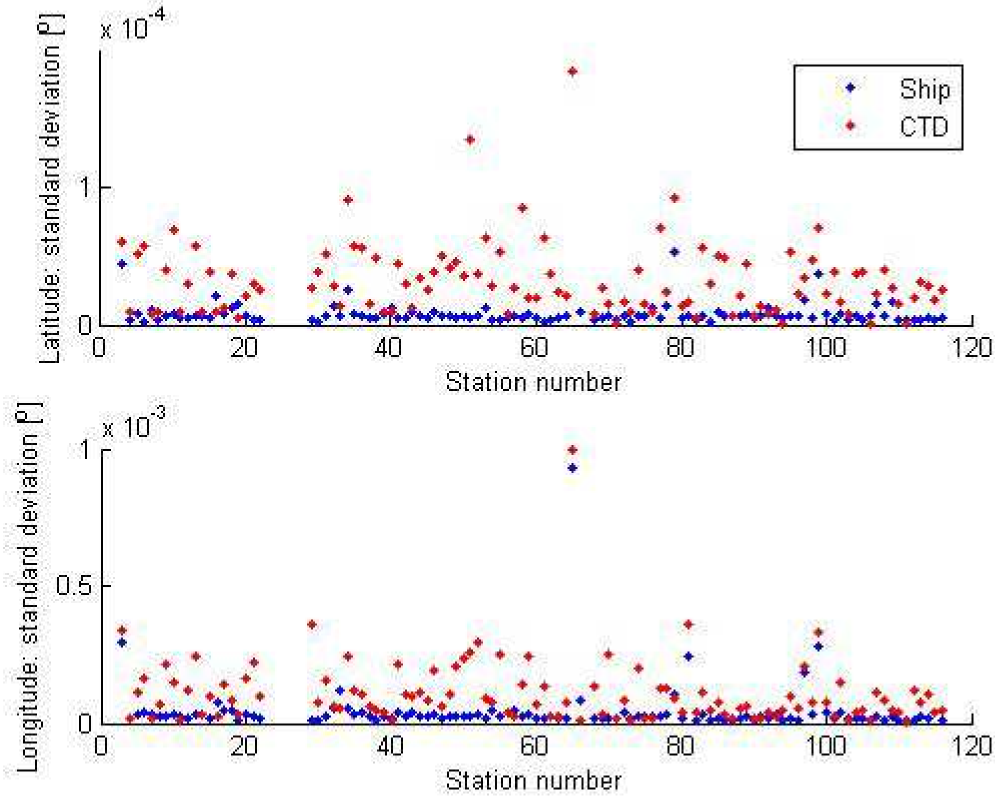

Figure D2: Standard deviations of a) latitude and b) longitude from ship GPS (blue) and CTD-GPS (red) during CTD casts.

D2 Comparison of ship and H. Bryhni's record of mooring position.

Mooring positions and time of deployment were a) noted down in the ship's scientific log book by the deck officers and b) bookmarked in H. Bryhni's personal GPS. The positions and differences are listed in Table D1. The agreement is good, and the difference of about 40 m reflects the difference in the placements of the GPS: The ship's GPS navigation system gives the position of the center of the boat while H. Bryhni's GPS was placed in the aft, close to where the mooring was actually released.

Table D1: Mooring positions obtained from the ships navigation system and from H. Bryhni's personal GPS.

	Latitude		Longitude		
	Ship	H.B.	Ship	H.B.	Difference (m)
SA	77,91769	77,91762	42,15760	42,15573	44
SB	77,00614	77,00638	34,45980	34,46083	37
SC	77,75074	77,75043	36,15027	36,15105	39
SD	77,00816	77,00800	34,05081	34,05237	43
SE	77,01024	77,00978	34,23745	34,23723	50

Appendix E: Results from the «reassembled» LADCP

A "new" LADCP was reassembled using electronics and housing from SN: 10012 and beams from SN:11434. This is not standard procedure, as ADCP components are calibrated as one unit. Figure E1-2 show LADCP profiles processed 1) Master and Slave together and 2) Master and Slave separately before (sta040) and after (sta100) LADCP reassembling. The

difference between Master and Slave does not appear to be larger when the reassembled instrument is used.

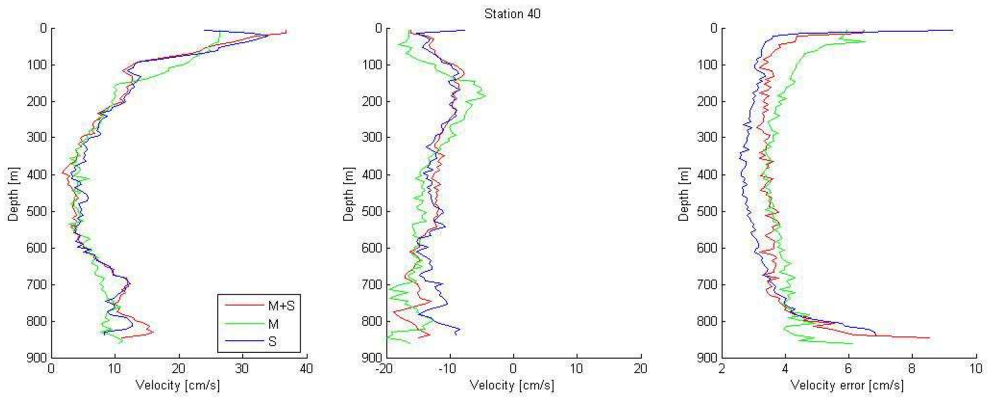

Fig E1: LADCP profiles of a) u b) v and c) error velocities at station 40.

