Cruise Report
RRS James Clark Ross
JR310 & JR272D
9 March – 14 April 2015

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British Antarctic Survey
Cambridge

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Introduction

Cruise JR310/JR272D took place on RRS James Clark Ross from 9 March to 14 April 2015. This cruise was comprised of three different elements: recovery and redeployment of BAS/LDEO moorings in the northwestern Weddell Sea and in Orkney Passage (SME #714/1), deployment of further instruments and an additional mooring in support of the DynOPO project (SME #715/1), and CTD casts along the A23 repeat hydrographic section from the Weddell Sea to South Georgia (SME #450/5). In practice the work in Orkney Passage was combined: moorings in the northwestern Weddell Sea were serviced first, followed by recoveries in Orkney Passage and CTD casts. Then the ship repeated the A23 section before returning to Orkney Passage to redeploy the moorings with the additional DynOPO instrumentation.

Overall this was a highly successful cruise, with all but two instruments and one acoustic release recovered from Orkney Passage, two separate CTD sections occupied across Orkney Passage, with further casts along and across the 3000-m isobath both upstream and downstream of the saddle point of the passage. All moorings were deployed in Orkney Passage, and the A23 section was reoccupied as planned. I would like to thank all personnel on board: the science party, science support, the ship's officers, and crew for their efforts on the cruise.

Povl Abrahamsen

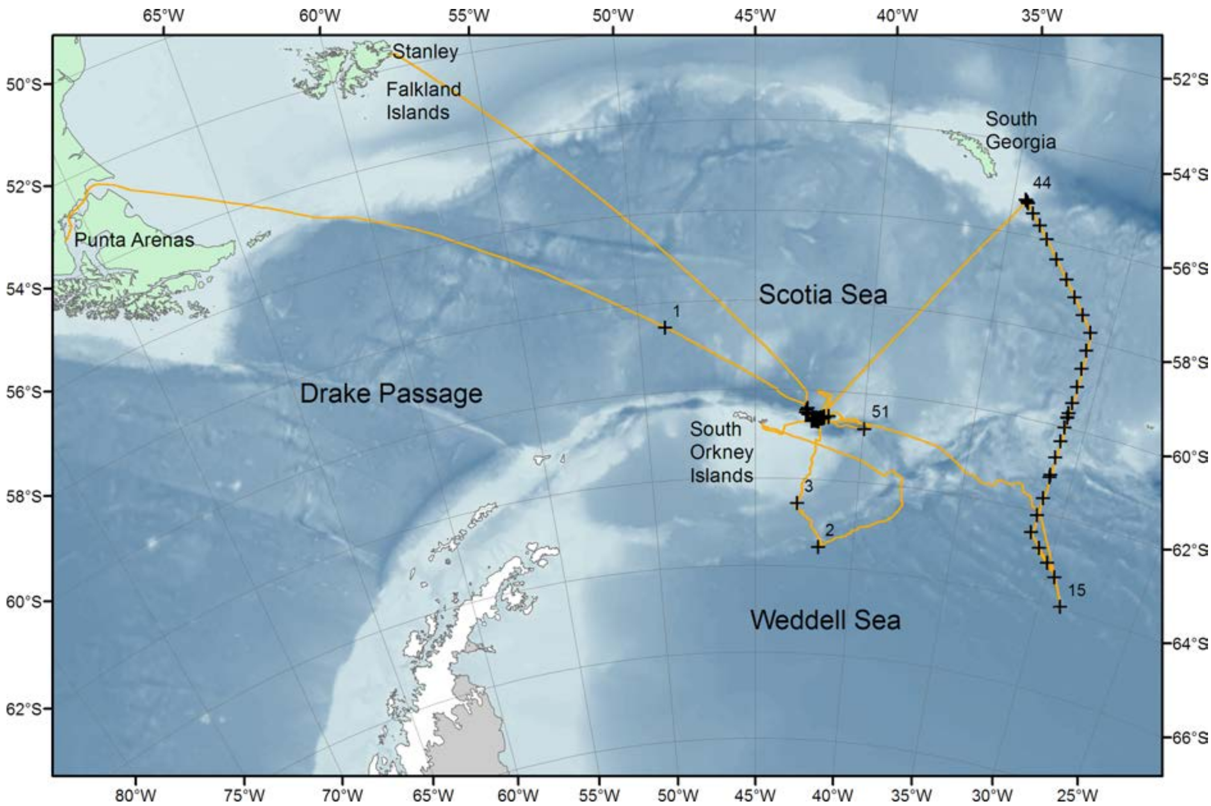
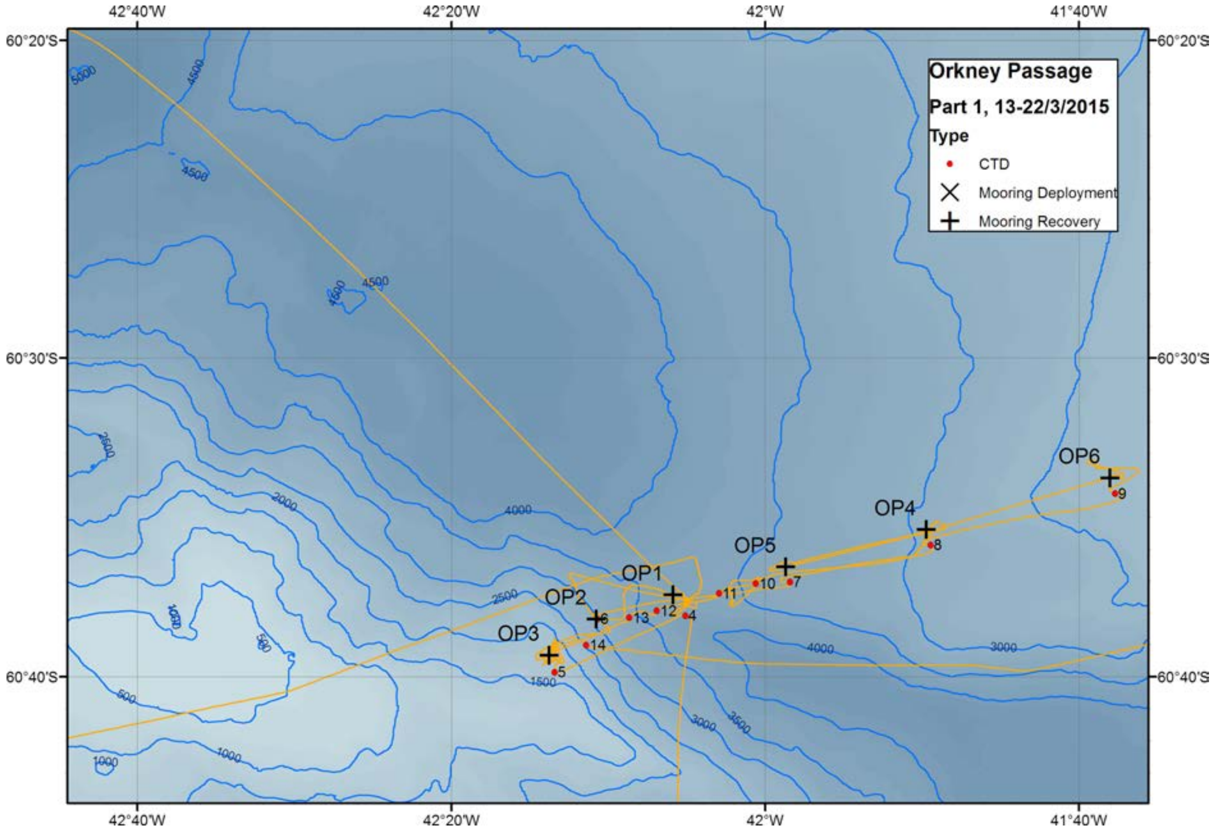


Figure 1: Overview of the cruise track and CTD stations occupied on JR310/JR272D

a



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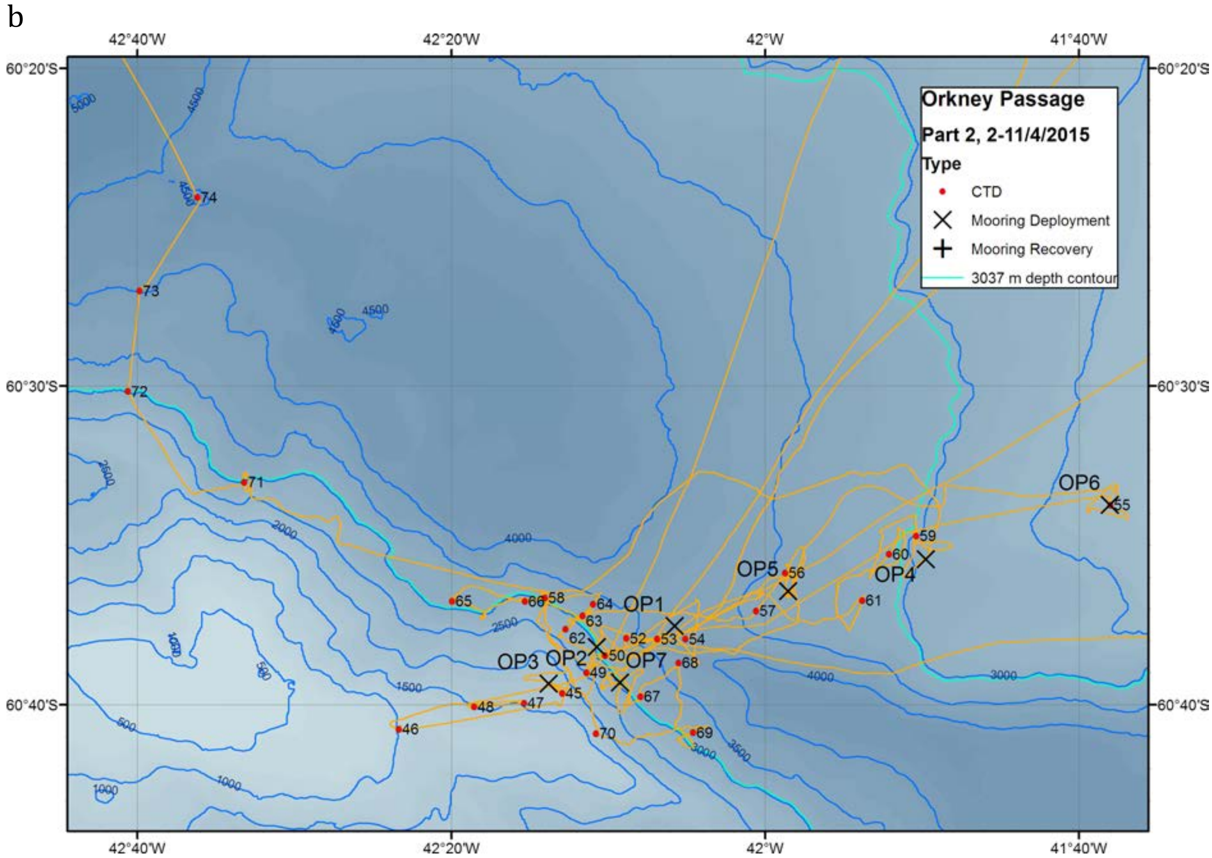


Figures 2a and b: CTD stations and moorings in Orkney Passage, during the first (a) and second (b) periods spent in this region. Depths are from multibeam surveys from previous UK, US, and German cruises to this area.

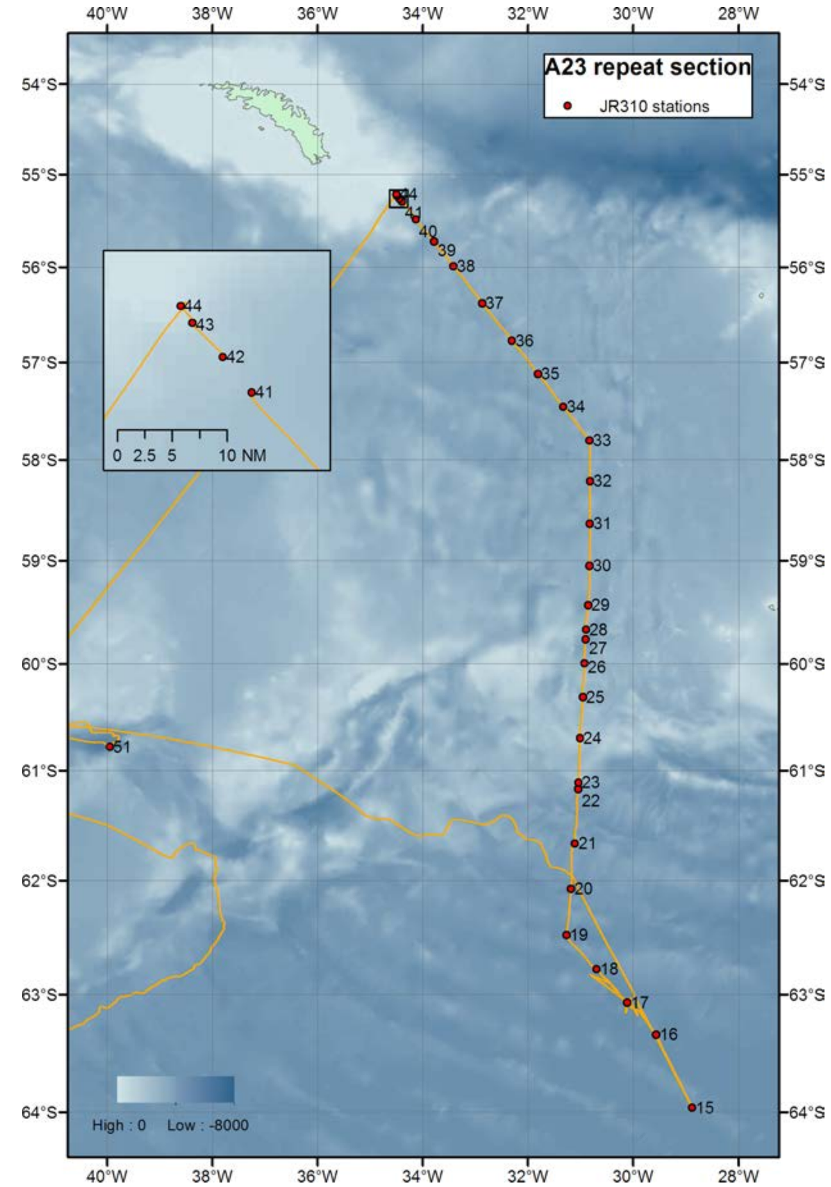
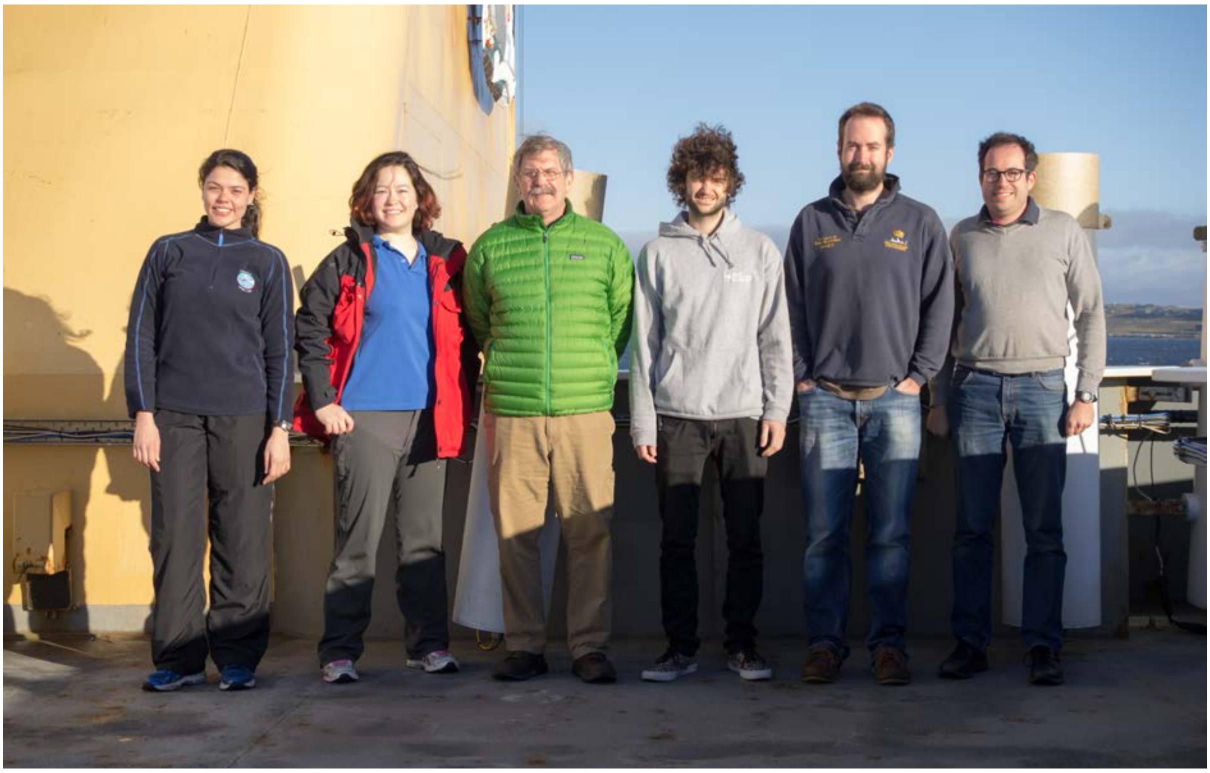


Figure 3: CTD stations on the A23 section; the inset shows the northernmost part of the section.

Cruise personnel

Science party

Povl Abrahamsen, PSO (BAS)
Marina Azaneu (UEA)
Lewis Drysdale (BAS & SAMS)
Eleanor Frajka-Williams (Southampton)
Bruce Huber (LDEO)
Ryan Patmore (BAS & Southampton)



Left to right: Marina, Eleanor, Bruce, Ryan, Lewis, Povl

Science support

Johnnie Edmonston, ICT
Paul Morgan, AME
Mark Preston, AME

Officers and crew

Graham Chapman, Master
Simon Evans, Chief Officer
Christopher Hipsey, 2nd Officer
Georgina Delph 3rd Officer
Lucy Faulkner, 3rd Officer
Charles Waddicor, ETO (Comms)
Luke Parnell, Chief Engineer
Christopher Donaldson, 2nd Engineer
Aleksandr Hardy, 3rd Engineer
Steven Eadie, 4th Engineer
Simon Wright, Deck Engineer
Julian Klepacki, ETO (Eng)
Hamish Gibson, Purser
Julie Hunt, Doctor
George Stewart, Bosun Science Ops
Clifford Mullaney, Bosun
John O'Duffy, Bosun's Mate
Steven Crickmore, AB
Martyn Dyer, AB
Kenneth Phelps, AB
Graham Waylett, AB
Shaun Bell, AB
Ian Herbert, Motorman*
Stephen Pictor, Motorman
Keith Walker, Cook
Padraig Molloy, 2nd Cook
James Newall, Steward
Derek Lee, Steward
Christian Savage, Steward

* disembarked 14/3


Alex (3rd Eng)


Charlie (ETO)


Christian (Stwd)


Chris (2nd Eng)


Christopher (2nd Off


Cliff (Bosun)


Derek (Stwd)


George (Bosun)


Georgina (3rd Off)


Graham (Master)


Graham (AB)


Hamish (Purser)


James (Stwd)


John-O (Bosun's Mate)


Johnnie (IT)


Julian (ETO Eng)


Julie (Doctor)


Keith (Cook)


Ken(AB)

Lucy (3th Off)


Luke (Ch Eng)


Mark (AME)


Martyn (AB)

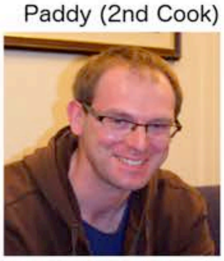

Paddy (2nd Cook)


Paul (AME)


Shaun (AB)


Simon (Ch Off)


Simon (Deck Eng)


Stephen (Motorman)


Steven (AB)


Steven (4th Eng)

Cruise narrative

Povl Abrahamsen

4/3: UK- and US-based personnel depart for Santiago.
5/3: Personnel arrive in Santiago, spend night.
6/3: Early morning flight from Santiago to Punta Arenas. Arrived on board 10:30. Initial safety brief followed by tour of ship. After lunch containers arrived, and unpacking commenced.
7/3: More unpacking, afternoon off.
8/3: Yet more unpacking and securing.
9/3: Early morning safety brief and boat drill. Shopping expedition to town at 10:30. Told batteries and other airfreight would arrive on ship; they were delivered at 12:30. Lunch and hot chocolate ashore, back on board for 14:00 shore leave expiration. Departed Punta Arenas at 15:20.
10/3: Batteries installed in Microcats and some Aquadopps. Steaming.
11/3: Rough weather overnight. Prepared more instruments: batteries in Aquadopps and first two releases. Left Argentine EEZ. Swath on at 21:07. Still steaming.
12/3: ADCP started just after breakfast. We started the day with a proof test of the CTD wire, followed by a test cast. Unfortunately the test failed, with a short circuit in the termination. Steaming continued, along with acoustic release preparations, and another proof test and test CTD were performed after dinner. This cast was successful, and was followed by salinity sampling.
13/3: A day of steaming. Apart from more minor preparation work, little was done with mooring equipment. Data from the previous day's CTD cast were processed, along with the first day of SADCP data. We had a meeting with the deck department to discuss plans for the mooring deployments, recoveries, and CTD casts – where we were notified that we needed two scientists on deck during nights. Just before dinner we passed through Orkney Passage and stopped to range to OP1 and OP2, both of which replied loud and clear. We were then notified that the ship was diverting to Laurie Island to rendezvous with the Shackleton for a personnel transfer.
14/3: One person (motorman) transferred to the Shackleton in Scotia Bay after breakfast. Steamed to east for the rest of the day. mstar working for CTD data processing.
15/3: Encountered sea ice just after midnight, slowed down, headed northeast to skirt around it. Spent whole day bashing through sea ice. Good progress most of the time.
16/3: Spent whole day breaking ice. Occasional large pools and leads, but also lots of new ice and old floes. Approaching M3 toward evening, decided on CTD cast at 3 am, before recovery. Arrived at M3 at 22:30, both releases talking loud and clear.
17/3: Early morning CTD: the cast began at 4 am, followed by a mooring release after breakfast. The mooring was not visible from the surface; after steaming around listening to the release, one sphere was spotted near the ship. This was eventually caught from the Wor Geordie and the mooring was recovered onto the forecastle, with a snatch block on the 20-tonne crane. All instruments were in working order; one SBE39 stopped logging in January, the others were all still logging. Overall a successful, if unconventional, mooring recovery.
18/3: More transit through the sea ice. Eventually we reached a point five miles east of the M2 position, where there was a wall of second-year ice blocking our progress. We deployed M2 at a similar depth near this point.