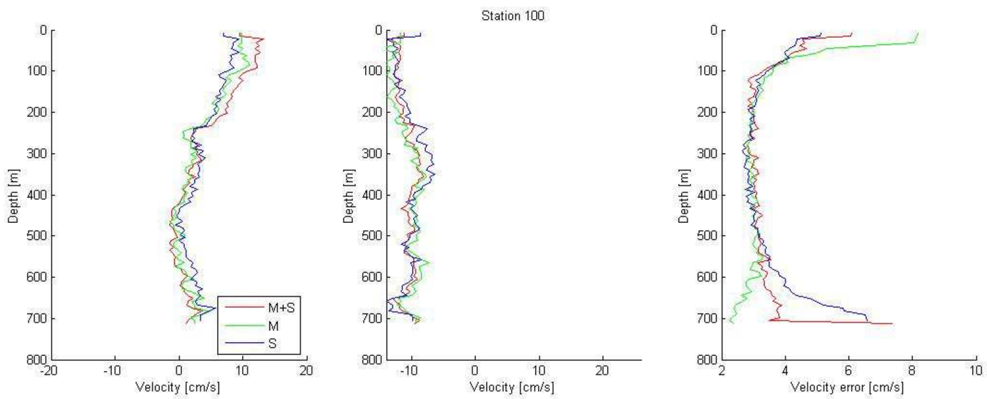

Fig E2: LADCP profiles of a) u b) v and c) error velocities at station 100.

Appendix F: ADCP setup files

RDI 300 kHz SN 8026

CF11101
EA0
EB0
ED3250
ES35
EX11111
EZ1111101
WA50
WB1
WD111100000
WF176
WN31
WP35
WS400
WV175
TE00:20:00.00
TP00:01.00
TF13/01/03 12:00:00
CK
CS
;
;Instrument = Workhorse Sentinel
;Frequency = 307200
;Water Profile = YES
;Bottom Track = NO
;High Res. Modes = NO
;High Rate Pinging = NO
;Shallow Bottom Mode= NO
;Wave Gauge = NO
;Lowered ADCP = NO
;Ice Track = NO
;Surface Track = NO
;Beam angle = 20
;Temperature = 0.00
;Deployment hours = 8640.00
;Battery packs = 1
;Automatic TP = NO
;Memory size [MB] = 256
;Saved Screen = 2
;
;Consequences generated by PlanADCP version 2.06:
;First cell range = 6.11 m
;Last cell range = 126.11 m
;Max range = 143.08 m
;Standard deviation = 1.26 cm/s
;Ensemble size = 774 bytes
;Storage required = 19.13 MB (20062080 bytes)
;Power usage = 442.16 Wh
;Battery usage = 1.0
;
; WARNINGS AND CAUTIONS:
; Advanced settings have been changed.

RDI 150 kHz SN 18595

CR1
CF11101
EA0
EB0
ED3500
ES35
EX11111
EZ1111101
WA50
WB0
WD111100000
WF352
WN56
WP45
WS400
WV175
TE00:20:00.00
TP00:02.00
TF13/01/01 12:00:00
CK
CS
;
;Instrument = Workhorse Sentinel
;Frequency = 153600
;Water Profile = YES
;Bottom Track = NO
;High Res. Modes = NO
;High Rate Pinging = NO
;Shallow Bottom Mode= NO
;Wave Gauge = NO
;Lowered ADCP = NO
;Ice Track = NO
;Surface Track = NO
;Beam angle = 20
;Temperature = 0.00
;Deployment hours = 8880.00
;Battery packs = 2
;Automatic TP = NO
;Memory size [MB] = 256
;Saved Screen = 3
;
;Consequences generated by PlanADCP version 2.06:
;First cell range = 8.40 m
;Last cell range = 228.40 m
;Max range = 241.42 m
;Standard deviation = 1.04 cm/s
;Ensemble size = 1274 bytes
;Storage required = 32.37 MB (33939360 bytes)
;Power usage = 834.99 Wh

RDI 75 kHz SN 18477

CR1
CQ255
CF11101
EA0
EB0
ED2250
ES35
EX11111
EZ1111101
WA50
WB0
WD111100000
WF704
WN49
WP40
WS800
WV175
TE01:00:00.00
TP00:03.00
TF13/01/01 12:00:00
CK
CS
;Instrument = Workhorse Long Ranger
;Frequency = 76800
;Water Profile = YES
;Bottom Track = NO
;High Res. Modes = NO
;High Rate Pinging = NO
;Shallow Bottom Mode= NO
;Wave Gauge = NO
;Lowered ADCP = NO
;Ice Track = NO
;Surface Track = NO
;Beam angle = 20
;Temperature = 0.00
;Deployment hours = 8880.00
;Battery packs = 4
;Automatic TP = NO
;Memory size [MB] = 256
;Saved Screen = 3
;
;Consequences generated by PlanADCP version 2.06:
;First cell range = 16.80 m
;Last cell range = 400.80 m
;Max range = 537.18 m
;Standard deviation = 1.20 cm/s
;Ensemble size = 1134 bytes
;Storage required = 9.60 MB (10069920 bytes)
;Power usage = 1761.04 Wh
;Battery usage = 3.9
; WARNINGS AND CAUTIONS:
; Advanced settings have been changed.