19/3: More steaming through the ice. Toward the evening, the ice became looser, but with bands of heavy second-year ice and bergy bits. Slow going.
20/3: Arrived at OP1 at 2 am. CTD cast, followed by another at OP3. After breakfast, we listened for OP3, but did not get a response. We attempted a blind release, but the mooring was still in position. Then we recovered OP2 before lunch and OP1 after lunch. Further CTD casts in evening and overnight in anticipation of further recoveries.
21/3: After a night of CTDs at the sites of OP2, 4, 5, and 6, we recovered OP6 and OP5 before lunch, and OP4 after lunch. Then CTDs overnight. Overall a very successful day.
22/3: Dragged for OP3. A railway wheel was attached to the end of the coring wire, with four grapnels at 3-m intervals above; this was then laid out in a loop of 500 m radius around the mooring, streamed out a further 1500 m to windward, and then pulled tight. Halfway through the top half of the mooring appeared at the surface. This was recovered, with a break just below the middle instrument group. In total, three of five instruments were recovered, along with eight floats and the top buoy. Six floats, a release, an Aquadopp, and a Microcat were not recovered. Overall, it is still an excellent result for Orkney Passage recoveries.
23/3: In transit to A23.
24/3: Arrived at A23 in the evening, and started with two CTD casts. Weather rapidly deteriorating after second cast, so no further CTDs. Minimum pressure of 959 hPa in evening, then rising.
25/3: Winds decreasing southerlies, but still rough. Waiting for conditions to improve before CTDs can resume.
26/3: Conditions improved sufficiently that CTDs could resume in morning. CTD casts (and transit) continuously from then on. In the afternoon and evening there were problems with one engine, causing the ship to slow down at times. This was resolved overnight by switching to one large and two small engines, and fixed the following morning.
27/3: Yet more CTDs. A sunny morning gave way to cloudy weather.
28/3: Another thrilling day of CTDs. Low visibility at times, but calm.
29/3: The CTDs continue. Another uneventful day, with a bit of swell and fairly low temperatures.
30/3: Even more CTDs. Work is progressing with preparing releases, beacons, and instruments for redeployment.
31/3: CTDs continuing – though the end is in sight. After CTD 41 we had a blackout caused by "human error" in the engine room: one of the engineers accidentally reversed into a switch, leading to the shutdown of the one large engine in use for propulsion and lighting. Systems were eventually brought back online and we finished A23 in the evening and set off toward Orkney Passage.
1/4: Transit to OP2. Preparations for mooring deployments continue.
2/4: Arrived at OP2 around 11:30 am, but weather, visibility, ice, and swell all precluded mooring work. Spent the rest of the day slowly steaming into the weather, with conditions worsening overnight.
3/4: Arrived back at OP2 at noon. Conditions improving, but still not ideal for a long mooring. Deployed OP3, and continued with CTD casts overnight.
4/4: CTD casts continued overnight from west of OP3 to OP2. In the morning the mooring deployment started; this was completed successfully, though the mooring was dropped slightly prematurely because the release rope jammed between the chain and anchor. Still, the mooring ended up 700 m downstream of the drop position! After triangulating, we headed to Orkney Deep to get a deep CTD cast – partly out of curiosity,

and mostly to try to fix the spooling on the CTD winch. Intention is to return and deploy OP1 in the morning.
5/4: Slightly delayed return to Orkney Passage, but not too late to deploy OP1. More CTDs overnight. Heating in boat, bridge, and navigation bridge decks failed in evening – getting cold in the PSO's cabin…
6/4: Intention was to deploy OP6 and OP4. The deployment of OP6 went well. However, ice was encroaching on OP4, and instead we deployed OP5. Heating returned in the evening.
7/4: The night's planned CTDs were cut short by sea ice. Instead, we moved northward, taking a CTD cast 4 km downstream of OP2. After daylight we steamed east toward OP4, which we deployed anchor first. We then steamed westward overnight, stopping for a few CTDs en route.
8/4: We did more CTD casts while contemplating what to do about OP7. There were leads in the ice, but nothing quite big enough for streaming the mooring. But we got lots of CTD casts downstream of Orkney Passage.
9/4: After some discussion of what to do about OP7, weight tests were performed on the 10-tonne crane using a load cell. This showed a deployment weight of around 900 kg in air, and 650 kg in water once the three buoys above the release were underwater. We concluded that it was safe to deploy OP7 anchor first, once the weights had been deployed using the Gilson winch. Temperatures were down to -11 in the morning (but with no wind), rising quickly in the evening when the wind picked up and veered from southerly to westerly.
10/4: We deployed OP7 in the morning. After an initial problem with the chain snagging around the top of the tandem releases, the anchor was brought back on board and then redeployed; the rest of the deployment went smoothly. After the cast we did further CTD casts upstream of Orkney Passage, before steaming downstream overnight.
11/4: We did more CTDs downstream of Orkney Passage and across the downstream sill in the evening. The final CTD cast ended with a bang in the evening, with two Niskin bottles (nos. 2 and 4) imploding for no apparent reason.
12/4: Steaming back to the Falklands. Writing and packing up. End-of-cruise dinner in the evening; menu: squid as starter, followed by steak Diane, and chocolate brownie for dessert!
13/4: More steaming, slowing down overnight.
14/4: Arrived at FIPASS centre berth in the morning; offloading of cargo for FIPASS and packing of the container was done remarkably quickly. The science party went ashore for a walk in the afternoon. First JR311 personnel embark.
15/4: Ship shifted berth in the morning. Labs signed off; JR311 mobilisation commences.
16/4: Four members of the science party disembark, and are taken to B&B in Darwin. More JR311 personnel arrive in evening.
17/4: Personnel returning to UK disembark for MOD flight.
18/4: Bruce Huber disembarks for Lan Chile flight to New York via Santiago.

Profiling Conductivity Temperature Depth (CTD) measurements

Lewis Drysdale

74 stations were sampled during this cruise, including what may be the deepest CTD cast ever done on JCR, reaching a depth of 6111 m (6185 dbar pressure). In addition to providing a full-depth view of the water mass properties in Orkney Deep, upstream of the Orkney Passage, this helped to resolve spooling problems affecting the CTD wire, which had previously required the deck engineer to be present in the winch room during hauls/upcasts. Details of the cast start, bottom, and end positions and depths are given in the event log in Appendix A.

CTD instrumentation and setup

The CTD rosette was comprised of a SBE-32 carousel water sampler holding twenty-four 12-litre Niskin bottles. Beneath the carousel was a SBE-9plus underwater unit with built-in pressure sensor, fitted with dual pumped SBE-3 temperature and SBE-4 conductivity sensors, and a single SBE-43 oxygen sensor in line with the primary temperature and conductivity sensors. Other sensors attached to the voltage channels of the SBE-9plus were a transmissometer, fluorometer, PAR sensor, and altimeter. Mounted on a vertical bar on the cage outward of the carousel was a SBE-35 high precision thermometer that made several temperature measurements each time a bottle was fired. A downward-looking LADCP and battery case were also attached.

The rosette was fitted with a plastic fin to avoid it spinning. Directly above the rosette was a swivel with built-in slip rings. The slip rings on the winch were connected to a SBE-11plus deck unit located in the UIC and connected to a Windows 7 PC running Seasave version 7.22.3.

Table 1: Calibration information for the sensors attached to the CTD.

Sensor	Parameter	Serial Number	Calibration date
SBE-3plus	Temperature	5043	08-May 2104
SBE-3plus	Temperature	2307	07-May 2014
SBE-4C	Conductivity	3419	23-Apr 2014
SBE-4C	Conductivity	4090	23-Apr 2014
SBE-9plus	Pressure	0541	21-May 2014
SBE-43	Oxygen	0620	02-May 2014
Chelsea AquaTracka iii	Chl-a Fluorescence	7235	24-Mar 2013
Wetlabs C-Star	Transmissometer	CST-1479DR	02-Jun 2014
Biospherical QCP-2200	PAR	7235	24-Apr-2013
Tritech PA200	Altitude	10127.244739	n/a
SBE-35	Temperature	0051	14-May 2014

When not in use the whole package was housed in the water bottle annexe, a heated space behind roller doors on the starboard side of the ship. Before each deployment the CTD, attached to the deck by a cradle, was maneuvered to the outer deck along a set of rails where the tension could come on the wire and it could be lowered easily into the water. Each deployment required three able bodies to steady the carousel with heaving lines. Data logging was started once the CTD had left the deck and all hands were off.

The procedure was to lower the CTD, stopping at 10 m wire out, where the rosette was left until conductivity-activated pumps turned on and the sensors were equilibrated with ambient conditions.

The pumps are typically expected to switch on 60 seconds after the instrument is deployed. We used the CTD in waters close to freezing point and air temperature well below zero. Here we saw that on many occasions the pumps took several minutes to turn on and the sensors (predominately conductivity) were very slow to equilibrate. The cause of this is thought to be linked to the air temperatures during deployment, despite the short time (minutes) between heated storage and immersion.

After the soak, the CTD was raised to 5 m, or as close to the surface as wave and swell condition allowed, and then lowered to within 20 m of the seabed. The altimeter began reading at 100 m above the seabed and was used to determine when to stop the payout of the wire. Bottles were fired at the bottom and on the upcast, where the procedure was to stop the CTD winch, hold the package *in situ* for 30 seconds to one minute to allow sensors to equilibrate, and then fire a bottle. Bottle sampling depths were chosen based on low vertical salinity gradients seen during the downcast. These included the bottom, the mixed layer and a few other depths. Salinity samples from these depths were used to calibrate the CTD conductivity and salinity. In order to let the SBE-35 standard thermometer acquire the required 8 readings for a mean temperature, there was a gap of 30 seconds or more between each firing.

On most casts up to station 37 8 bottles were fired per cast, with 4 bottles sampled; the number of bottles fired was increased to 20 on most casts after cast 38; this was mainly done to obtain more SBE-35 readings. From station 60 onward we reverted to firing 8 bottles when possible.

On many of the upcasts there were brief stops to allow the deck engineer to adjust the spooling of the wire onto the storage drum. After station 51, when over 6000 m of wire were used and the spooling of the wire was adjusted on the upcast, this was no longer necessary.

The CTD sampling was largely a success. One problem, which is fairly inherent in the type of environment we are trying sample, was the cold. There was a constant struggle to keep the sensors from freezing up during recovery and deployment. Nevertheless, and despite best efforts, conductivity drift in the secondary appeared to increase following a spell of very cold weather (see calibration section below).

The only other major problem was during the last cast, when 2 Niskin bottles (bottles 2 and 4) shattered, rendering them unusable. The cause of this is still unknown and is even more mysterious given that the bottles were not side-by-side, but separated by a fully intact bottle.

CTD processing

Data were collected using Seabird Electronics' Seasave software, followed by initial post-processing in SBEDataProcessing and further processing in Matlab using the mstar processing suite, developed at NOCS.

Seabird processing

Data were recorded and viewed using Seasave version 7.22.3. For each cast 4 files were created:

jr310_XXX.hex	hexadecimal (raw) ascii data file
jr310_XXX.XMLCON	ascii configuration file with calibration information
jr310_XXX.hdr	ascii header file containing sensor information
jr310_XXX.bl	ascii file containing bottle fire information

After every deployment a batch script was run to copy the raw data to the network drives and do some preliminary processing with SBEDataProcessing version 7.22.2. This included creating a sound velocity profile for updating the EM122 and a coarser resolution copy of the data for sending to the Met Office. Once data have been backed up to the network drive, the .hex file is passed through the Align CTD and Cell Thermal Mass modules of SBEDataProcessing. Align CTD offsets for temporal offsets between the sensors on the CTD; in this case, the oxygen measurements were advanced by five seconds. Cell thermal mass corrects for the effects of conductivity cell thermal mass from the measured conductivity. Once complete the following three files were transferred to the network drive 'Legdata'.

JR310_XXX_align_ctm.cnv	.cnv file, align ctd and cell thermal mass
JR310_XXX_align.cnv	.cnv file, align ctd.
JR310_XXX.cnv	.cnv file, no adjustment

SBE-35 high precision thermometer

Once the CTD was on deck and secured, data from the SBE-35 were uploaded using Seaterm version 1.59. The procedure for this was to switch the deck unit on, open the software, click "connect", and then "upload". Once the data had been uploaded the sample history was cleared by entering the command "*samplenum=0*". A status command (*ds*) was used before and after upload to ensure that the sample numbers matched the log records for each cast. The process batch script transferred across the file and its nomenclature was:

JR310_XXX_sbe35.asc

More information on the SBE-35 is found in the CTD calibration section.

Mstar processing

CTD data were processed on a dedicated MacBook (s/n W08121CN64C) using the mstar Matlab scripts written by Brian King at NOCS. Each cruise makes its own changes to mstar scripts, necessarily to the naming conventions of the directories, but also small changes to the source code directly. Previous cruise reports are valuable sources of information in this respect, notably from JR299 and JR235/236/239. In the spirit of good housekeeping, the following is a brief summary of mstar processing used on JR310.

m_setup_jr310 was run any time matlab was opened on the MacBook. This sets up the environment for ctd processing with mstar.

1. CTD processing, part 1: ctd_all_part_1_jr310

msam_01	downcast file created, sample file created.	dcs_jr310_XXX.nc sam_jr310_XXX.nc
mctd_01	raw CTD file created	ctd_jr310_XXX_raw.nc
mdcs_01	create empty data cycles file*	dcs_jr310_XXX.nc
mctd_02a	raw file updated	ctd_jr310_XXX_raw.nc
mctd_02b	24hz file created	ctd_jr310_XXX_24hz.nc
mctd_02c	downcast file updated	dcs_jr310_XXX.nc
mctd_02d	Applies fallrate flag**	ctd_jr310_XXX_24hz_fr.nc
mctd_03_jr310	1hz file created for ADCP	ctd_jr310_001_1hz.nc
mdcs_02	Populate the downcast file	dcs_jr310_XXX.nc
mdcs_03_jr310	decide where upcast ends*	ctd_jr310_001_1hz.nc ctd_jr310_001_psal.nc ctd_jr310_002_1hz_psal.nc

* requires user input.
** not needed on this particular cruise.

Check data with **ctdcheckplotjr310,** which produces plots of various variables for user checking.

2. CTD processing part 2: ctd_all_part_2_jr310

Creates the 2-dbar downcast and upcast files as well as 24hz downcasts and upcasts.

mctd_04_jr310	Sort pressure, and average downcast data to 2 dbar, interpolate gaps and recalculate potemp.	Other stuff
mfir_01	read in bottle file and create firing file	fir_jr310_XXX_bl.nc
mfir_02	merge time from ctd onto file.	fir_jr310_XXX_time.nc
mfir_02	merge ctd upcast data onto firing file.	fir_jr310_XXX_ctd.nc
mfir_04	paste ctd fir data into sam file	sam_jr310_XXX.nc
mdcs_pos	adds lat and lon for start, bottom and end, and also depth and altimeter for bottom*	dcs_jr310_XXX_pos.nc

Check data with **ctd_checkplot_2db_JR310**.

3. CTD processing part 3: ctd_all_part_3_jr310

Creates the 2 dbar CTD files.

mdcs_04	merge positions onto ctd start bottom end times	dcs_jr310_XXX_pos.nc
mdcs_05	apply positions to set of files	fir_jr310_XXX_bl.nc
mctd_04depth	calculate depth for 2-dbar and 24-Hz files and lat/lon read in,	Updates: ctd_jr310_XXX_24hz_dn.nc ctd_jr310_XXX_2db.nc

4. CTD processing part 4: ctd_all_part_4_jr310

Preparing files for calibration – inputting bottle salt information and SBE35 data into the mstar structures.

msal_01_jr310	Creates files from salts spreadsheets and applies offset (over time).*	sal_jr310_XXX.nc sal_jr310_XXX.csv
msal_02	Paste salinity data into sample file.	sam_jr310_XXX.nc
msbe35_01 *msbe35_02*	Average sbe35 temperatures	
msam_02	calculate residuals in sam file	sam_jr310_XXX_resid.nc

* Needs to be manually edited after entering bottle salts into spreadsheets, and evaluating the standards (See section on calibrations).

5. Apply calibrations: JR310_ctdcal

The evaluations of sensor drift were made after step 4, as described in the following chapter. After the offsets or scale factors were determined, the appropriate transformations were included in *temp_apply_cal* and *cond_apply_cal*. Then the JR310_ctdcal script was run, to apply the calibrations to all stations, creating the final calibrated data files.

JR310_ctdcal	Applies temperature and conductivity calibrations to primary and secondary sensors using the temp_apply_cal.m and cond_apply_cal.m scripts. Then copies primary sensors to "cond" and "temp" and recalculates salinity and potential temperature for all three sets of sensors.	ctd_jr310_XXX_2db_cal.nc ctd_jr310_XXX_2up_cal.nc ctd_jr310_XXX_1hz_cal.nc ctd_jr310_XXX_24hz_cal.nc ctd_jr310_XXX_24hz_dn_cal.nc ctd_jr310_XXX_24hz_up_cal.nc

CTD calibration

Eleanor Frajka-Williams

Temperature field calibrations

Overview of sampling protocol, as relevant to temperature field calibrations

A high-accuracy SBE35 was installed on the CTD rosette during JR310. This instrument was used to carry out field calibrations of the pair of 911 sensors on the rosette. The SBE35 was automatically triggered each time a bottle was fired. During JR310, four bottle stops were typically chosen at the bottom, in the surface mixed layer, and in two additional regions of low gradients (in temperature or salinity). In one of the early casts, one of the Niskin bottles leaked, and so at least two bottles were fired per bottle stop. At each firing, the SBE35 was automatically triggered. It took 8 temperature samples over a span of 8.8 seconds, which were averaged and returned as a single measurement along with the max – min of those 8 measurements (returned as a `diff' value, in raw counts).

Mid-cruise changes (station 44 to 45).

Mid-way through the cruise (after station 44), Bruce noticed that the SBE35 was installed with half of the plastic bushing still present on the probe, contrary to recommendations in the SBE35 manual. This bushing was removed and not replaced for the remainder of the stations. The overall effect of the bushing appeared to be to reduce the sensitivity of the SBE35, which was more apparent in regions of stronger temperature variability.

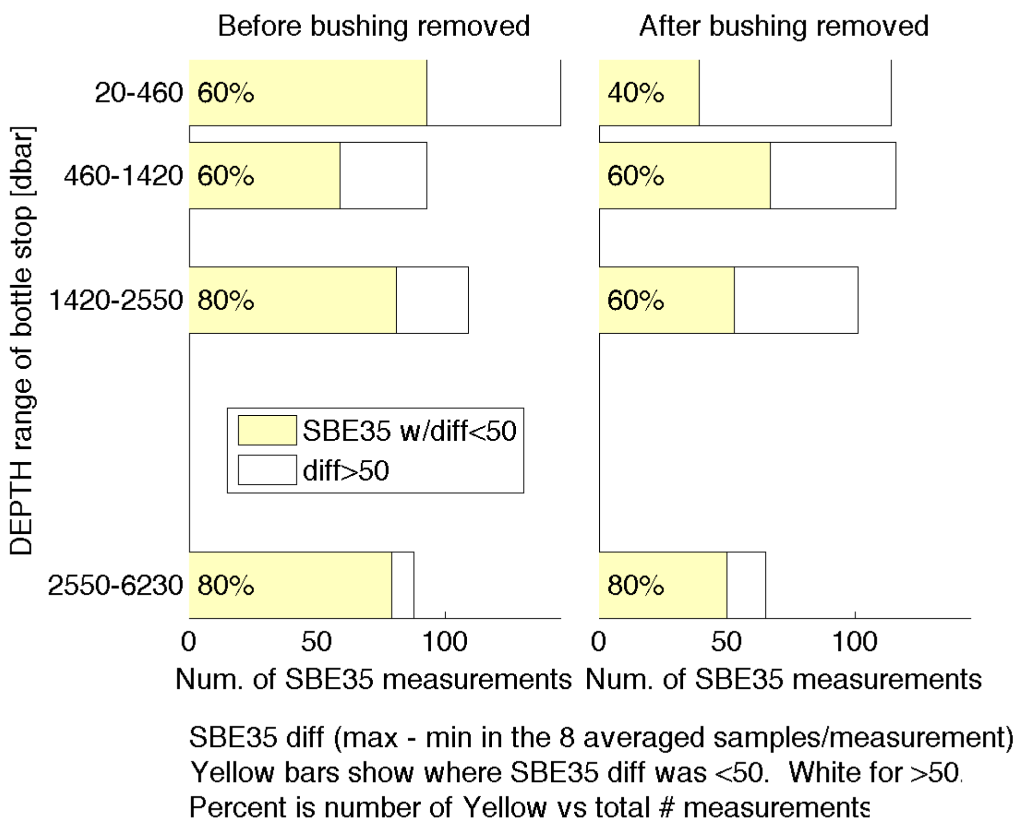


Figure 4: Number of SBE35 measurements, binned in pressure, for stations 1-44 (left) and 44-end (right). The yellow bars indicate those samples for which the `diff' value was less than a threshold of 50 (i.e. where

temperature was relatively stable over the 8 samples averaged to create each SBE35 measurement). After the plastic bushing was removed, the percentage of samples with low variability was smaller, consistent with the increased sensitivity of the SBE35 to temperature variations.

Temperature offsets between SBE35 and 911.

Over the cruise, there were >1466 SBE35 measurements at bottle stops where the SBE35 diff value was below the threshold of 50. The offset between the SBE35 and 911 was less than 1 milli-degree for both the primary and secondary sensors, with the SBE911 reporting measurements which were too warm. Considering past calibrations of the two installed sensors, the 911s had drifted by 0.5 and 0.8 millidegrees between 2012 and 2014 calibrations. The SBE35, in contrast, is known to be extremely stable.

Due to the bushing issue, the lower two panels of Figure 5 show the temperature offsets before the bushing was removed (left) and after (right). While the mean offset remains largely the same (-0.86 millidegrees for primary and -0.73 millidegrees for secondary), the distribution has shifted somewhat, to be more centered around the median.

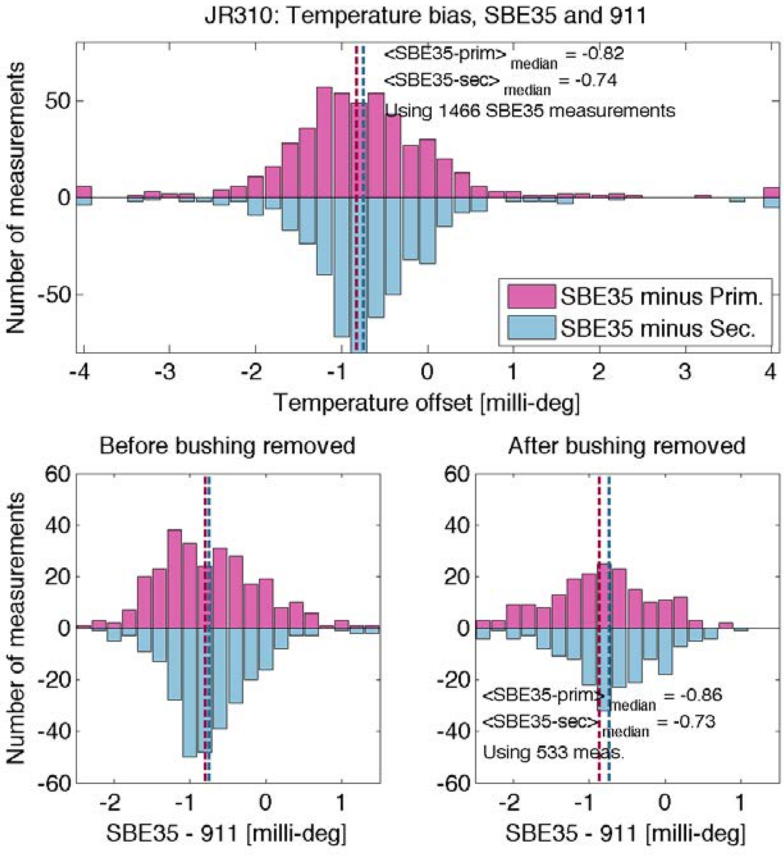


Figure 5: Temperature offset between the SBE35 and pair of 911 on JR310. The top panel shows the overall differences (SBE35 minus 911) in millidegrees for primary (pink) and secondary (blue) over stations 1-55. The lower panels show the differences before the bushing was removed (left) and after (right). While the median offset does not change, the distribution, particularly for the primary sensor, is peakier.

Depth dependence of temperature offsets.

Past repeats of the A23 hydrographic section found a depth dependence of the SBE35-SBE911 offsets. We investigated that here as well, shown in Figure 6. Before the bushing was removed, Figure 6 (left), there was an apparent depth dependence, with the SBE911 reading colder than the SBE35 in the top 500 m, and the SBE911s reading warmer below about 1400 m (using these pressure bins). After the bushing was removed, the depth dependence was reduced (Figure 6 (right)). We conclude that for this cruise, there is negligible depth dependence to the bias recorded by the 911.

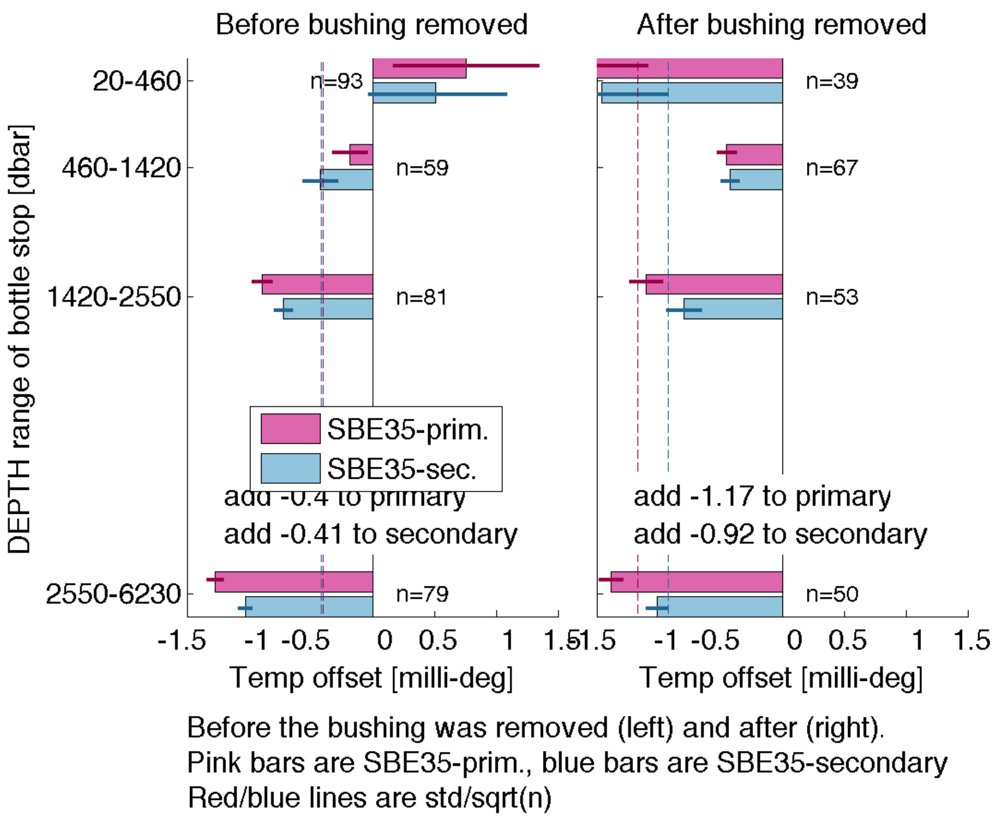


Figure 6: Temperature offsets between the SBE35 and pair of SBE911 on JR310 binned by the depth of the bottle stop. The left panel shows the offset (calculated as SBE35 – SBE911 measurements) for the first 44 stations, during which an extra plastic bushing was present on the SBE35. The right panel shows the offset for stations 45-55, after the bushing was removed (as recommended in the manual). The bars show the mean offset in each depth range, and the horizontal lines, the standard deviation divided by the squareroot of the number of measurements used (n). Pink colors denote the primary sensor, and blue the secondary. The vertical dashed lines show the average bias, after gridding as shown into pressure bins. However, these offsets were not used in the correction.

Final temperature corrections applied.

Due to the sensitivity of the depth-binned-and-then-averaged offsets (Figure 6) on the choice of the number of bins, we chose to simply use the median offset, computed from all samples from stations after the bushing was removed. These offsets are printed in Figure 5, lower-right panel. The offset applied was adding -0.00086 to the primary conductivity sensor, and -0.00073 to the secondary sensor. This offset was applied as a constant correction, and was less than a millidegree in both cases.

Salinometer drift evaluation

Since the salinometer was not re-standardized during the cruise, the standards run before and after each crate were used to determine a drift in the salinometer. This drift was computed using the **evaluate_standards.m** script in the mstar routines, after creating the **sal_jr310_XXX.csv** spreadsheets with the data from the bottle salts. Offsets were applied during the mstar processing in the function **msal_01.m,** which was run during **ctd_all_part4.m** (see CTD processing section).

Conductivity field calibrations

Overview of sampling protocol, as relevant to conductivity field calibrations.

Typically 4 water samples were taken from each CTD cast: 1 at the bottom, 1 in the surface mixed layer, and two additional samples in regions of low gradients (temperature and/or salinity). In the latter half of the cruise, several replicates were taken, usually from the bottom depth. Water samples were analysed for conductivity measurements in the controlled temperature lab, as described above. These conductivity measurements were then used to calculate salinity (for the controlled temperature and surface pressure). Salinities were then converted back to conductivities at the bottle depths using the measured pressure and SBE35 temperatures. Using SBE35 temperatures meant that the bottle conductivity estimates were independent from the SBE911 conductivity measurements, but limited samples to those where the SBE35 `diff' value was less than the threshold of 50.

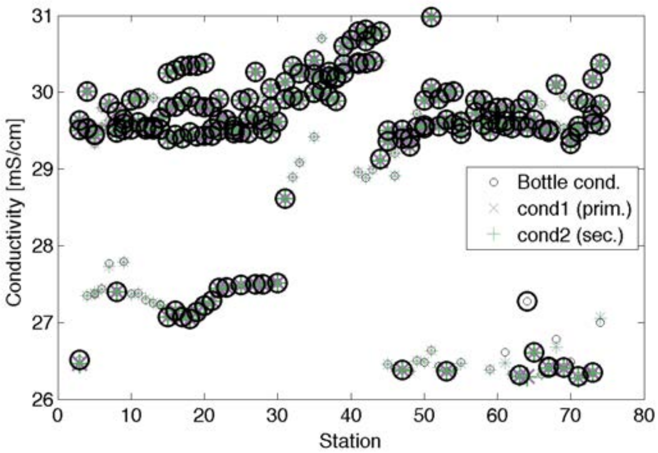


Figure 7: Conductivity measurements on JR310. Circles show bottle conductivities, x's and crosses show primary and secondary conductivity, respectively. Larger symbols indicate those samples where the SBE35 diff value was less than the threshold of 50.

Mid-cruise changes (station 51 to 52).

On cast 52 and beyond, CTD operators noticed that the conductivity differences between the primary and secondary cells had increased by a factor of 4-5. During this time, the air temperatures were below -5 deg Celcius, and with the new track system on the JCR, the CTD was exposed to ambient temperatures for 5 or more minutes on some casts, before the CTD could be secured and the hanger door lowered. After some discussion with the bridge and deck crew, 2 additional heaters were installed in the hanger, and the CTD-securing was simplified to allow for the hanger door to be shut more quickly after the CTD was recovered.

Figure 8 shows the ratio of sensor to bottle conductivity by station number. Cast 67 had a misfired/software issue where it said bottles 1, 2, 3, 4 then 1 were fired. From this figure, it appears that the sensors were relatively stable through the first part of the cruise. From stations in the 50s and beyond, the ratio drifted, particularly of the secondary sensor, indicating a change in sensitivity of the sensor.

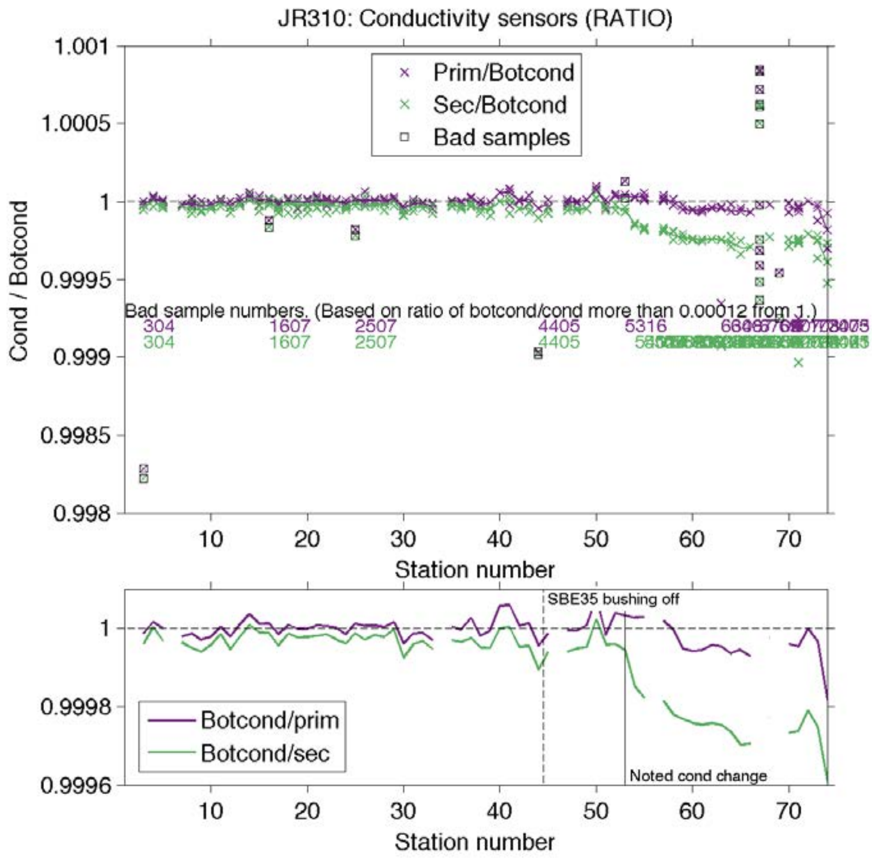


Figure 8: The ratio of sensor conductivity to bottle conductivity, by station number. The top plot shows all samples (excluding a few that were outside the axes limits). The lower panel shows the ratio for primary (purple) and secondary (green) sensor to the bottle conductivity, averaged for each station.

Calibration method & investigation.

Seabird recommends that for field calibrations of conductivity, only slope corrections are applied. These are calculated as

$$slope = \frac{\sum_i^n \alpha_i \beta_i}{\sum_i^n \alpha_i \alpha_i}$$

where the alphas are the 911 sensor conductivities and the betas the bottle conductivities. A running mean of these values is shown in Figure 9. The primary sensor hovers around a slope of 1, meaning that the values from the sensor and bottle measurements are comparable. The secondary sensor has a ratio slightly greater than 1, which begins to drift upwards for stations 51-55. During these casts, the air temperature (lower panel, Figure 9) was particularly cold (sub -5 degrees).

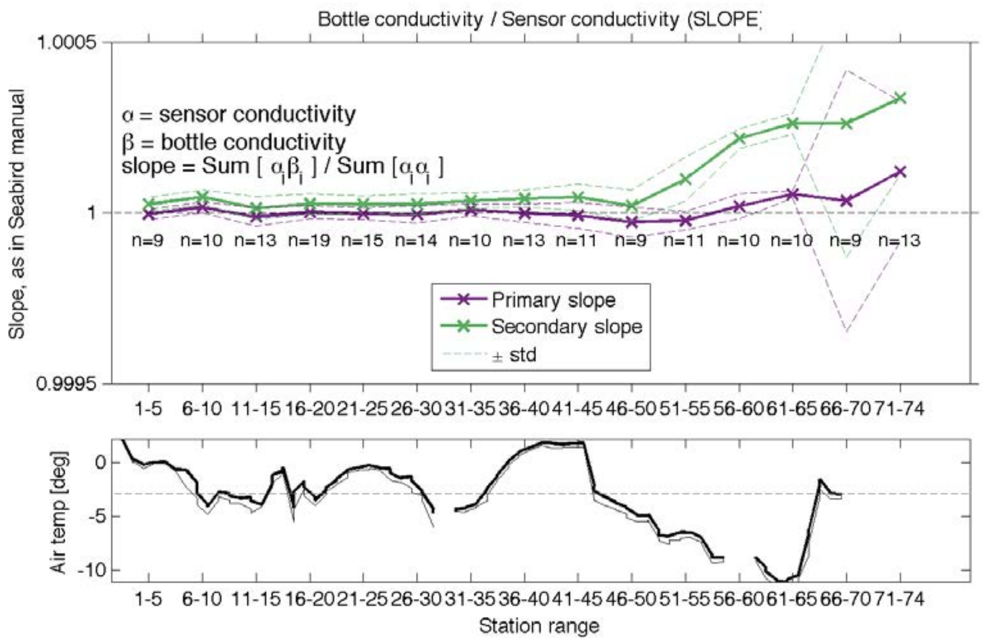


Figure 9: Slope between the bottle conductivity and sensor conductivity, calculated as in the Seabird manual. The lower panel shows the air temperatures during the cast (average- thick and minimum –thin), while the dashed gray line shows the average temperature during casts on the cruise. Casts 46-56 were in colder air temperatures than previously.

Final conductivity corrections applied.

For the primary sensor, no correction was applied over stations 1-59 (apparent slope correction from Figure 9 would be 0.999997. For the secondary sensor, stations 1-53, a correction of 1.000033 was applied.

Over the latter stations, 60-74, a slope correction of 1.000016 was applied to the primary sensor. For stations 63-74, a correction of 1.00031 to the secondary sensor.

Over the range of stations 54-62, the secondary sensor continued to drift. Here, a linear correction was applied as

$$Slope = 1.450415\text{e-}5 * station\_number + 0.999363$$

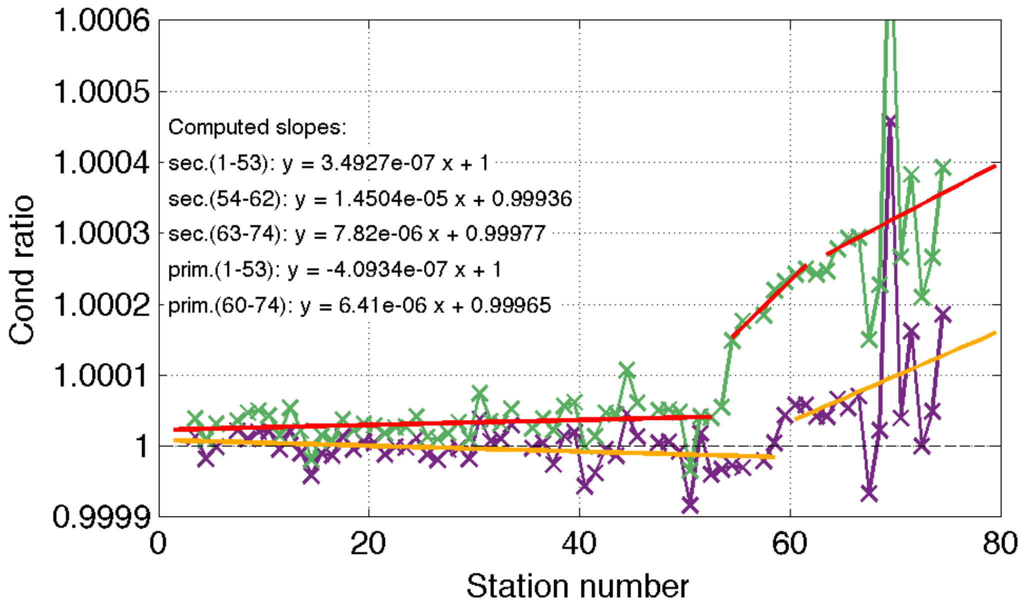


Figure 10: Conductivity ratio for primary (purple) and secondary (green) with linear regression lines added. The slope over the last segment of stations is difficult to determine given the scatter in the values. Over the first 50 or so stations, the slopes were very small. While the equations for the straight lines are shown in the figure, a mean slope was used over the first and last segments, with a linear regression only applied to the secondary conductivity, stations 54-62.

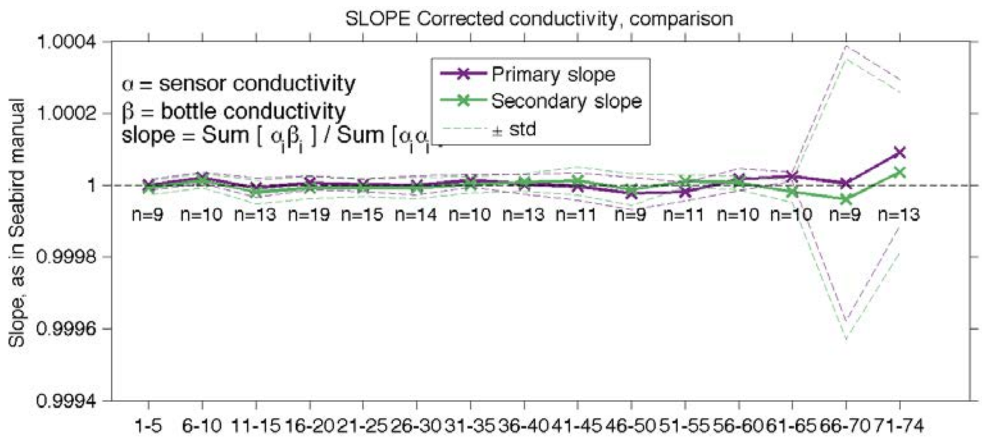


Figure 11: Comparison of corrected sensor conductivity to bottle conductivity.

Final changes to salinity, using corrected conductivity.

To compare the final outputs from the sensors against bottle salts, the average profiles during the first set of stations and latter sets of stations were compared. The offset during the first 59 stations for the primary sensor was exceedingly small, indicating that the sensor was performing very well compared to the bottle samples. After station 59, the primary sensor correction resulted in a change of 0.01 in salinity, which is non-negligible. Overall, it is recommended to use the primary sensor pair for all analysis from these CTDs.

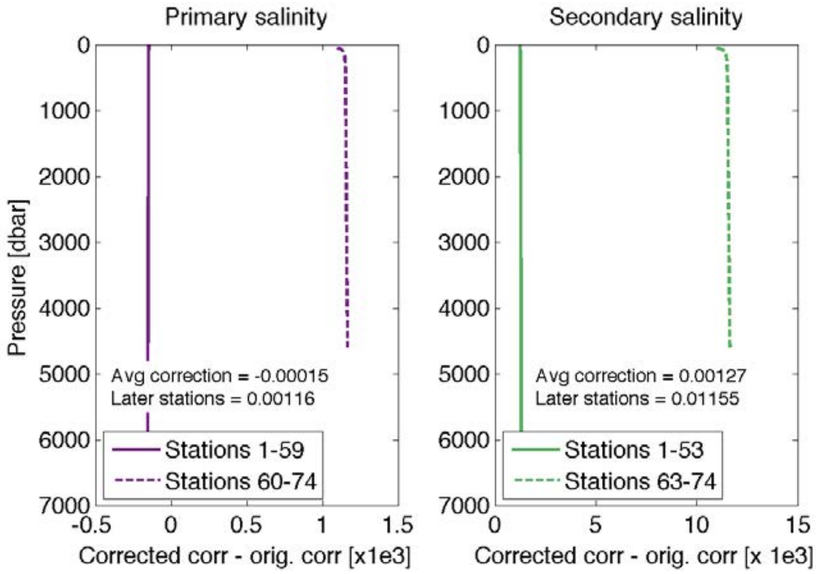


Figure 12: Average salinity change between the corrected and original conductivities.

Notes on the analysis and determination of above corrections.

Due to the time involved in reading data into and out of the mstar software, data were extracted from mstar before determining the corrections stated above. The data files used included the

1. SBE35 ASCII files. These files were loaded in mstar using **msbe35_01_nodcs.m** This script created the file **sbe_jr310_all.nc** which contained all the SBE readings. It also created the file **sbe_jr310_all.mat** which is just a dump of the data and header from the netcdf file. These were further loaded and compared to CTD data in the file **load_jr310_sbe.m** (creating **sbe_all.mat**).
2. SAM sample files. Individual **sam_jr310_XXX.nc** files were created during the **ctd_all_part4.m** step in the mstar processing of the CTD, and contain the bottle salts as measured by the salinometer as well as temperatures/conductivities extracted from the CTD data for the bottle stops. The code **ctd_cal_jr310.m** was run in order to generate a **sam_jr310_all.nc** file, containing all sample files for the whole cruise. These were then loaded for non-mstar use by **load_sam.m** (creating **sam_jr310_all.mat**).
3. CTD 24 hz upcast data. These were loaded from **ctd_jr310_XXX_24hz_up.nc** file that was generated during the CTD mstar processing. These were loaded by the file **load_jr310_raw_ctd.m.**

For temperature corrections, see the file **check_sbe35_bushing.m**. This file uses the SAM and SBE35 data to compare the temperatures from the SBE911 and SBE35. It was written specifically for the issues we experienced on this cruise, namely, the removal of the plastic bushing mid-way through the cruise.

For conductivity corrections, which were applied after a temperature correction was determined, see the file **check_cond1.m.** This uses the SAM, SBE35, ctd upcasts and the 2 dbar downcast files (**ctd_jr310_XXX_2db.nc**). It also loads the oceanlogger underway data (**ocl_jr310_01.nc**) to compare the air temperatures with the casts.

Lowered Acoustic Doppler Current Profiler

Marina Azaneu

Instrument Configuration

On cruise JR310 a single RDI 300-kHz Workhorse Monitor LADCP was used. The instrument was fitted on the CTD frame with a downward-looking orientation. Before each cast, a pre-deployment test script was run to verify that the internal electronics were performing correctly. Both the test script and deployment scripts are included below. The instrument was configured to record 16 depth bins in a 10 m bin length, in a narrow bandwidth with 5 m blanking distance. The complete setup file of the instrument is presented below.

Pre-deployment test script

PS0	Print system configuration, so this is included in the transcript file
PA	Run standard pre-deployment tests
PT200	Run all built-in tests
PC2	Display orientation and other sensor data
RS	Display space used/free on memory card

Deployment script

PS0	Print system configuration, so this is included in the transcript file
CR1	Reset ADCP to factory defaults
RN JR310	Prefix for file names
CF11101	Record data to memory card – don't send to serial port
EA00000	Set heading alignment to 0
EB00000	Set heading bias to 0
ED00000	Set depth to 0
ES35	Set salinity to 35
EX00000	Use beam coordinates, no coordinate transformation
EZ0011101	Uses manual speed of sound, depth and salinity
TE00:00:01.00	Set ensemble interval to 1 second
TP00:01.00	Time between pings: 1 second
WM15	Set to LADCP mode
LD111100000	Record velocity, correlation, echo intensity, and percent good
LF0500	Set blanking distance to 5 m
LN016	16 depth bins
LP00001	1 ping per ensemble
LS1000	Set bins length to 10 m
LV250	Maximum radial speed of 2.5 m/s
LW1	Set ADCP to narrow bandwidth
SM1	Set as master LADCP
SI0	
SA001	Send synchronizing pulse before each water ping
SW05000	Wait 500 ms after sending pulse
CK	Save as user defaults
CS	Start pinging

Data Processing

The binary files recorded by the instrument, together with the log files, were downloaded to the local computer and copied to the server JRLB after each cast. The data were processed using a package fully written in Matlab code, originally developed at Lamont-Doherty Earth Observatory (LDEO) by Martin Visbeck and updated by Andreas Thurnherr (version LDEO IX_10). This package calculates velocity based both on the velocity inversion and shear methods.

Modifications to the set_cast_params.m script were made by Marina Azaneu and Povl Abrahamsen to load CTD, GPS, and SADCP data from the JCR. This created files containing CTD time series and CTD profile data from the mstar-processed CTD data with resolution of 1 Hz ('ctd_jr310_XXX_1hz_psal.nc') and averaged into 2 dbar ('ctd_jr310_XXX_2db.nc'), respectively. GPS time series were also generated during the processing (based on the 1-Hz CTD data), in addition to SADCP time series. These auxiliary data are not required for the LADCP processing, but are essential for acquiring better quality results.

Two main modifications were applied to the original scripts. Firstly, it was noticed that if the same station were processed twice, there was a conflict when the software overwrites the created auxiliary data (CTD time series '/Converted_input/JR310_XXX_ctd.txt'; CTD profile data '/Converted_input/JR310_XXX_ctdprof.txt'; navigation data '/Converted_input/JR310_XXX_nav.txt'; and SADP time series '/Converted_input/JR310_XXX_sadcp.mat'), leading to unreasonable results. Thus, the script was modified to verify the existence of these files and delete them before creating the new files. The second modification regards the SADCP data, which were considered too noisy in some stations. After testing different thresholds, it was defined that only SADCP data with percent good higher than 25% would be used for the LADCP processing. Both modifications are included on the set_cast_params.m file.

Results

The LADCP was used in all CTD stations, except for cast 51 (See Appendix A) due to the high depth reached in this station. There was no evident issue during the processing of most of the stations, with the data looking reasonably good. On stations 14 and 58 the ADCP did not detect the bottom correctly; this problem was overcome by forcing the software to use its own bottom track/ranges rather than using RDI's through setting parameter p.btrk_mode to 2. On station 14 the bottom detection still did not work as intended, and the bottom depth needed to be set manually (in Matlab, by inserting a break point into getbtrack.m). All other casts ran as intended, without any need for manual intervention.

As an example of the obtained results, Figure 13 and Figure 14 present the depth-averaged velocities of WSDW (neutral density 28.27 $kgm^{-3} \geq \gamma_n \leq 28.4\ kgm^{-3}$) and WSBW ($\gamma_n \geq 28.4\ kgm^{-3}$) layer for casts in the Orkney Passage area and along the A23 WOCE repeat transect, respectively. Figure 15 shows the velocity components for casts along A23 section.

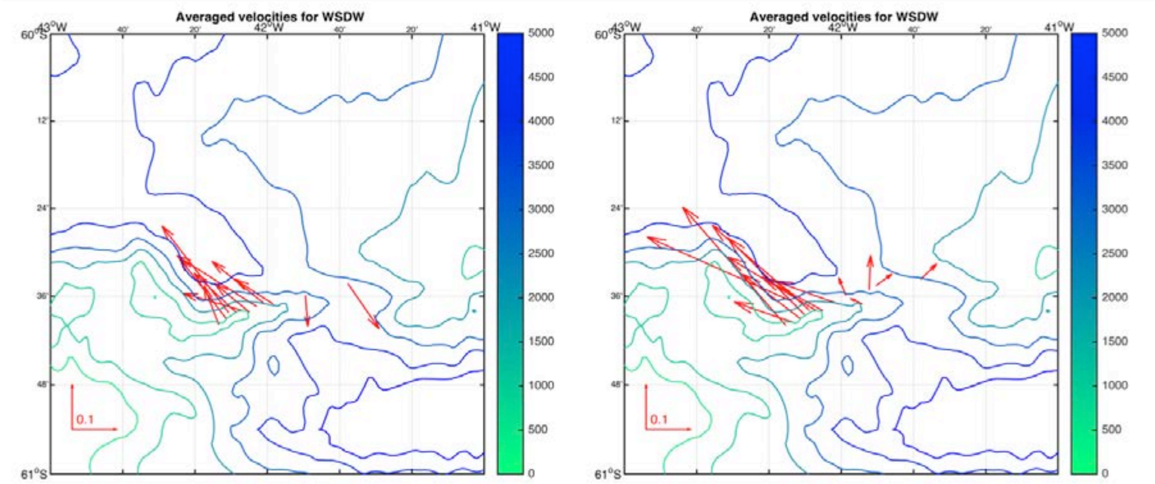


Figure 13: Averaged velocities (m.s-1) for WSDW layer along section Orkney Passage 1 (left) and Orkney Passage 2 (right). The projection used is Mercator.

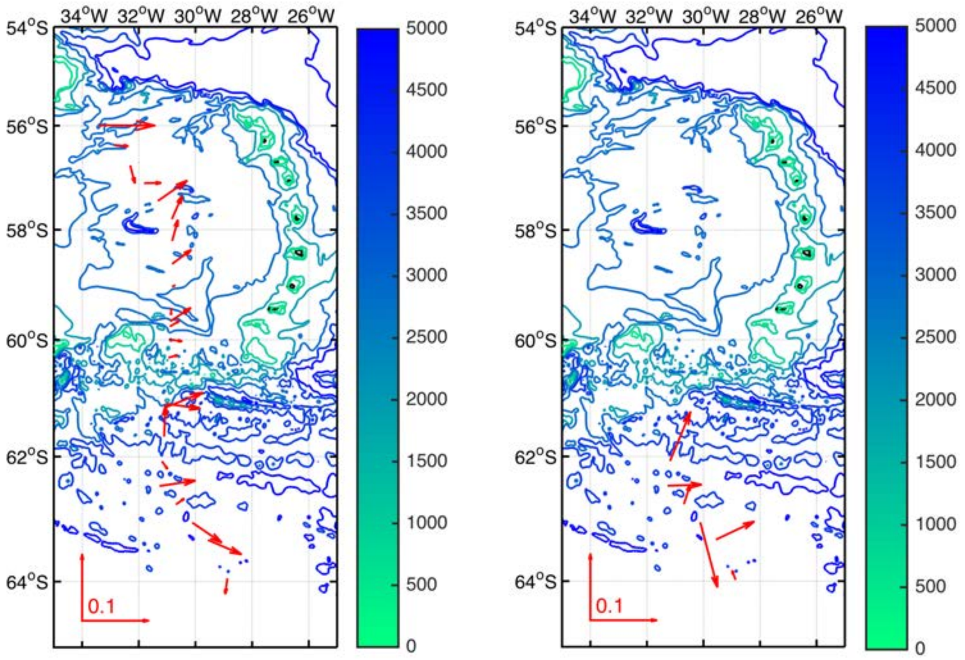


Figure 14: Averaged velocities (m.s-1) for WSDW (left) and WSBW (right) layer along A23 section. The projection used is Mercator.

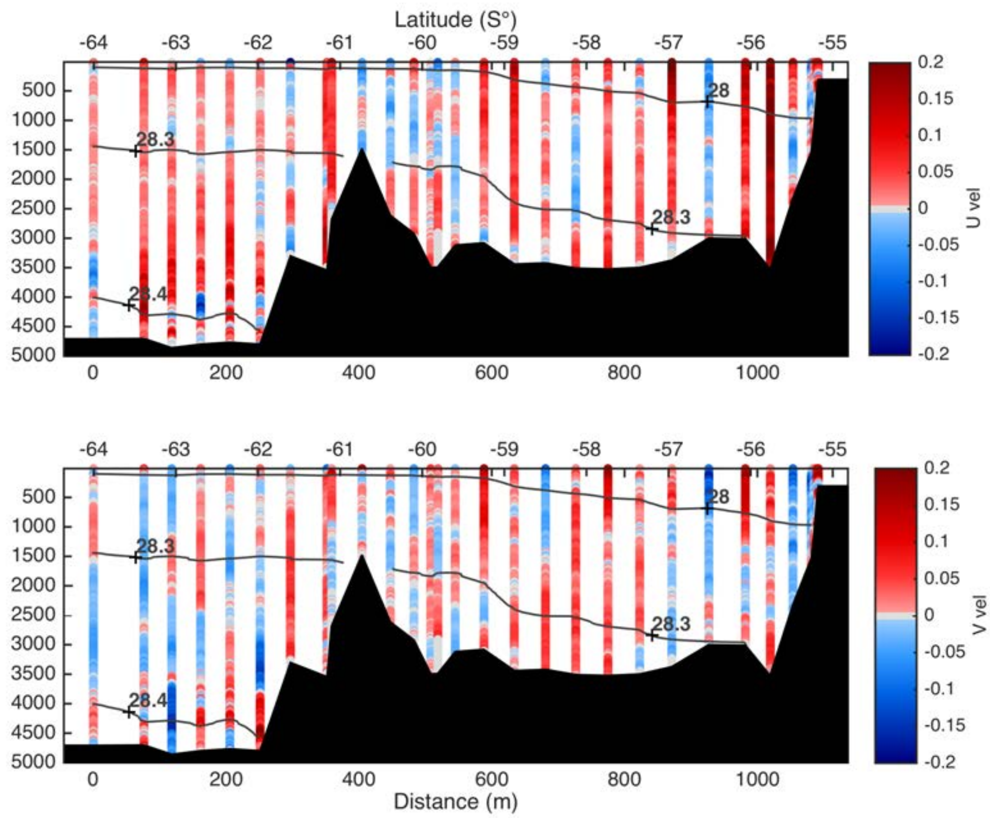


Figure 15: Zonal (upper panel) and meridional (bottom panel) velocities along the repeat section A23.

Underway instrumentation

Ryan Patmore

Data collection

There were 21 streams of underway data collected these streams were given the following names:

anemometer	emlog-vhw	furuno-rmc	oceanlogger	seatex-psxn
ashtech	emlog-vlw	furuno-zda	seaspy	seatex-vtg
dopplerlog	furuno-gga	glonass	seatex-gga	seatex-zda
ea600	furuno-gll	gyro	seatex-gll	tsshrp
em122	furuno-rmc	netmonitor	seatex-hdt	winch

Of these only the data streams of interest were used in the final mstar processing. The chosen streams were as follows:

anemometer

ashtech

ea600

Instrument: Kongsberg EA600 single beam 12kHz 16-degree echosounder

This is a record of bathymetry depth below the ship. For a lot of the duration the EA600 was set on passive mode, which means that it was set up to listen to the return ping of the central beam of the EM122 swath. Pinging was turned off on the EM122 during mooring deployment and recovery meaning that this passive method could not be used at these times.

Throughout the cruise the EA600 was set to use a speed of sound of 1500 m/s. Bottom detection ranges and display settings were also altered, occasionally causing data dropouts when incorrect settings were used. At the deepest depths, the "transmit power" needed to be increased (although the instrument was in passive mode and was not transmitting!); otherwise the instrument did not expect to receive returns beyond a pre-defined depth range.

When running in passive mode, the EA600 and EM122 were both triggered by K-SYNC sonar synchronisation system; when running in active mode, the EA600 pinged as frequently as possible.

em122

gyro

oceanlogger

seatex_gll

winch

Processing (mstar)

The underway processing took place using the mstar package consisting of both unix and Matlab scripts. The mstar scripts did not initially run as desired and various alterations were required, any significantly modified Matlab scripts were flagged via an addition of jr310 to the file name.

mstar modifications

Various useful scripts were added to the directory mexec_processing_scripts_v2 during this cruise, of which are:

Matlab – added scripts

m_time_check_01	Makes a plot of time verses data points stored for any nc file produced by mstar. This was mostly used as a preliminary check for corruptions in the data, this was usually in the form of a time reversal caused by an error in the .mat file or the data produced by the m_jr310_daily script for a specific day.
m_time_check_all	Runs m_time_check_01 for all data streams.
m_rerun_1day	Reruns processing for a chosen data stream and particular day, for this script to run correctly the relevant .mat file in scs_mat will first need removed. This script was mainly produced to get rid of data corruptions such as time reversals arising predominantly from running update_allmat prior to the termination of sedexec_startall. It first runs through the section of update_allmat associated with the chosen data stream to recreate the .mat file that was removed. It will then run through relevant parts of the m_jr310_daily for the chosen day. Then unless it is the pos stream is required to be reprocessed then this script call mmerge_nav remerging pos to the correct day and stream. If it is the pos stream that needs to be rerun mmerge_nav_all will be called as pos is merged into all data streams at this step. All script calls: • *ms_update_aco_to_mat* – updates the .mat file for a particular data stream • *mday_00* – creates _edit.nc files from the .mat files • *mmerge_nav_all_jr310* – merges the pos stream with all data streams

- *mday_00_clean*
- *msim_01_jr310*
- *mem120_01_jr310*
- *msim_02_jr310*
- *mem120_02_jr310*
- *mgyr_01*
- *mmerg_nav*

UNIX - alterations

The *sedexec* scripts that deal with the raw data conversion seemed to have both incompatibility with Macintosh systems and noise produced in the Anemometer data stream so revisions were made to both *sedexec* and *sedscript* to resolve this. The *sedexec* script contains various sed commands, one of which deals with the replacement of certain characters and patterns within the data files. *sedscript* is called by *sedexec* and it contains the defined characters that are required.
A key part of the unix script is the removal of carriage returns within the data, this was originally done through the sed command. It turned out that this particular use of the sed command did not seem to be recognised by Macintosh computers. This was remedied by removing the carriage return replacement in *sedexec* and placing a tr command in *sedexec,* the tr in this case does a straight forward removal rather than a replacement.
The other problem was that when the Anemometer was initialised it produced data which was nonsensical and unreadable. This was fixed by including all characters appearing in this initial section in the existing tr command to remove them.
Once these two items we resolved mstar was reading in NaN properly, which is what missing data is converted into with *sedexec*. To fix this an additional line was added to *sedscript* to replace occurrences of NaN with -99999.

UNIX - alterations

sedexec_startall	Converts files in *scs_raw* to an mstar compatible format, outputting to *scs_sed*. It first looks up variable names in *list_jcr* that correspond to the underway data streams in use and then parses these variables to *sedexec* which does the data conversion on these relevant streams. Lastly it calls a script called *sedexec_ended*, which returns a string to command line when the all processes are complete.

Matlab - alterations

m_setup_jr310	This function was set up to be called automatically when opening matlab, it was used to define useful variables and paths for running mstar scripts.
update_allmat	Reads files located in the scs_sed directory and parses the data to .mat files in scs_mat.
m_jr310_daily	Takes input in the form of Julian days then runs various processing scripts for that day. Scripts called are: • *mday_00_get_all_jr310*

- *mday_clean_all_jr310*
- *msim_01_jr310*
- *mem120_01_jr310*
- *msim_02_jr310*
- *mem120_02_jr310*

mmerg_nav_all_jr310	Merges the the position data from pos with all data streams. Calls *mmerg_01*
mapend_all	The output of the *mmerg_nav_all_jr310* script is kept in separate Julian day chunks, this scripts appends all the *_merged.nc* files for day into one continuous stream outputting as *{data stream}_jr310_01.nc*
mbest_all	Calls: • *mbest_01*- reads from *pos_jr310_01.nc* (the nav stream) and deflates the time resolution from the original ~1 second sampling rate down to a 30 second resolution through averaging outputting to *pos_jr310_ave.nc* • *mbest_02*- calculates speed, course and distrun from *pos_jr310_ave.nc* and outputting to *pos_jr310_spd.nc* • *mbest_03*- similar to *mbest_01,* reads from *gyr_jr310_01.nc* and a calculates 30 second time averaged version of the data outputting to *gyr_jr310_ave.nc* • *mbest_04* – takes *pos_jr310_spd.nc* and merges the vector-averaged heading onto the averaged speed and course outputting to *bst_jr310_01.nc*
mtruew_01	Merges navigational data from *bst_jr310_01.nc* derived from *pos* data and merges it with the true wind field from met_jr310_01.nc. Producing two output files, *met_jr310_true* and *met_jr310_trueav.*

Salinometer

Ryan Patmore

Two streams of salinity samples were taken for calibration purposes, one for instruments used for CTD casts and another for the underway data.

Standard seawater

IAPSO Standard seawater was used in the preparation of the salinometer; it has a precisely know electrical conductivity ratio so that calibration can be made. The specifics details of the batch used are:

Provider	OSIL
Batch Number	P155
K_{15}	0.99981
Practical salinity	34.993
Expiry	19th September 2015

Salinometer

The salinometer used on JR310/JR272D was Guildline Autosal 8400B s/n 65763, with a peristaltic pump attached to the intake tube.

CTD calibration

For the CTD samples seawater was collected using the Niskin bottles a various depths during CTD operation. The depths at which samples were taken were decided by the CTD operator, the amount of samples and depth levels at which samples were taken varied largely throughout the cruise due to multiple factors. For the most part, once the CTD had been secured on deck one 200 ml of sample water would be taken from the Niskin bottles for each depth level. Bottles were racked in sets of 24 initially stored half filled with milli-Q water. For a sample to be taken from the Niskin bottles the milli-Q would be emptied out, the bottles would then be rinsed three times with sample seawater then finally filled with this sample water. The threads of the bottles would then be wiped dry, a plastic insert placed and caps replaced. The bottles would be filled to the neck with an air gap that was small enough to reduce the effects of evaporation of the salinity but large enough to mix out any stratification that forms when the bottles are left to stand. Once a crate of samples were filled it would be moved to the temperature control room where the salinometer was kept so that the bottle could acclimatise to the correct temperature for processing. This room was kept at 19˚C with a general variance of around ±1°C with most of the variation occurring when the room when people were present. The salt bottle samples were processed with the salinometer after being left for at least 24 hours at 19˚C. The salinometer is left on standby with instruments filled with milli-Q and the intake pipe left to stand also in a bottle of milli-Q.

Once acclimatised, the salinity samples were run with a standardised procedure. To prepare the salinometer and remove any signals from previous samples the cell would be flushed with a part used/old bottle of standardised seawater and then with a new bottle of standard seawater. Prior to running any standardised seawater the bottles would be gentle agitated to remove any stratification that might have formed during storage. The flush process would done in the standby setting, the pumps would be turned on then the machine would be flushed once the chamber had filled past the conductivity sensors then this would be repeated. A sample would then be run by first agitating for the same reasons as before, the intake pipe would then be cleaned with a Kim-wipe to remove any contaminants of the previous sample, the lid of the sample removed and the bottle threads would be wiped to remove any salt that might negatively alter the salinity reading. The samples plastic cap would then be removed and the intake pipe would be inserted into the bottle avoiding any contact with skin that might induce contaminants. The machine would then be flushed thrice with the sample water before a reading would be taken, and flushed once between each reading. Before each reading was taken it was important to check that no bubbles had formed on the conductivity sensors, as bubbles can largely skew the results. To gain a reliable reading three measurements would be taken from each bottle and if required (the first three readings have a larger variance than ±0.00002) a further reading would be taken. This procedure would then be repeated for the next sample starting from where the sample is agitated until a full case was run. It would usually happen that cases of samples were processed in each session, for consistency the salinometer would be flushed with standard seawater between each case.

As a side note on readings, there were a couple of items that might affect reliability. When left on the read setting the numbers displayed would continually drift usually rising with time and thus the machine would be left no longer than ten seconds before taking a reading to ensure accuracy. Also, as salinity bottles are left to stand without a cap evaporation is allowed to take place and hence the salinity of the sample is allowed to increase slightly, these effects were minimised by only removing caps when required.

Underway calibration

Similar to the CTD calibration, salinity samples were taken in order to calibrate the conductivity measurements attained. The samples were collected via water that was pumped from under the ship directly into a sink in the preparation lab. To avoid excessive strain on the pumps the inflow was turned off whilst the ship was in ice, for quite a large proportion of the cruise the pumps were turned off due to ice which restricted the amount of samples that could be taken. This on top of the fact that this sampling was not started until part way through the cruise meant that the sample size for this was relatively small when compared with CTD salinity samples.

When sampling was possible, the aim was to take one sample every four hours. For each sample, the sequential bottle would be chosen, emptied of its milli-Q water, rinsed three times with the pumped seawater then final filled, again, leaving a small air gap. The bottle neck and thread would be wiped with blue roll, a plastic stopper inserted, the screw cap replaced, and the time of sampling would then be noted on a log sheet.

Problems with the salinometer

At first the salinometer was not working correctly and required inspection by the AME before it was giving reliable readings. It was thought that the issue was arising from biological growths appearing in the salinometer. To resolve this a chemical recommended for use by Seabird documentation called Triton-X (octyl phenol ethoxylate) was flushed through the system. The Triton-x was used as a dilute solution and a couple of drops of the chemical were added to a bottle of milli-Q water to make up the solution to be used. Upon the first two flushes the problem with the readings was still present and it was not until a third flush had taken place that the measurements given were decided to be adequately trustworthy.

A further minor issue is that bubbles would occasionally form in the chamber and sit against the entrance. This formation would not usually effect the measurements, however, it was at risk of floating up to one of the sensors which would have an effect. It was possible to get rid of the bubbles by flushing system with the peristaltic pump turned on and the internal one off.

Ship-mounted Acoustic Doppler Current Profiler (SADCP)

Marina Azaneu

Introduction

In the R.R.S. James Clark Ross, ocean currents are measured by a 75 KHz RD Instruments Ocean Surveyor Ship-mounted Acoustic Doppler Current Profiler (SADCP). VmDas software (version 1.42) was used for data acquisition, archiving and display. The final processing of data was performed using a set of Matlab routines during the cruise (see section 1.4). The JR165 report was used as a guide for processing.

Settings

The instrument was set up to run in narrowband mode for the entire JR310 cruise. It was configured to acquire data in beam coordinate system, profiling 50 bins with a 16 m bin length, 1 profiling ping per ensemble. Blanking distance at the surface was set to 8 m; the ADCP was set to ping as fast as possible (in VmDas). It was run independently from the SSU all the time, with bottom tracking off and maximum bottom search depth of 800 m for most of the stations. The misalignment angle and scaling factor were calculated during post-processing. See below the command file mostly used for the cruise.

JR310 SADCP Command file

CR1	Reset ADCP to factory defaults
CB611	Set the data collection baud rate to 38400, no parity, 1 stop bit, 8 data bits
NP1	Switch on Narrowband
NN50	Use 50 Narrowband bins
NS1600	Narrowband bin length: 16 m
NF0800	Narrowband blanking length: 8 m
WP000	Switch off Broadband (note: the following commands starting with “W” are ignored since Broadband is off)
WN100	Use 100 Broadband bins (not used)
WS800	Broadband bin length: 8 m (not used)
WF0800	Broadband blanking length: 8 m (not used)
WV390	Broadband ambiguity velocity: 390 cm/s (not used)
BP00	Disable single-ping bottom track
BX8000	Set maximum bottom search depth to 800 m (not used since bottom track is off)
WD111100000	output velocity, correlation, echo intensity, percent good
TP000050	Half a second between bottom and water pings
TE00000100	One second between ensembles (overridden by VmDas)
EZ1020001	Calculate speed of sound, no depth sensor, external synchro heading sensor, no pitch or roll being used, no salinity sensor, use internal transducer temperature sensor
EX00000	Output beam coordinate data (rotations are done in software)
EA6008	Set transducer misalignment (60.08°)
ED00063	Set transducer depth (6.3 m on JCR)
ES0	Set Salinity (ppt) [salinity in transducer well = 0]
CX0,0	Disable external trigger (from K-Sync or SSU)
CK	Save this setup to non-volatile memory in the ADCP

Sequence files and output data format

Filenames from VmDas are in the format JR310xxx_000nnn.aaa, where xxx is the file sequence number, nnn is the file number within that sequence and aaa is the file type. The file sequence number is set in the software and incremented on each restart of recording, while the file number starts at 0 and is automatically increased by VmDas each time the file size becomes larger than the max size (in this case, 10 MB).
During data acquisition, 9 different files types are created for each sequence. (.LOG, .ENR, .ENS, .ENX, .LTA, .NMS, .STA, N1R and .VMO), being .ENR the binary raw data file and .N1R the raw navigation data obtained from the ship's Seatex GPS system. The table below summarizes the main information of each file sequence, outlining the file name, start and end time of the file sequence (first and last $PADCP lines from .N1R files), the configuration used and relevant comments.

Post-processing using Matlab

The original Matlab scripts for processing the SADCP data were obtained originally from IFM Kiel, adapted and modified by several people through the years. Thus, it is important to check if the modifications are adequate for your cruise.

For processing the data it is necessary to define some information on the script:

1) Paths to the raw files ('RAWPATH') and to the folder where the files must be stored ('PATH');
2) Framework of the data files ('filename') and cruise name ('cruise');
3) Number of sequences to be processed ('files') - important to notice that only the stations included in this file will be considered in the final average file;
4) Averaging interval ('superaverage') – interval over which the ping ensembles will be averaged, in seconds;
5) Year;
6) Upper ('ref_uplim') and lower ('ref_lowlim') limit of the reference layer. In the JR310 cruise these limits were defined as 400 m and 600 m.
7) Misalignment angle ('misalignment_nband' for narrowband and 'misalignment_bband' for broadband) and scaling factor ('amplitude_nb' for narrowband and 'amplitude_bb' for broadband)

In the JR310 cruise, the equipment operated in narrowband continuously and then only the 'misalignment_nband' and 'amplitude_nb' parameters were modified. In the first run, the values were set to 0 and 1, respectively, and the processing was applied only to the segments without bottom tracking (1:2,4:8,12:13,15:22,24) until segment 24. We then obtained the median angle (-0.0399) and scaling factor (1.0191) values from plot 'adcp_calib_calc.ps' and ran the processing a second time using these parameters for all the segments, including the ones with bottom tracking. This method was applied because the processing tends to consider only segments with bottom tracking for determining the angle and scaling factors. Considering that most of the segments didn't have bottom tracking on, we decided to increase the number of used sections to increase accuracy of estimates.

Detailed information on processing steps and individual scripts can be found on report "jr165_adcp_report". Modifications to the original script were included to optimize the processing in cases were some of the defined segments are already processed (lines

358-372). In this case, the stations already processed with the same angle and scaling factor defined in the script will only be loaded to the workspace, not reprocessed. In lines 389-393, these parameters are included in the 'OS75_sgl_ping' file. Also, in lines 505-509 commands were included to save the averaged data files ('JR3100ss_0000cc_ave_ping.mat' and 'JR3100ss_0000cc_abs.mat') after each processed segment instead of saving only one file including all the stations. 'ss' refers to the segment number and 'cc' to the last sequence of the segment.

Besides the segment's individual files, the script originally saves the file JR310000_000000_zzz_abs.mat' (where zzz is the highest file number included in the processing), which contains the absolute horizontal velocity (after correction for ship velocity), navigation information, and information regarding reference layer and bin depths for all the stations included in processing. This file is the main data used for plotting results, and is also used in the LADCP processing. Figure 16 presents zonal and meridional velocity profiles during the whole data acquisition period. Figure 17 shows the depth-averaged velocities along the ship track.

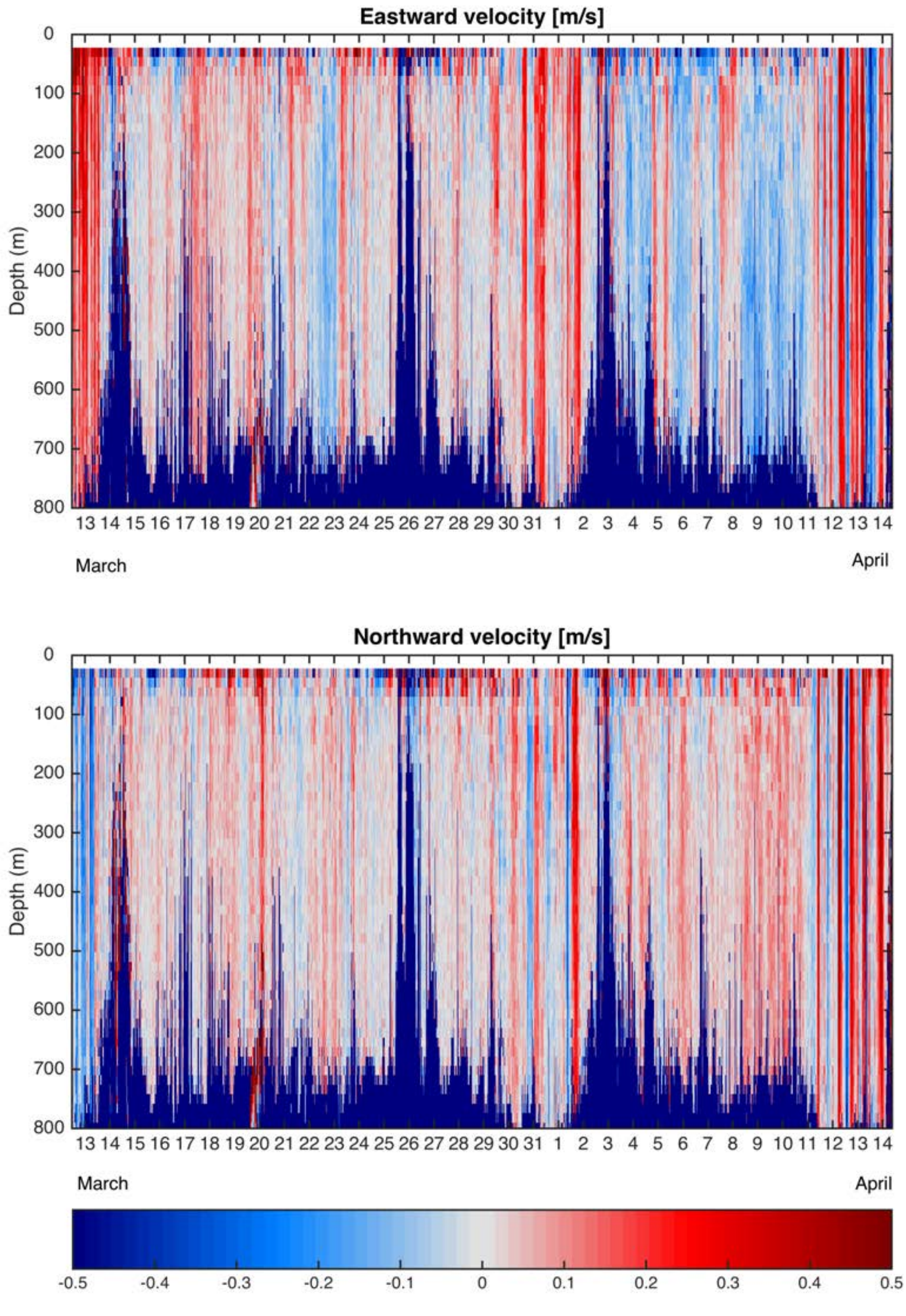


Figure 16: Zonal and meridional velocity profiles during the whole SADCP data acquisition period.

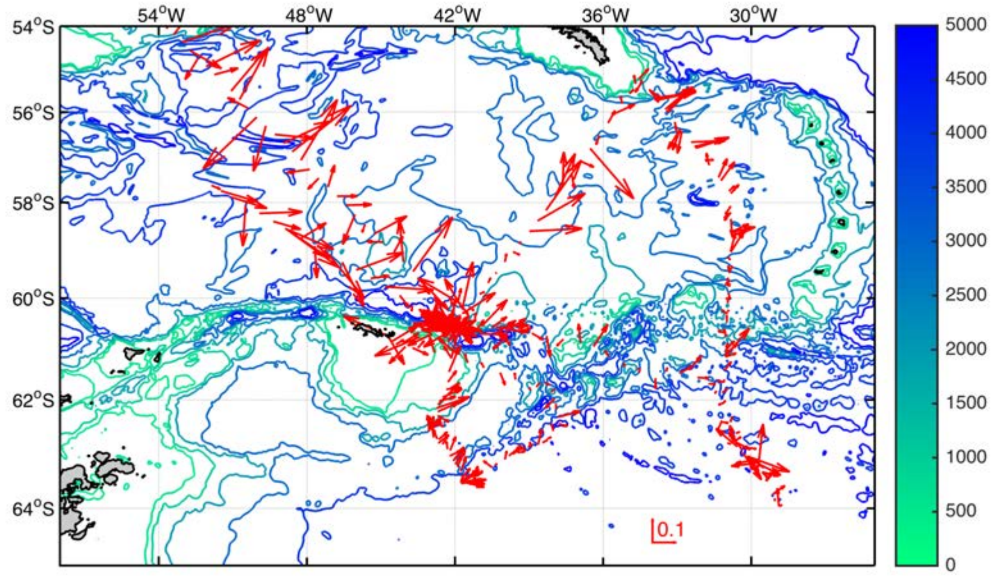


Figure 17: Depth-averaged SADCP observations along the ship track (one every 50 is shown). Only data with more than 25 percent good and varying from the average values the maximum of 2*standard deviation value.

Swath bathymetry

Povl Abrahamsen

The multi-beam sonar on the JCR, a Kongsberg Simrad EM122, was running during most of the cruise, from after leaving the Chilean and Argentine exclusive economic zones, until shortly before we arrived in Stanley. The data have been split into five surveys, one for the transit to Orkney Passage, to Laurie Island and south to M3 (JR310), from M3 to Orkney Passage (jr310_b), from Orkney Passage to the south end of A23 (jr310_d), from the north end of A23 to Orkney Passage plus minor excursions from Orkney Passage to the north because of weather and to the east to Orkney Deep and back (jr310_f), and finally for the transit from Orkney passage to Stanley (jr310_g). The division into surveys is shown in Figure 18. Survey jr310_c contains the start of the transit from Orkney Passage to A23, but was discontinued as incorrect gridding settings were specified, and data were not being displayed on the EM122 workstation and helm displays. Survey jr310_e does not contain any data; after setting up the new survey, I had to restart the EM122 workstation, and when I subsequently tried to log data to the survey, the computer refused to log to that survey, so jr310_f was set up instead.

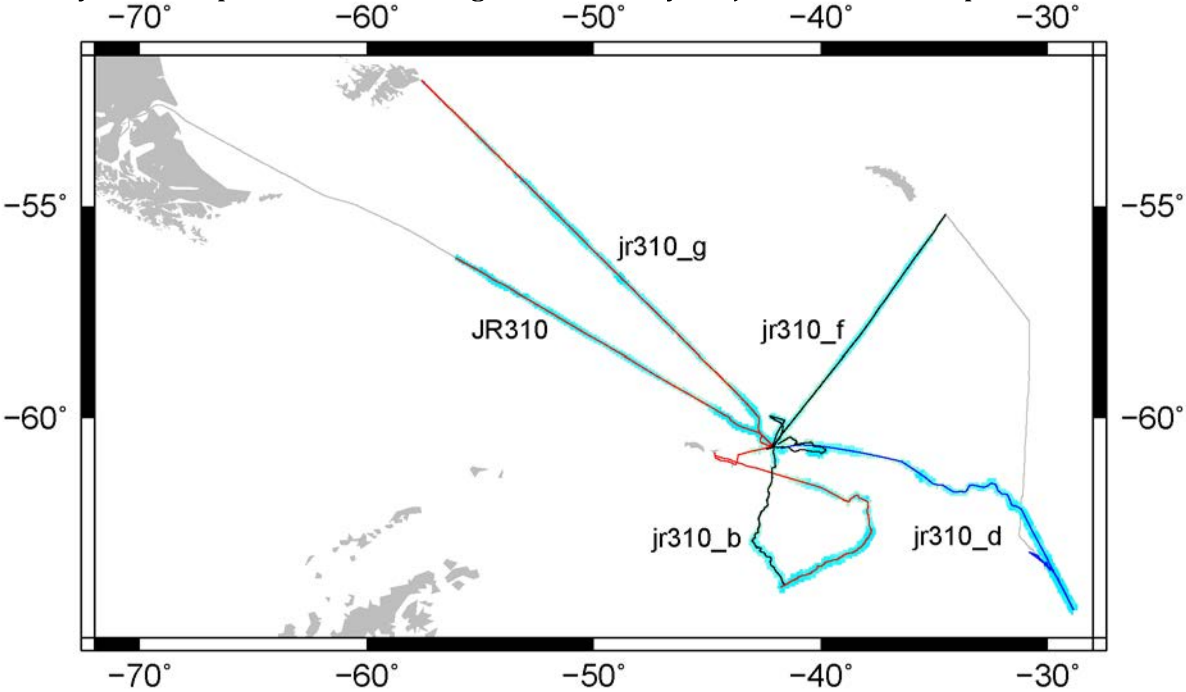


Figure 18: Overview of the swath bathymetry data from JR310/272D, with track colours alternating between red, black, and blue. Sections where data were not recorded are shown in gray.

Instruments and methods

Data acquisition was performed on a Windows 7 workstation, em122, running Simrad's SIS software. The default settings, as described in the notes "Using the EM122 multibeam on an opportunistic basis", by Gwen Buys and Alex Tate, version 3.0 dated 28/4/2013, were used – with varying maximum beam angles, depending on the weather and ice conditions. For most of the cruise a beam angle of 60 degrees was used. CTD casts were imported regularly as sound velocity profiles, to represent local conditions. The details of the profiles used at different points in the cruise are in the table in Appendix C.

Data from this cruise have not been cleaned and processed on board. Generally the data appear to be clean and of good quality, though some cleaning will be required, especially when the ship was in sea ice. During the two episodes of rough weather encountered on 26/3 and 3/4 most, if not all, data were missing because of poor returns from the seabed, possibly exacerbated by bubbles beneath the transducers.

Centre beam depths

The EM122 centre beam is used for the ship-track bathymetry. The output is found on the legdata folder under scs/Compress in .ACO format, and has been included in the underway data processing described in a previous chapter.

Moorings

Povl Abrahamsen

A total of seven moorings were recovered on JR310, one of which needed to be dragged. Eight moorings were deployed. The triangulated locations of the moorings are given in the table below, along with the times the anchors/tops were dropped or the moorings were released. When possible, new (or updated) triangulations have been used in the table below.

Mooring	Deployment (drop time)	Recovery (release time)	Latitude	Longitude	Depth (m)
M3 (1115)	23/03/11 21:47	17/03/15 12:02	63° 31.303' S	041° 45.989' W	4524
M2 (15XX)	18/03/15 20:35		62° 33.320' S	042° 57.353' W	3024
OP1 (1315)	02/04/13 17:06	20/03/15 16:29	60° 37.432' S	042° 05.879' W	3625
OP2 (1315)	01/04/13 21:30	20/03/15 12:09	60° 38.186' S	042° 10.775' W	3023
OP3 (1315)	01/04/13 10:30	22/03/15 15:32?	60° 39.315' S	042° 13.775' W	1752
OP4 (1315)	03/04/13 20:25	21/03/15 16:05	60° 35.391' S	041° 49.747' W	2949
OP5 (1315)	29/03/13 21:00	21/03/15 13:33	60° 36.559' S	041° 58.693' W	3403
OP6 (1315)	30/03/13 18:37	21/03/15 11:00	60° 33.767' S	041° 38.036' W	2340
OP1 (15XX)	05/04/15 20:05		60° 37.522' S	042° 05.761' W	3644
OP2 (15XX)	04/04/15 15:54		60° 38.173' S	042° 10.714' W	3036
OP3 (15XX)	03/04/15 20:25		60° 39.322' S	042° 13.801' W	1738
OP4 (15XX)	07/04/15 15:59		60° 35.434' S	041° 49.752' W	2972
OP5 (15XX)	06/04/15 18:36		60° 36.424' S	041° 58.531' W	3423
OP6 (15XX)	06/04/15 13:08		60° 33.727' S	041° 38.033' W	2338
OP7 (15XX)	09/04/15 13:38		60° 39.289' S	042° 09.248' W	3060

A brief description of the mooring operations is given below, with details for each mooring as required. Mooring recoveries and deployments were generally done using the storage drum of the BAS mooring winch, except M3, which was recovered on the forecastle. When possible, deployments were done anchor last; however, because of heavy sea ice, moorings OP4 and OP7 were deployed anchor first.

M3 was covered in 7-8/10 sea ice, with some heavy floes interspersed between thin ice. After assessing the drift of the ice, a decision was made to release the mooring, with the expectation that it would surface near the edge of a large lead. Unfortunately this did not happen, and when the mooring had risen (ranges to the release were constant) no mooring components were visible on the surface. The ship then proceeded to steam slowly on a steady course through the ice, ranging to the acoustic release regularly. When the range was at a minimum, the ship turned to a perpendicular course, eventually homing in on the location of the mooring to within 200 m. However, there were still no obvious surface buoys visible – but eventually one buoy was spotted between two heavy ice floes, just to starboard of the front deck. Grappling for the wire from that location failed, and eventually two persons were lowered to the buoys using the “Wor Geordie” personnel transfer basket from the forward crane, attaching a strop to the buoys and hoisting them back on board. The buoys turned out to be the middle of the mooring; the ends of the wire were then secured to the ship, a snatch block installed on the crane, and the wires brought onto the starboard mooring winch on the forecastle. The mooring was recovered onto the forecastle, with used wire being lowered onto the cargo hatch. Two 17-inch buoys and the surface buoy were lost, probably becoming caught under ice floes. However, the rest of the mooring, and all instruments, were successfully recovered, with four years of data. The deployment of M2 was much less eventful, taking place off the back deck, anchor first because of sea ice.

In Orkney Passage, OP2 was the first mooring to be recovered; apart from minor snags in the wire this recovery was uneventful. After OP2 we had intended to recover OP3, but no response was received from the acoustic release. The location of the mooring was verified using the EM122 multibeam sonar using the “water column” display; the floats on the mooring were clearly visible in the expected location. A blind release was attempted, but the mooring still remained on the seabed. The ship then relocated to OP1, which was successfully recovered. The following day OP6, OP5, and OP4 were recovered.

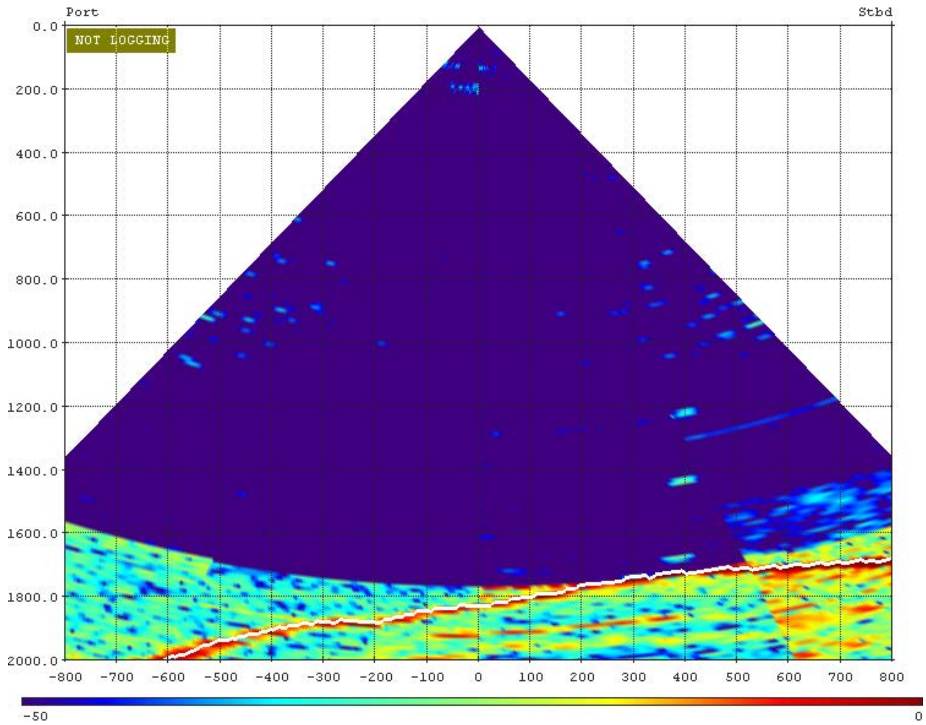


Figure 19: EM122 water column image from 22/03/2015 13:27:01, while streaming out wire for the dragging of OP3. The mooring is clearly visible 400 m to starboard.

On the next day we returned to OP3. Communications were still unsuccessful, so dragging was attempted. This was done using the ship’s coring warp, using a 350-kg locomotive wheel as an anchor at the end; above this a three-ton weak link and a swivel were installed. Four grapnels were then installed at 2-m intervals on the bottom of the wire. The anchor was lowered about 500 m SSE from the mooring location, reaching the seabed with 1800 m of wire out, and the ship then steamed slowly clockwise in a circle around the mooring at a range of 350-420 m, past the anchor point, and then straight to SSE, coming to a stop 725 m from the mooring with 5822 m of wire out. The wire was then slowly hauled back; occasionally the tension on the winch did increase and then drop suddenly; this was probably caused by the wire dragging across the rough seabed. At 15:32 floats were spotted on the surface; only two groups of floats and a top float were visible. After the dragging gear was recovered, the mooring components were recovered; it turned out that the wire was sheared about 10 cm beneath a Microcat beneath the middle group of floats. Thus three of five instruments on the mooring were recovered. The lowest 50 m of the mooring were still visible on the EM122 after the dragging, so future recovery of the remaining instruments might be possible.

On the A23 section all of the Microcats from the recovered moorings and the new instruments (both from NMEP and those purchased by the University of Southampton for DynOPO) were deployed in groups of five on CTD casts, by attaching them to spare OTE Niskin bottle frames, and inserting them in the rosette in place of Niskin bottles 19-24. The eleven CTD stations used for these calibration casts were 15-17, 20, 22, 26, 27, 29, 31, and 32.

Moorings were redeployed after A23; because of rough weather a short mooring, OP3 was deployed first; on this mooring several people observed that the 40-m wire segment at the bottom of the mooring looked much shorter than expected. We did not measure the wire, but suggest that it is measured on recovery.

OP2 was the next mooring to be deployed. We initially expected to use the winch's payout counter to locate the instruments on the wire. However, when the wire was installed on the winch, the wire lengths were off by around 15%. Offsets from the marked distances were computed to compensate for these inaccuracies. On the remaining moorings, the manufacturer's labels, which had been installed at 50-m intervals, were used together with the winch's readout, to compute offsets. This proved to work well, with tape markers being installed as the wire exited the winch. During the deployment of OP2, there was confusion about the location of one marker. To check the depth, the wire was hauled back in, and unfortunately an RBRsoloT that was attached to the wire (72248), was pulled onto the starboard bulwark, bending the shield around the temperature sensor and the sensor itself. This instrument was removed from the mooring and replaced with another. The bent instrument was tested in the lab, and as it still appeared to work, it was subsequently mounted between the two releases on OP1 as a test.

Moorings OP1 and OP6 were deployed next, without any particular incidents. We had initially expected to deploy OP4 next, but it was covered with ice, so instead we deployed OP5.

The following day we deployed OP4 anchor first because of the surrounding sea ice. Half way through the deployment, after the middle buoys had been deployed, we noticed that the mooring wire was relatively slack. Because of concerns that the mooring was not buoyant enough the buoys were recovered, with two buoys removed from the middle. It subsequently turned out that the buoyancy calculations for this mooring had been incorrect: an incorrect wire diameter was used. Either we should have used two wheels, or we needed to remove buoyancy. After the two middle buoys were removed the rest of the mooring was deployed; it sank at 1 m/s, slightly slower than the other moorings. However, the anchor weight should still be sufficient for the deployment.

The location for the final mooring, OP7, was still surrounded by sea ice. While there were leads nearby that might have been just large enough for a buoy-first deployment, the captain was reluctant to do this, fearing that the ice might snag on the floats or instruments during deployment. With the relatively low breaking load of the wire (1.8

tons), we were initially reluctant to do an anchor-first deployment. However, we measured the tension above the lower buoys using the aft crane and a load cell, which was 900 kg in air and about 650 kg once the buoys were in the water. With a safety factor of over 2.5, it was deemed safe to deploy the mooring anchor first, as long as the anchor and lower buoyancy were deployed using the Gilson winch, only transferring load onto the mooring wire once the buoyancy was in the water. However, during the deployment the wires snagged and the tension was taken off the Gilson winch prematurely. This caused the chain beneath the releases to wind themselves over the top of the tandem kit. The only way to untangle the releases was to carefully bring them back inboard using the mooring winch, with all personnel well clear of the wire. Once the anchor had been lowered onto the deck, the chain was easily freed from the releases, and the anchors lowered back over the transom using the mooring wire, again with all personnel clear of the wire. The rest of the deployment was relatively straight forward; the ADCP buoy was lifted with the Gilson winch. One Microcat (12463) had damaged threads in the hole for the left clamp bolt; this meant that the clamp could not be fully tightened. Instead, electrical tape was applied to the wire, along with extra tape to secure the clamp on the instrument; this should be sufficient to hold the instrument in position. The last mooring deployment was completed on 9 April, more than one day before we needed to leave Orkney Passage.

Instrumentation

The Orkney Passage and M2/M3 moorings all use 3/16" (5 mm) 3x19 plastic-jacketed galvanized wire, supplied by Mooring Systems Inc. (MSI), with an outer diameter of 6.5 mm, and swaged sockets to fit 1/2" shackles. Most of the instrumentation used on the OP and M moorings is clamped onto the mooring wire, with only the ADCPs and RCM11 current meters installed in line. The table below gives an overview of the instrument types used, and the tools required to remove them from the mooring wire – or in the case of the ADCPs and RCM11s, the tools required to remove them from their in-line frames/buoys.

Model	Parameters	Tools required	Connector	Serial nos.
SBE-39	T & P	3/8" socket	internal	4897 (OP3) & all M2/M3
SBE-39	T only	3/16" Allen key	4-pin / internal	Remaining instruments
RBRsoloT10k	T only	5 mm Allen key	Mini-USB	All
SBE-37SM	T & C only	3/8" socket	4-pin	8267 (OP6)
SBE-37SM	T, C, P	3/8" socket	3-pin	2707 & 2956
SBE-37SM	T, C, P	3/8" socket	4-pin	Remaining instruments
SBE-37SMP (old type)	T, C, P	3/8" socket	4-pin	S/N below 9000
SBE-37SMP (new type)	T, C, P	3/8" socket	4-pin	S/N above 9000
Aquadopp DW (6000 m)	U, V, W, T, P	17 mm socket & spanner	Round	Instruments on OP5 & OP6
Aquadopp DW (6000 m)	U, V, W, T, P	9/16" socket & spanner	Square	all M2/M3
Aquadopp DW (3000 m)	U, V, W, T, P	9/16" socket & spanner	Round	9378 (OP3)

Aquadopp DW (3000 m)	U, V, W, T, P	13 mm socket & spanner	Round	9392 (OP7)
Aquadopp DW (6000 m)	U, V, W, T, P	13 mm socket & spanner	Square	S/N below 3000
Aquadopp DW (6000 m) – short housing	U, V, W, T, P	13 mm socket & spanner	Round	8556 (OP7)
Aquadopp DW (6000 m)	U, V, W, T, P	13 mm socket & spanner	Round	Remaining instruments
Long Ranger ADCP	U, V, W (profile), T, P	28 & 9/16" socket & spanner	Square	
RCM11	U, V, T, C	Punch, 5 mm Allen key	DSU reader	

The RBRsoloT's were supplied with clamps that used one bolt to tighten the clamp onto the wire and instrument. We found that if the instruments were inserted into the clamp such that it tensioned onto the instrument's label, the instrument was clamped securely; otherwise it was slightly loose.

The ADCPs were installed in MSI SB47-3000 buoys with custom frames. These were quite simple to use; we found that the frames above the transducer heads could be installed by three people in the lab, using 9/16" and 27 mm tools. However, the nuts on the four rods going through the buoy required 28 mm sockets/spanners. ADCP 3301 had been shipped from NMEP without a tool kit, and without battery cables. The memory card had also been removed; rather than installing the 48 MB card supplied by NMEP, we used a BAS-owned 256 MB card. Replacement battery cables were made by AME, but since battery connectors were not available, the cables were soldered onto the batteries and onto the wiring loom. The connectors should be replaced on the wiring loom when the instrument is recovered. One power pin was also broken off the endcap connector on this ADCP, so it cannot currently be powered externally.

The intention was to start all instruments at midnight on 2/4/2015. However, because of some confusion, some Aquadopps were set up to start at noon on 1/4, some at midnight on 2/4, and some at noon on 2/4. ADCP 22182 was started at midnight on 5/4, because of previous problems communicating with it, caused by the endcap connector being fully inserted. ADCP 3301 was initially started on 2/4; however, as it was not beeping similarly to the other ADCPs, it was stopped on 9/4, checked, found to be working, and restarted at 01:00 on 9/4.

The RCM11 current meters all indicated that they were logging on recovery, with word counts varied from 125105 to 195081. All of the DSUs' word counts incremented. However, when the data were downloaded the only instrument that had a full record was no. 532. The other instruments (no. 521 and 592) had higher word counts, but had stopped logging data in January and July 2014, respectively. This is in line with the instruments' performance on previous deployments: the voltage threshold on the data storage units (DSUs) is close to the voltage when using lithium batteries, so no data are recorded even though the instruments continue to operate. The clock had failed on one DSU (14742), causing it to insert a time stamp between every two instrument records (of 7 words), accounting for its increased word count. To reconstruct the actual times of the data, all time stamps were removed, along with the two first data records; the times were then recomputed, and the time series of tilt was compared with that of Aquadopp 6112. These covaried quite strongly, and the comparison indicated where a total of 13 records were missing on 4 days. These have been replaced with NaNs, and the time stamps updated accordingly during post-processing; the missing records are indicated in the table in Appendix D.

Appendix A: Event log

The event numbers below are from the bridge event log. CTD times are from the processed data files (dcs_jr310_XXX_pos.nc). Mooring and other times are either from the bridge event log or from notes made on deck. Positions are from the Seapath GPS, with depths from the EM122 multibeam echo sounder. Mooring depths are corrected relative to the surface; CTD and other depths are below the transducer.

Note that there is no event 67, while there are two events 75 and 92; these have been differentiated by appending letters a and b.

Event no.	Event (WPT)	Time (UTC)	Position	Depth	Description/notes
1	Test CTD	12/03/2015 12:48	57° 44.954'S 051° 28.791'W	4166	CTD cast aborted, because of problems with wire termination. No data acquired.
2	CTD 1 (test cast)	12/03/2015 21:28:23 12/03/2015 21:32:00 12/03/2015 22:38:17 13/03/2015 00:05:12	58° 33.020'S 048° 52.396'W 58° 33.021'S 048° 52.398'W 58° 33.020'S 048° 52.400'W 58° 33.022'S 048° 52.402'W	3873 3872 3873 3874	Logging started Downcast started Bottom End of upcast
3	Mooring ranging	13/03/2015 20:46 13/03/2015 20:51	60° 37.655'S 042° 05.054'W 60° 37.689'S 042° 04.881'W		Ranges acquired from OP1 and OP2
4	CTD 2 (near M3)	17/03/2015 07:00:49 17/03/2015 07:04:41 17/03/2015 08:39:20 17/03/2015 10:09:25	63° 31.151'S 041° 46.703'W 63° 31.173'S 041° 46.693'W 63° 32.318'S 041° 46.106'W 63° 33.389'S 041° 44.905'W	4561 4561 4584 4596	Logging started Downcast started Bottom End of upcast
5	M3 recovery	17/03/2015 12:02 17/03/2015 14:15 17/03/2015 16:16 17/03/2015 17:48 17/03/2015 18:18	63° 30.777'S 041° 46.159'W 63° 31.125'S 041° 43.292'W 63° 29.921'S 041° 40.003'W 63° 28.910'S 041° 38.091'W 63° 28.606'S 041° 37.463'W		Release command sent Mooring sighted Wor Geordie deployed to grapple mooring Recovery complete, except for loose floats Last floats recovered

6	M2 deployment	18/03/2015 19:02 18/03/2015 20:35 18/03/2015 21:08	62° 34.253'S 042° 58.676'W 62° 33.390'S 042° 57.556'W 62° 33.320'S 042° 57.353'W	3038 3031 3024	Deployment started, anchor first Mooring top released (GPS position) On seabed (triangulated position & depth)
7	CTD 3 (near M2)	18/03/2015 22:15:21 18/03/2015 22:21:29 18/03/2015 23:11:55 19/03/2015 00:12:32	62° 33.412'S 042° 56.253'W 62° 33.412'S 042° 56.252'W 62° 33.413'S 042° 56.252'W 62° 33.511'S 042° 56.475'W	3036 3036 3037 3030	Logging started Downcast started Bottom End of upcast
8	ADCP test	19/03/2015 20:00 19/03/2015 20:18	61° 39.542'S 042° 17.143'W 61° 39.504'S 042° 17.137'W	763 764	Testing ADCP with bottom track
9	CTD 4 (near OP1; OPCTD10)	20/03/2015 04:59:56 20/03/2015 05:01:09 20/03/2015 06:02:16 20/03/2015 07:18:35	60° 38.083'S 042° 05.068'W 60° 38.083'S 042° 05.067'W 60° 38.089'S 042° 05.075'W 60° 38.086'S 042° 05.078'W	3676 3679 3676 3680	Logging started Downcast started Bottom End of upcast
10	CTD 5 (near OP3; OPCTD5)	20/03/2015 08:34:39 20/03/2015 08:37:43 20/03/2015 09:06:52 20/03/2015 09:40:54	60° 39.855'S 042° 13.420'W 60° 39.854'S 042° 13.418'W 60° 39.854'S 042° 13.416'W 60° 39.854'S 042° 13.420'W	1623 1623 1623 1622	Logging started Downcast started Bottom End of upcast
11	OP3 attempted recovery	20/03/2015 10:11 20/03/2015 10:50 20/03/2015 11:18	60° 39.278'S 042° 13.798'W 60° 39.479'S 042° 13.228'W 60° 39.480'S 042° 13.231'W	1745 1795 1789	Mooring visible on EM122; still no response from release Release command sent; no reply Recovery postponed
12	OP2 recovery	20/03/2015 12:09:42 20/03/2015 12:28 20/03/2015 13:34 20/03/2015 14:39	60° 38.473'S 042° 09.959'W 60° 38.473'S 042° 09.958'W 60° 37.637'S 042° 11.624'W 60° 36.939'S 042° 12.359'W		Release command sent & acknowledged Mooring sighted on surface First floats on board Recovery complete
13	OP1 recovery	20/03/2015 16:29:00 20/03/2015 16:51 20/03/2015 17:56 20/03/2015 19:15	60° 37.708'S 042° 05.026'W 60° 37.673'S 042° 04.999'W 60° 37.433'S 042° 06.052'W 60° 37.130'S 042° 08.305'W		Release command sent & acknowledged Mooring sighted on surface First floats on board Final elements on board, in a tangled mess

14	CTD 6 (near OP2; OPCTD7)	20/03/2015 20:13:25 20/03/2015 20:16:45 20/03/2015 21:07:25 20/03/2015 22:06:15	60° 38.188'S 042° 10.684'W 60° 38.188'S 042° 10.684'W 60° 38.188'S 042° 10.681'W 60° 38.187'S 042° 10.681'W	3010 3010 3007 3007	Logging started Downcast started Bottom End of upcast
15	CTD 7 (near OP5; OPCTD13)	20/03/2015 23:26:03 20/03/2015 23:26:03 21/03/2015 00:25:07 21/03/2015 01:29:59	60° 37.019'S 041° 58.401'W 60° 37.019'S 041° 58.401'W 60° 37.025'S 041° 58.405'W 60° 37.027'S 041° 58.405'W	3361 3361 3363 3361	Logging started Downcast started Bottom End of upcast
16	CTD 8 (near OP4; OPCTD16)	21/03/2015 03:14:07 21/03/2015 03:18:44 21/03/2015 04:08:04 21/03/2015 05:10:46	60° 35.872'S 041° 49.450'W 60° 35.870'S 041° 49.448'W 60° 35.875'S 041° 49.447'W 60° 35.873'S 041° 49.445'W	2957 2958 2958 2957	Logging started Downcast started Bottom End of upcast
17	CTD 9 (near OP6; OPCTD19)	21/03/2015 06:40:45 21/03/2015 06:40:45 21/03/2015 07:25:49 21/03/2015 08:15:38	60° 34.264'S 041° 37.691'W 60° 34.264'S 041° 37.691'W 60° 34.264'S 041° 37.686'W 60° 34.264'S 041° 37.684'W	2334 2334 2337 2339	Logging started Downcast started Bottom End of upcast
18	OP6 recovery	21/03/2015 11:00:27 21/03/2015 11:23 21/03/2015 11:46 21/03/2015 12:18	60° 33.793'S 041° 37.309'W 60° 33.794'S 041° 37.312'W 60° 33.652'S 041° 37.646'W 60° 33.781'S 041° 38.206'W	2278 2291 2316	Release command sent & acknowledged Mooring sighted on surface First floats on board Recovery complete
19	OP5 recovery	21/03/2015 13:33:13 21/03/2015 14:06:20 21/03/2015 14:26:43 21/03/2015 14:59:03	60° 36.443'S 041° 57.983'W 60° 36.466'S 041° 58.084'W 60° 36.434'S 041° 58.897'W 60° 36.538'S 041° 59.386'W	 3398 3406	Release command sent & acknowledged Mooring sighted on surface First floats on board Recovery complete
20	OP4 recovery	21/03/2015 16:05:32 21/03/2015 16:27:30 21/03/2015 17:05 21/03/2015 17:52	60° 35.162'S 041° 48.986'W 60° 35.131'S 041° 49.154'W 60° 35.454'S 041° 49.486'W 60° 36.103'S 041° 50.319'W	 2893 2932 2978	Release command sent & acknowledged Mooring sighted on surface First floats on board Recovery complete

21	CTD 10 (OPCTD12)	21/03/2015 20:04:15	60° 37.084'S 042° 00.594'W	3438	Logging started
		21/03/2015 20:08:51	60° 37.084'S 042° 00.586'W	3438	Downcast started
		21/03/2015 21:07:59	60° 37.083'S 042° 00.592'W	3437	Bottom
		21/03/2015 22:26:22	60° 37.082'S 042° 00.607'W	3437	End of upcast
22	CTD 11 (OPCTD11)	21/03/2015 23:12:42	60° 37.390'S 042° 02.919'W	3507	Logging started
		21/03/2015 23:12:42	60° 37.390'S 042° 02.919'W	3507	Downcast started
		22/03/2015 00:12:52	60° 37.388'S 042° 02.920'W	3507	Bottom
		22/03/2015 01:26:07	60° 37.390'S 042° 02.919'W	3507	End of upcast
23	CTD 12 (OPCTD9)	22/03/2015 02:20:35	60° 37.930'S 042° 06.879'W	3561	Logging started
		22/03/2015 02:23:56	60° 37.928'S 042° 06.888'W	3565	Downcast started
		22/03/2015 03:27:04	60° 37.930'S 042° 06.887'W	3565	Bottom
		22/03/2015 04:40:36	60° 37.928'S 042° 06.886'W	3568	End of upcast
24	CTD 13 (OPCTD8)	22/03/2015 05:51:46	60° 38.149'S 042° 08.642'W	3414	Logging started
		22/03/2015 05:51:46	60° 38.149'S 042° 08.642'W	3414	Downcast started
		22/03/2015 06:50:42	60° 38.149'S 042° 08.643'W	3403	Bottom
		22/03/2015 08:06:30	60° 38.150'S 042° 08.644'W	3404	End of upcast
25	OP3 recovery (dragging)	22/03/2015 10:48	60° 39.458'S 042° 13.355'W	1787	Weight deployed, attaching grapnels
		22/03/2015 12:10:25	60° 39.457'S 042° 13.358'W	1793	Weight on seabed; 1800 m wire out
		22/03/2015 14:22	60° 39.634'S 042° 14.158'W	1706	Vessel stopped; 5822 m wire out, hauling
		22/03/2015 15:32	60° 39.642'S 042° 14.166'W		Mooring sighted on surface
		22/03/2015 16:50	60° 39.452'S 042° 13.785'W	1708	Weight off seabed
		22/03/2015 17:42	60° 39.316'S 042° 13.637'W	1754	Weight recovered
		22/03/2015 18:18	60° 38.880'S 042° 13.410'W	1898	First floats on board
		22/03/2015 18:32	60° 39.021'S 042° 13.565'W	1846	Recovery complete
26	CTD 14 (OPCTD6)	22/03/2015 19:24:24	60° 39.003'S 042° 11.402'W	2518	Logging started
		22/03/2015 19:27:55	60° 39.002'S 042° 11.402'W	2518	Downcast started
		22/03/2015 20:12:11	60° 39.002'S 042° 11.402'W	2517	Bottom
		22/03/2015 21:05:52	60° 39.002'S 042° 11.402'W	2527	End of upcast

27	CTD 15 (A23-24)	24/03/2015 19:32:51 24/03/2015 19:36:37 24/03/2015 20:57:42 24/03/2015 23:12:59	63° 57.917'S 028° 52.602'W 63° 57.918'S 028° 52.603'W 63° 57.918'S 028° 52.606'W 63° 57.919'S 028° 52.603'W	4815 4812 4818 4801	Logging started Downcast started Bottom End of upcast
28	CTD 16 (A23-25)	25/03/2015 04:24:27 25/03/2015 04:27:12 25/03/2015 05:48:47 25/03/2015 07:47:41	63° 20.797'S 029° 34.102'W 63° 20.796'S 029° 34.103'W 63° 20.737'S 029° 33.886'W 63° 21.064'S 029° 33.220'W	n/r n/r 4761 4659	Logging started Downcast started Bottom End of upcast
29	CTD 17 (A23-26)	26/03/2015 13:32:07 26/03/2015 13:34:51 26/03/2015 14:56:20 26/03/2015 16:56:28	63° 04.360'S 030° 06.889'W 63° 04.364'S 030° 06.910'W 63° 04.344'S 030° 06.830'W 63° 04.349'S 030° 06.766'W	4881 4892 4886 4887	Logging started Downcast started Bottom End of upcast
n/a		26/03/2015 17:54 to 26/03/2015 21:54			Vessel steaming slowly and stopping for tests, because of problems with engine sensor (originally believed to be problem with propulsion motor)
30	CTD 18 (A23-27)	26/03/2015 22:59:36 26/03/2015 23:02:14 27/03/2015 00:24:00 27/03/2015 02:23:03	62° 46.930'S 030° 41.368'W 62° 46.931'S 030° 41.365'W 62° 46.969'S 030° 41.620'W 62° 46.970'S 030° 41.625'W	4836 4838 4832 5347	Logging started Downcast started Bottom End of upcast
31	CTD 19 (A23-28)	27/03/2015 06:09:13 27/03/2015 06:12:00 27/03/2015 07:33:51 27/03/2015 09:03:51	62° 28.947'S 031° 16.176'W 62° 28.946'S 031° 16.175'W 62° 28.950'S 031° 16.178'W 62° 28.945'S 031° 16.179'W	4809 4802 4807 4811	Logging started Downcast started Bottom End of upcast
32	CTD 20 (A23-29)	27/03/2015 11:44:39 27/03/2015 11:48:57 27/03/2015 13:10:50 27/03/2015 15:07:23	62° 04.538'S 031° 11.123'W 62° 04.537'S 031° 11.108'W 62° 04.516'S 031° 11.006'W 62° 04.549'S 031° 10.898'W	4860 4859 4863 4852	Logging started Downcast started Bottom End of upcast

33	CTD 21 (A23-30)	27/03/2015 17:46:37 27/03/2015 17:50:21 27/03/2015 18:49:15 27/03/2015 19:52:14	61° 40.186'S 031° 06.113'W 61° 40.175'S 031° 06.116'W 61° 39.941'S 031° 06.348'W 61° 39.800'S 031° 06.515'W	3179 3177 3315 3368	Logging started Downcast started Bottom End of upcast
34	CTD 22 (A23-32)	27/03/2015 23:26:03 27/03/2015 23:29:25 28/03/2015 00:28:01 28/03/2015 02:02:30	61° 10.210'S 031° 02.749'W 61° 10.211'S 031° 02.748'W 61° 10.260'S 031° 02.753'W 61° 10.259'S 031° 02.753'W	3475 3469 3477 3484	Logging started Downcast started Bottom End of upcast
35	CTD 23 (A23-33)	28/03/2015 03:28:32 28/03/2015 03:30:55 28/03/2015 04:15:23 28/03/2015 05:05:25	61° 06.559'S 031° 02.475'W 61° 06.560'S 031° 02.475'W 61° 06.559'S 031° 02.476'W 61° 06.559'S 031° 02.477'W	2595 2591 2595 2597	Logging started Downcast started Bottom End of upcast
36	CTD 24 (A23-34)	28/03/2015 08:18:58 28/03/2015 08:21:09 28/03/2015 08:49:15 28/03/2015 09:23:24	60° 41.965'S 031° 00.583'W 60° 41.964'S 031° 00.583'W 60° 41.971'S 031° 00.587'W 60° 41.972'S 031° 00.588'W	1627 1626 1621 1621	Logging started Downcast started Bottom End of upcast
37	CTD 25 (A23-35)	28/03/2015 11:53:08 28/03/2015 11:56:58 28/03/2015 12:45:39 28/03/2015 13:39:34	60° 18.847'S 030° 57.384'W 60° 18.856'S 030° 57.404'W 60° 18.918'S 030° 57.507'W 60° 18.922'S 030° 57.509'W	2650 2665 2755 2765	Logging started Downcast started Bottom End of upcast
38	CTD 26 (A23-36)	28/03/2015 16:00:24 28/03/2015 16:03:02 28/03/2015 16:53:34 28/03/2015 18:17:09	59° 59.657'S 030° 55.745'W 59° 59.661'S 030° 55.754'W 59° 59.670'S 030° 55.762'W 59° 59.671'S 030° 55.765'W	2991 2999 3009 2990	Logging started Downcast started Bottom End of upcast
39	CTD 27 (A23-37)	28/03/2015 19:57:51 28/03/2015 20:00:35 28/03/2015 21:07:39 28/03/2015 22:43:34	59° 45.975'S 030° 54.401'W 59° 45.974'S 030° 54.381'W 59° 45.968'S 030° 54.332'W 59° 45.971'S 030° 54.332'W	3795 3796 3796 3794	Logging started Downcast started Bottom End of upcast

40	CTD 28 (A23-38)	29/03/2015 00:03:31 29/03/2015 00:08:02 29/03/2015 00:59:37 29/03/2015 01:56:44	59° 40.418'S 030° 53.796'W 59° 40.423'S 030° 53.792'W 59° 40.424'S 030° 53.795'W 59° 40.419'S 030° 53.798'W	2925 2930 2922 2929	Logging started Downcast started Bottom End of upcast
41	CTD 29 (A23-39)	29/03/2015 04:14:12 29/03/2015 04:16:57 29/03/2015 05:24:17 29/03/2015 06:53:05	59° 26.134'S 030° 51.596'W 59° 26.135'S 030° 51.595'W 59° 26.140'S 030° 51.588'W 59° 26.134'S 030° 51.597'W	3465 3457 3458 3457	Logging started Downcast started Bottom End of upcast
42	CTD 30 (A23-40)	29/03/2015 09:29:39 29/03/2015 09:33:07 29/03/2015 10:26:37 29/03/2015 11:26:46	59° 02.960'S 030° 49.772'W 59° 02.957'S 030° 49.774'W 59° 03.018'S 030° 49.821'W 59° 03.019'S 030° 49.817'W	3118 3119 3117 3117	Logging started Downcast started Bottom End of upcast
43	CTD 31 (A23-41)	29/03/2015 14:10:13 29/03/2015 14:12:38 29/03/2015 15:13:09 29/03/2015 16:46:04	58° 38.054'S 030° 49.464'W 58° 38.054'S 030° 49.456'W 58° 38.110'S 030° 49.470'W 58° 38.104'S 030° 49.474'W	3547 3543 3543 3538	Logging started Downcast started Bottom End of upcast
44	CTD 32 (A23-42)	29/03/2015 19:24:21 29/03/2015 19:27:15 29/03/2015 20:39:18 29/03/2015 22:17:51	58° 12.625'S 030° 49.465'W 58° 12.635'S 030° 49.459'W 58° 12.772'S 030° 49.322'W 58° 12.772'S 030° 49.315'W	3994 3991 4006 3997	Logging started Downcast started Bottom End of upcast
45	CTD 33 (A23-43)	30/03/2015 01:29:54 30/03/2015 01:33:58 30/03/2015 02:34:15 30/03/2015 03:46:44	57° 48.095'S 030° 49.955'W 57° 48.094'S 030° 49.954'W 57° 48.094'S 030° 49.954'W 57° 48.094'S 030° 49.958'W	3616 3616 3582 3584	Logging started Downcast started Bottom End of upcast
46	CTD 34 (A23-44)	30/03/2015 06:57:03 30/03/2015 06:59:19 30/03/2015 08:02:30 30/03/2015 09:14:13	57° 27.489'S 031° 19.661'W 57° 27.490'S 031° 19.663'W 57° 27.491'S 031° 19.660'W 57° 27.488'S 031° 19.658'W	3750 3752 3758 3755	Logging started Downcast started Bottom End of upcast

47	CTD 35 (A23-45)	30/03/2015 11:50:22 30/03/2015 11:53:46 30/03/2015 12:52:17 30/03/2015 13:54:47	57° 07.100'S 031° 48.886'W 57° 07.101'S 031° 48.885'W 57° 07.099'S 031° 48.888'W 57° 07.100'S 031° 48.890'W	3449 3456 3441 3452	Logging started Downcast started Bottom End of upcast
48	CTD 36 (A23-46)	30/03/2015 16:34:33 30/03/2015 16:36:39 30/03/2015 17:32:29 30/03/2015 18:35:41	56° 46.474'S 032° 18.249'W 56° 46.485'S 032° 18.243'W 56° 46.532'S 032° 18.230'W 56° 46.531'S 032° 18.232'W	3235 3235 3237 3235	Logging started Downcast started Bottom End of upcast
49	CTD 37 (A23-47)	30/03/2015 21:44:25 30/03/2015 21:54 30/03/2015 22:12:39 30/03/2015 22:13:43 30/03/2015 23:15:17 31/03/2015 00:33:05	56° 22.938'S 032° 52.387'W 56° 22.873'S 032° 52.372'W 56° 22.865'S 032° 52.370'W 56° 22.865'S 032° 52.369'W 56° 22.865'S 032° 52.371'W 56° 22.864'S 032° 52.368'W	3122 3133 3133 3133 3140 3134	CTD in water – but pumps would not start CTD recovered and cells flushed with seawater Logging started; CTD redeployed Downcast started Bottom End of upcast
50	CTD 38 (A23-48)	31/03/2015 04:17:36 31/03/2015 04:20:21 31/03/2015 05:16:37 31/03/2015 06:27:26	55° 59.425'S 033° 25.182'W 55° 59.422'S 033° 25.182'W 55° 59.425'S 033° 25.181'W 55° 59.426'S 033° 25.184'W	3051 3049 3057 3057	Logging started Downcast started Bottom End of upcast
51	CTD 39 (A23-49)	31/03/2015 08:57:44 31/03/2015 09:00:04 31/03/2015 09:59:57 31/03/2015 11:25:34	55° 43.552'S 033° 47.115'W 55° 43.549'S 033° 47.114'W 55° 43.528'S 033° 47.132'W 55° 43.528'S 033° 47.133'W	3494 3498 3511 3494	Logging started Downcast started Bottom End of upcast
52	CTD 40 (A23-50)	31/03/2015 13:37:11 31/03/2015 13:41:16 31/03/2015 14:25:07 31/03/2015 15:23:21	55° 29.081'S 034° 08.006'W 55° 29.081'S 034° 08.006'W 55° 29.081'S 034° 08.006'W 55° 29.077'S 034° 08.004'W	2451 2453 2453 2452	Logging started Downcast started Bottom End of upcast
53	CTD 41 (A23-50A)	31/03/2015 17:08:00 31/03/2015 17:10:38 31/03/2015 17:47:24 31/03/2015 18:39:17	55° 17.348'S 034° 23.999'W 55° 17.359'S 034° 24.002'W 55° 17.396'S 034° 23.998'W 55° 17.396'S 034° 23.999'W	2068 2073 2071 2073	Logging started Downcast started Bottom End of upcast

n/a		31/03/2015 18:48 31/03/2015 19:06	55° 17.396'S 034° 23.999'W		Power outage – engine accidentally shut down Power back on
54	CTD 42 (A23-51)	31/03/2015 19:48:58 31/03/2015 19:51:11 31/03/2015 20:17:24 31/03/2015 21:01:41	55° 15.565'S 034° 26.629'W 55° 15.564'S 034° 26.631'W 55° 15.564'S 034° 26.631'W 55° 15.563'S 034° 26.633'W	1503 1502 1501 1499	Logging started Downcast started Bottom End of upcast
55	CTD 43 (A23-51A)	31/03/2015 21:53:07 31/03/2015 21:55:37 31/03/2015 22:15:01 31/03/2015 22:45:31	55° 13.790'S 034° 29.390'W 55° 13.795'S 034° 29.392'W 55° 13.799'S 034° 29.399'W 55° 13.797'S 034° 29.399'W	1019 1030 1023 1018	Logging started Downcast started Bottom End of upcast
56	CTD 44 (A23-52)	31/03/2015 23:28:55 31/03/2015 23:31:33 31/03/2015 23:43:25 01/04/2015 00:01:00	55° 12.913'S 034° 30.482'W 55° 12.913'S 034° 30.482'W 55° 12.910'S 034° 30.479'W 55° 12.910'S 034° 30.477'W	549 549 548 549	Logging started Downcast started Bottom End of upcast
57	CTD 45 (near OP3; OPCTD5)	03/04/2015 16:30:45 03/04/2015 16:36 03/04/2015 17:20:20 03/04/2015 17:25:03 03/04/2015 17:53:43 03/04/2015 18:39:45	60° 39.505'S 042° 13.340'W 60° 39.503'S 042° 13.333'W 60° 39.617'S 042° 13.032'W 60° 39.616'S 042° 13.029'W 60° 39.634'S 042° 12.923'W 60° 39.617'S 042° 12.722'W	1777 1778 1737 1738 1750 1784	CTD deployed, but problems with winch. CTD recovered CTD redeployed, logging started Downcast started Bottom End of upcast
58	OP3 deployment	03/04/2015 19:33 03/04/2015 20:25:27 03/04/2015 20:53:13	60° 39.617'S 042° 12.719'W 60° 39.334'S 042° 13.844'W 60° 39.322'S 042° 13.801'W	1774 1727 1738	Top float deployed Mooring released (GPS position) On seabed (triangulated position & depth)
59	CTD 46 (OPCTD2)	03/04/2015 22:49:31 03/04/2015 22:52:33 03/04/2015 23:17:32 03/04/2015 23:45:08	60° 40.682'S 042° 23.261'W 60° 40.685'S 042° 23.264'W 60° 40.758'S 042° 23.346'W 60° 40.780'S 042° 23.371'W	1022 1023 1014 1009	Logging started Downcast started Bottom End of upcast
60	CTD 47 (OPCTD4)	04/04/2015 01:18:56 04/04/2015 01:21:16 04/04/2015 01:54:33 04/04/2015 02:37:38	60° 39.961'S 042° 15.380'W 60° 39.955'S 042° 15.369'W 60° 39.943'S 042° 15.349'W 60° 39.942'S 042° 15.349'W	1505 1507 1507 1512	Logging started Downcast started Bottom End of upcast

61	CTD 48 (OPCTD3)	04/04/2015 03:40:01 04/04/2015 03:42:53 04/04/2015 04:12:05 04/04/2015 04:49:08	60° 40.064'S 042° 18.541'W 60° 40.064'S 042° 18.542'W 60° 40.063'S 042° 18.541'W 60° 40.058'S 042° 18.545'W	1490 1485 1487 1488	Logging started Downcast started Bottom End of upcast
62	CTD 49 (OPCTD6)	04/04/2015 05:57:37 04/04/2015 05:59:54 04/04/2015 06:44:43 04/04/2015 07:43:39	60° 38.996'S 042° 11.379'W 60° 38.998'S 042° 11.381'W 60° 38.996'S 042° 11.383'W 60° 38.997'S 042° 11.381'W	2536 2533 2533 2529	Logging started Downcast started Bottom End of upcast
63	CTD 50 (near OP2; OPCTD7)	04/04/2015 08:26:42 04/04/2015 08:30:16 04/04/2015 09:24:58 04/04/2015 10:32:46	60° 38.437'S 042° 10.226'W 60° 38.441'S 042° 10.219'W 60° 38.458'S 042° 10.191'W 60° 38.461'S 042° 10.192'W	3144 3145 3155 3156	Logging started Downcast started Bottom End of upcast
64	OP2 deployment	04/04/2015 13:16 04/04/2015 15:54:56 04/04/2015 15:54:56 04/04/2015 16:33	60° 37.786'S 042° 06.412'W 60° 38.511'S 042° 10.315'W 60° 38.490'S 042° 10.272'W 60° 38.173'S 042° 10.714'W	3590 3116 3116 3036	Top float deployed Mooring released (GPS position) Mooring released (stern position) On seabed (triangulated position & depth)
65	CTD 51 (Orkney Deep)	05/04/2015 00:49:42 05/04/2015 00:51:49 05/04/2015 02:45:17 05/04/2015 05:32:46	60° 46.902'S 039° 57.004'W 60° 46.900'S 039° 57.004'W 60° 46.903'S 039° 57.004'W 60° 45.802'S 039° 56.297'W	6108 6109 6110 5889	Logging started Downcast started Bottom End of upcast
66	Weight test	05/04/2015 15:53 05/04/2015 16:18	60° 37.789'S 042° 05.374'W 60° 37.776'S 042° 05.357'W	3654 3655	Tested weight of mooring anchor and releases using Gilson winch load cell; readings between 1.4 and 1.9 tons – unrealistically high.
68	OP1 deployment	05/04/2015 17:00:00 05/04/2015 20:05:44 05/04/2015 20:05:44 05/04/2015 20:46	60° 36.733'S 042° 01.186'W 60° 37.878'S 042° 05.546'W 60° 37.856'S 042° 05.502'W 60° 37.522'S 042° 05.761'W	3476 3667 3667 3644	Top float deployed Mooring released (GPS position) Mooring released (stern position) On seabed (triangulated position & depth)
69	CTD 52 (OPCTD8)	05/04/2015 22:46:05 05/04/2015 22:56:28 05/04/2015 23:52:46 06/04/2015 01:09:08	60° 37.800'S 042° 08.864'W 60° 37.799'S 042° 08.865'W 60° 37.922'S 042° 08.837'W 60° 37.921'S 042° 08.839'W	3313 3309 3346 3346	Logging started Downcast started Bottom End of upcast

70	CTD 53	06/04/2015 01:50:19	60° 37.970'S 042° 06.863'W	3601	Logging started
	(OPCTD9)	06/04/2015 02:05:52	60° 37.931'S 042° 06.892'W	3581	Downcast started
		06/04/2015 03:07:37	60° 37.943'S 042° 06.863'W	3574	Bottom
		06/04/2015 04:22:16	60° 37.945'S 042° 06.862'W	3574	End of upcast
71	CTD 54	06/04/2015 05:02:44	60° 37.937'S 042° 05.069'W	3671	Logging started
	(near OP1;	06/04/2015 05:23:18	60° 37.941'S 042° 05.068'W	3673	Downcast started
	OPCTD10)	06/04/2015 06:25:57	60° 37.942'S 042° 05.069'W	3670	Bottom
		06/04/2015 07:49:22	60° 37.942'S 042° 05.068'W	3675	End of upcast
72	CTD 55	06/04/2015 09:45:33	60° 33.646'S 041° 38.049'W	2306	Logging started
	(near OP6;	06/04/2015 09:52:46	60° 33.650'S 041° 38.048'W	2306	Downcast started
	OPCTD19)	06/04/2015 10:34:06	60° 33.744'S 041° 37.980'W	2307	Bottom
		06/04/2015 11:29:47	60° 33.754'S 041° 38.003'W	2307	End of upcast
73	OP6	06/04/2015 12:33:28	60° 33.437'S 041° 37.492'W	2284	Top float deployed
	deployment	06/04/2015 13:08:04	60° 33.775'S 041° 38.020'W	2314	Mooring released (GPS position)
		06/04/2015 13:08:04	60° 33.750'S 041° 37.980'W	2314	Mooring released (stern position)
		06/04/2015 13:36:41	60° 33.727'S 041° 38.033'W	2338	On seabed (triangulated position & depth)
74	OP5	06/04/2015 17:13	60° 35.654'S 041° 57.646'W	3409	Top float deployed
	deployment	06/04/2015 18:36:25	60° 36.619'S 041° 58.494'W	3391	Mooring released (GPS position)
		06/04/2015 18:36:25	60° 36.595'S 041° 58.463'W	3391	Mooring released (stern position)
		06/04/2015 19:17:50	60° 36.424'S 041° 58.531'W	3423	On seabed (triangulated position & depth)
75a	CTD 56	06/04/2015 21:13:47	60° 35.867'S 041° 58.729'W	3440	Logging started
	(near OP5;	06/04/2015 21:20:31	60° 35.871'S 041° 58.728'W	3442	Downcast started
	OPCTD13)	06/04/2015 22:22:38	60° 35.870'S 041° 58.726'W	3440	Bottom
		06/04/2015 23:40:19	60° 35.871'S 041° 58.726'W	3441	End of upcast
75b	CTD 57	07/04/2015 00:36:59	60° 37.060'S 042° 00.591'W	3437	Logging started
	(OPCTD12)	07/04/2015 01:00:26	60° 37.061'S 042° 00.587'W	3438	Downcast started
		07/04/2015 01:58:32	60° 37.069'S 042° 00.562'W	3437	Bottom
		07/04/2015 03:21:30	60° 37.062'S 042° 00.581'W	3438	End of upcast

76	CTD 58 (OP2CTD N3)	07/04/2015 06:55:16 07/04/2015 07:10:33 07/04/2015 08:02:12 07/04/2015 09:17:11	60° 36.715'S 042° 13.958'W 60° 36.710'S 042° 13.970'W 60° 36.652'S 042° 14.032'W 60° 36.436'S 042° 14.248'W	3079 3083 3103 3174	Logging started Downcast started Bottom End of upcast
77	OP4 deployment	07/04/2015 14:52 07/04/2015 15:59:09 07/04/2015 15:59:09 07/04/2015 16:28:45	60° 35.455'S 041° 49.867'W 60° 35.459'S 041° 49.868'W 60° 35.436'S 041° 49.843'W 60° 35.434'S 041° 49.752'W	2953 2957 2957 2972	Anchor deployed Top float released (GPS position) Top float released (stern position) On seabed (triangulated position & depth)
78	CTD 59 (near OP4; OPCTD16)	07/04/2015 18:12:19 07/04/2015 18:15:27 07/04/2015 19:05:45 07/04/2015 20:16:53	60° 34.969'S 041° 50.389'W 60° 34.969'S 041° 50.390'W 60° 34.711'S 041° 50.361'W 60° 34.123'S 041° 50.429'W	2971 2971 2999 3033	Logging started Downcast started Bottom End of upcast
79	CTD 60 (OPCTD15)	07/04/2015 21:28:26 07/04/2015 21:58:25 07/04/2015 22:50:50 07/04/2015 23:59:05	60° 36.016'S 041° 53.358'W 60° 35.793'S 041° 53.014'W 60° 35.286'S 041° 52.103'W 60° 34.475'S 041° 51.524'W	3201 3170 3074 3306	Logging started Downcast started Bottom End of upcast
80	CTD 61 (OPCTD14)	08/04/2015 03:39:45 08/04/2015 03:47:31 08/04/2015 04:44:06 08/04/2015 05:51:43	60° 37.583'S 041° 54.557'W 60° 37.523'S 041° 54.497'W 60° 36.734'S 041° 53.810'W 60° 36.586'S 041° 53.702'W	3233 3215 3244 3246	Logging started Downcast started Bottom End of upcast
81	CTD 62 (OP2CTD N2A)	08/04/2015 09:39:30 08/04/2015 09:43:46 08/04/2015 10:28:53 08/04/2015 11:24:54	60° 37.843'S 042° 13.135'W 60° 37.825'S 042° 13.114'W 60° 37.635'S 042° 12.703'W 60° 37.523'S 042° 12.323'W	2593 2609 2764 2888	Logging started Downcast started Bottom End of upcast
82	CTD 63 (OP2CTD N2)	08/04/2015 11:59:03 08/04/2015 12:04:56 08/04/2015 12:57:59 08/04/2015 14:01:39	60° 37.369'S 042° 12.146'W 60° 37.343'S 042° 12.098'W 60° 37.210'S 042° 11.633'W 60° 37.049'S 042° 11.053'W	2967 3002 3149 3254	Logging started Downcast started Bottom End of upcast

83	CTD 64 (OP2CTD N2C)	08/04/2015 14:32:28 08/04/2015 14:36:38 08/04/2015 15:32:41 08/04/2015 16:37:39	60° 37.060'S 042° 11.374'W 60° 37.048'S 042° 11.336'W 60° 36.850'S 042° 10.949'W 60° 36.591'S 042° 10.619'W	3192 3219 3290 3476	Logging started Downcast started Bottom End of upcast
84	Weight test	08/04/2015 17:36 08/04/2015 18:00	60° 36.487'S 042° 10.475'W 60° 36.486'S 042° 10.475'W	3541 3538	Tested weight of mooring anchor and releases using crane and separate load cell; readings between 650 (in water) and 900 kg (in air)
85	CTD 65 (OP2CTD N6)	08/04/2015 21:18:16 08/04/2015 21:23:35 08/04/2015 22:29:39 08/04/2015 23:32:43	60° 36.877'S 042° 19.909'W 60° 36.877'S 042° 19.908'W 60° 36.757'S 042° 19.938'W 60° 36.591'S 042° 19.988'W	3107 3115 3148 3171	Logging started Downcast started Bottom End of upcast
86		09/04/2015 01:00 09/04/2015 02:42	60° 37.307'S 042° 17.972'W 60° 37.140'S 042° 17.833'W	2856 2982	Attempted to break ice and create pool for OP2CTD N5; unsuccessful, so carried on
87	CTD 66 (OP2CTD N4)	09/04/2015 03:38:45 09/04/2015 03:46:36 09/04/2015 04:52:28 09/04/2015 06:04:48	60° 36.686'S 042° 16.057'W 60° 36.709'S 042° 15.976'W 60° 36.760'S 042° 15.295'W 60° 36.705'S 042° 14.523'W	2927 2913 2865 3002	Logging started Downcast started Bottom End of upcast
88	CTD – cast aborted	09/04/2015 07:12 09/04/2015 08:24:21	60° 38.872'S 042° 09.025'W 60° 39.416'S 042° 10.336'W	3206 2667	Vessel on DP – then relocated several times CTD in water; because of the late cast start, the cast was stopped at the PSO’s request.
89	OP7 deployment	09/04/2015 10:46 09/04/2015 10:55 09/04/2015 10:58 09/04/2015 13:38:09 09/04/2015 13:38:09 09/04/2015 13:57:40	60° 39.407'S 042° 09.136'W 60° 39.406'S 042° 09.136'W 60° 39.406'S 042° 09.142'W 60° 39.408'S 042° 09.140'W 60° 39.399'S 042° 09.091'W 60° 39.289'S 042° 09.248'W	3013 3018 3005 3015 3015 3060	Anchor deployed Anchor recovered Anchor redeployed Top float released (GPS position) Top float released (stern position) On seabed (triangulated position & depth)
90	CTD 67 (near OP7; OP2CTD S3)	09/04/2015 16:41:08 09/04/2015 16:44:44 09/04/2015 17:39:43 09/04/2015 18:43:48	60° 39.896'S 042° 08.085'W 60° 39.890'S 042° 08.075'W 60° 39.739'S 042° 07.931'W 60° 39.632'S 042° 07.712'W	3053 3058 3192 3197	Logging started Downcast started Bottom End of upcast

91	CTD 68 (OP2CTD S3C)	09/04/2015 19:55:52 09/04/2015 19:58:13 09/04/2015 21:00:11 09/04/2015 22:18:56	60° 38.682'S 042° 05.504'W 60° 38.684'S 042° 05.506'W 60° 38.685'S 042° 05.506'W 60° 38.710'S 042° 05.507'W	3707 3696 3705 3699	Logging started Downcast started Bottom End of upcast
92a	CTD 69 (OP2CTD S5)	10/04/2015 02:07:48 10/04/2015 02:16:19 10/04/2015 03:20:03 10/04/2015 04:26:01	60° 41.007'S 042° 05.354'W 60° 40.991'S 042° 05.263'W 60° 40.866'S 042° 04.581'W 60° 40.698'S 042° 03.788'W	2909 2960 3258 3382	Logging started Downcast started Bottom End of upcast
92b	CTD 70 (OP2CTD S3A)	10/04/2015 06:36:41 10/04/2015 06:41:49 10/04/2015 07:11:22 10/04/2015 07:52:41	60° 40.895'S 042° 10.783'W 60° 40.896'S 042° 10.783'W 60° 40.895'S 042° 10.783'W 60° 40.808'S 042° 10.636'W	1764 1761 1764 1832	Logging started Downcast started Bottom End of upcast
93	CTD 71 (last1)	10/04/2015 12:49:52 10/04/2015 12:52:03 10/04/2015 13:50:04 10/04/2015 14:48:13	60° 32.827'S 042° 33.174'W 60° 32.843'S 042° 33.187'W 60° 33.031'S 042° 33.185'W 60° 33.288'S 042° 33.154'W	3143 3087 2965 2777	Logging started Downcast started Bottom End of upcast
94	CTD 72 (last2)	10/04/2015 16:02:33 10/04/2015 16:04:58 10/04/2015 16:55:10 10/04/2015 17:55:04	60° 30.182'S 042° 40.597'W 60° 30.178'S 042° 40.598'W 60° 30.178'S 042° 40.603'W 60° 30.175'S 042° 40.602'W	3030 3005 3030 3037	Logging started Downcast started Bottom End of upcast
95	CTD 73 (last3)	10/04/2015 18:44:55 10/04/2015 18:48:09 10/04/2015 19:55:43 10/04/2015 21:11:41	60° 27.025'S 042° 39.862'W 60° 27.026'S 042° 39.862'W 60° 27.025'S 042° 39.865'W 60° 27.027'S 042° 39.865'W	3990 3991 3987 3981	Logging started Downcast started Bottom End of upcast
96	CTD 74 (last4)	10/04/2015 22:02:38 10/04/2015 22:07:21 10/04/2015 23:24:16 11/04/2015 00:53:13	60° 24.080'S 042° 36.173'W 60° 24.079'S 042° 36.175'W 60° 24.079'S 042° 36.173'W 60° 24.082'S 042° 36.170'W	4525 4525 4524 4524	Logging started Downcast started Bottom End of upcast

Appendix B: SADCP table

Seq.	$PADCP times	Files	Configuration	Comments
1	12/03/2015 11:27:59.26 13/03/2015 11:24:09.02	JR310001_000000-5.ENR JR310001_000000-1.N1R	NP1; nn50; ns1600; nf0800; BT off; 800 m range	
2	13/03/2015 11:24:50.91 14/03/2015 06:31:57.68	JR310002_000000-3.ENR JR310002_000000-1.N1R		
3	14/03/2015 06:33:09.53 14/03/2015 15:00:57.22	JR310003_000000-1.ENR JR310002_000000.N1R	NP1; nn32; ns1600; nf0800; BT on; 500 m range	
4	14/03/2015 15:01:45.11 15/03/2015 14:30:31.61	JR310004_000000-4.ENR JR310004_000000-1.N1R	NP1; nn50; ns1600; nf0800; BT off; 800 m range	
5	15/03/2015 14:30:49.89 16/03/2015 04:20:25.37	JR310005_000000-4.ENR JR310005_000000-1.N1R		
6	16/03/2015 12:57:04.80 17/03/2015 15:43:08.31	JR310006_000000-5.ENR JR310006_000000-1.N1R		
7	17/03/2015 15:43:41.01 18/03/2015 14:03:45.34	JR310007_000000-4.ENR JR310007_000000-1.N1R		
8	18/03/2015 14:04:07.99 19/03/2015 13:09:45.91	JR310008_000000-4.ENR JR310008_000000-1.N1R		
9	19/03/2015 13:11:27.86 20/03/2015 01:25:13.23	JR310009_000000-1.ENR JR310009_000000.N1R	NP1; nn50; ns1600; nf0800; BT on; 800 m range	20:00h: ship stopped on DP (769 m) to check ADCP alignment; 20:10 to 20:19h: ship moved slowly in direction 041 with heading 299.
10	20/03/2015 01:27:26.52 20/03/2015 01:27:31.41	JR3100010_000000.ENR JR3100010_000000.N1R	NP1; nn50; ns1600; nf0800; BT off; 800 m range	Problems with serial port connection; no data in the segment
11	------	JR3100011_000000.LOG JR3100011_000000.N1R		No data in the segment; Empty N1R file
12	20/03/2015 01:28:09.64 20/03/2015 09:21:13.71	JR3100012_000000-6.ENR JR3100012_000000-2.N1R	NP1; nn50; ns1600; nf0800; BT off; 800 m range	
13	21/03/2015 09:21:34.00 22/03/2015 18:56:24.03	JR3100013_000000-7.ENR JR3100013_000000-2.N1R		
14	22/03/2015 18:56:49.11 22/03/2015 18:58:31.51	JR3100014_000000.ENR JR3100014_000000.N1R		No data in the segment

15	22/03/2015 18:58:50.97 24/03/2015 20:18:45.19	JR3100015_000000-10.ENR JR3100015_000000-3.N1R		
16	24/03/2015 20:19:09.76 25/03/2015 20:09:28.72	JR3100016_000000-3.ENR JR3100016_000000-1.N1R		
17	25/03/2015 20:09:51.38 26/03/2015 18:21:28.74	JR3100017_000000-4.ENR JR3100017_000000-1.N1R		
18	26/03/2015 18:21:49.27 27/03/2015 16:01:48.10	JR3100018_000000-3.ENR JR3100018_000000-1.N1R		Stopped logging at 13:09:38 - ensemble 27706
19	27/03/2015 16:02:09.40 28/03/2015 23:22:21.77	JR3100019_000000-6.ENR JR3100019_000000-2.N1R		
20	28/03/2015 23:24:03.44 29/03/2015 22:21:37.58	JR3100020_000000-4.ENR JR3100020_000000-1.N1R		
21	29/03/2015 22:21:57.29 31/03/2015 03:35:59.57	JR3100021_000000-6.ENR JR3100021_000000-2.N1R		
22	31/03/2015 03:36:28.04 31/03/2015 18:47:29.85	JR3100022_000000-3.ENR JR3100022_000000-1.N1R		Segment stopped with power outage;
23	31/03/2015 19:29:49.05 31/03/2015 19:30:13.42	JR3100023_000000.ENR JR3100023_000000.N1R		No data in the segment
24	31/03/2015 19:30:34.84 31/03/2015 23:08:04.81	JR3100024_000000.ENR JR3100024_000000.N1R		
25	31/03/2015 23:08:51.48 31/03/2015 00:39:02.79	JR3100025_000000.ENR JR3100025_000000.N1R	NP1; nn50; ns1600; nf0800; BT on; 800 m range	
26	01/04/2015 00:39:33.36 02/04/2015 22:37:13.51	JR3100026_000000-9.ENR JR3100026_000000-3.N1R	NP1; nn50; ns1600; nf0800; BT off; 800 m range	
27	02/04/2015 22:37:36.63 03/04/2015 22:10:47.52	JR3100027_000000-4.ENR JR3100027_000000-1.N1R		
28	03/04/2015 22:11:07.64 04/04/2015 23:22:13.91	JR3100028_000000-5.ENR JR3100028_000000-1.N1R		
29	04/04/2015 23:22:52.96 06/04/2015 00:47:50.89	JR3100029_000000-5.ENR JR3100029_000000-1.N1R		
30	06/04/2015 00:48:12.34 06/04/2015 21:47:57.54	JR3100030_000000-4.ENR JR3100030_000000-1.N1R		

31	06/04/2015 21:48:17.41 07/04/2015 21:07:33.25	JR3100031_000000-4.ENR JR3100031_000000-1.N1R		
32	07/04/2015 21:07:44.27 08/04/2015 21:08:39.61	JR3100032_000000-5.ENR JR3100032_000000-1.N1R		
33	07/04/2015 21:09:01.08 08/04/2015 21:13:45.79	JR3100033_000000-5.ENR JR3100033_000000-1.N1R		
34	09/04/2015 21:14:05.79 11/04/2015 00:41:47.31	JR3100034_000000-5.ENR JR3100034_000000-1.N1R		
35	11/04/2015 00:42:08.24 12/04/2015 20:04:21.87	JR3100035_000000-8.ENR JR3100035_000000-3.N1R		Stopped logging at 19:06:14 - ensemble 62545 (during Helicopter drill)
36	12/04/2015 20:04:58.69 13/04/2015 20:47:22.39	JR3100036_000000-4.ENR JR3100036_000000-1.N1R		Stopped logging at 19:11:13 - ensemble 34015
37	13/04/2015 20:47:37.36 14/04/2015 09:20:17.58	JR3100037_000000-2.ENR JR3100037_000000.N1R		ADCP stopped and switched off at 09:20.

Appendix C: Swath log

The table below gives a summary of when swath data were recorded, and which speed of sound profiles were used. All times are UTC.

Survey	Lines	Date	Time	XBT/CTD for SVP	file name	Location/ station	Notes
JR310	1	11/3	21:07	jr276_13			
	4	12/3	00:10				Beam angles changed to 55°.
	24	12/3	21:41			test 1	
	25	13/3	00:06	jr276_13		test 1	
	37	13/3	12:37			1	
	38	13/3	12:38	JR310 CTD 1	JR310_CTD001_thinned		
	45	13/3	20:37			Near OP1	
	46	13/3	20:53	JR310 CTD 1	JR310_CTD001_thinned	Near OP1	
	47	14/3	22:07				Beam angles changed to 50°.
	55	14/3	06:43				Beam angles changed to 60°.
	59	14/3	10:25			Scotia Bay	
	60	14/3	11:32	JR310 CTD 1	JR310_CTD001_thinned	Scotia Bay	
	122	17/3	01:33			M3	
jr310_b	0	17/3	18:55	JR310 CTD 2	JR310_CTD002_thinned	M3	
	2	17/3	21:29				Beam angles changed to 50°.
	3	17/3	22:45				Beam angles changed to 60°.
	25	18/3	20:37			M2	
	26	19/3	00:29	JR310 CTD 2	JR310_CTD002_thinned	M2	
	49	19/3	23:51				SIS crashed
	50	19/3	23:55	JR310 CTD 2	JR310_CTD002_thinned		
	52	20/3	02:05				Bottom temporarily lost
	57	20/3	07:07			4	

jr310_c	0 0	22/3 22/3	21:18 22:12	JR310 CTD 4	JR310_CTD004_thinned	14	 Restarted SIS because data were not being gridded (or gridded data were not being displayed)
jr310_c	1 1	22/3 22/3	22:16 22:38	JR310 CTD 4	JR310_CTD004_thinned		 Restarted SIS
jr310_d	0 44	22/3 24/3	22:42 19:24	JR310 CTD 4	JR310_CTD004_thinned	 15	
	n/a	25/3	01:51	JR310 CTD 15	JR310_CTD015_thinned		
	46 53	25/3 26/3	12:49 10:17				Misc. tests, with short intervals of data saved. Data mostly rubbish because of weather.
n/a	n/a	26/3 27/3 28/3 30/3 31/3	am 10:30 23:12 11:34 12:27	JR310 CTD 16 JR310 CTD 19 JR310 CTD 27 JR310 CTD 34 JR310 CTD 38	JR310_CTD016_thinned JR310_CTD019_thinned JR310_CTD027_thinned JR310_CTD034_thinned JR310_CTD038_thinned		Data not recorded, but sound velocity profiles updated at times given on left.
jr310_f	0 34	1/4 2/4	00:05 10:44	JR310 CTD 38	JR310_CTD038_thinned	44	
	35 39	2/4 2/4	10:44 15:02	JR310 CTD 4	JR310_CTD004_thinned		
	40 46	3/4 3/4	09:13 14:56	JR310 CTD 4	JR310_CTD004_thinned		
	47 50	3/4 4/4	22:16 01:23	JR310 CTD 4	JR310_CTD004_thinned	 51	
	51 59	4/4 4/4	06:23 14:26	JR310 CTD 4	JR310_CTD004_thinned	51	
jr310_g	0 4	10/4 10/4	08:49 12:50	JR310 CTD 4	JR310_CTD004_thinned	 71	
	5 5	10/4 10/4	15:02 15:57	JR310 CTD 4	JR310_CTD004_thinned	71 72	

	6 6	10/4 10/4	18:05 18:50	JR310 CTD 4 JR310_CTD004_thinned	72 73	
	7 7	10/4 10/4	21:09 22:01	JR310 CTD 4 JR310_CTD004_thinned	73 74	
	8 89	11/4 14/4	00:58 10:22	JR310 CTD 74 JR310_CTD074_thinned	74	

Appendix D: Mooring tables

Recoveries

M3 (2011-2015)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start/stop time, UTC (dd/mm/yyyy hh:mm:ss)	Clock drift (hh:mm:ss)	First good/Last good record/comments (times are instrument times – uncorrected for drift)
537	4023	Novatech RF-700A1 J05-055					not recovered – presumed lost under an ice floe
519	4041	Aquadopp 2317	U, V, W, T, P	30	23/03/2011 18:00 17/03/2015 21:11	+00:06:36	23/03/2011 23:00:00 17/03/2011 12:00:00
483	4087	SBE-37SM 1351	T, C, P	15	22/03/2011 12:00 17/03/2015 19:35	+00:10:52	23/03/2011 23:00:00 17/03/2015 12:00:03
347	4213	SBE-39 1247	T, P	15	22/03/2011 12:00	-00:12:08	23/03/2011 22:45:00 22/04/2014 01:00:03 stopped recording due to low battery
245	4315	SBE-39 0229	T	15	23/03/2011 18:00	-00:04:03	23/03/2011 22:44:59 17/03/2015 12:00:00
119	4441	SBE-39 0083	T	15	23/03/2011 18:00	-00:02:55	23/03/2011 22:45:00 17/03/2015 12:00:04
24	4536	SBE-37SM 4119	T, C, P	15	23/02/2011 18:00	+00:06:51	23/03/2011 22:45:00 17/03/2015 12:00:05
18	4542	Aquadopp 1752	U, V, W, T, P	30	23/03/2011 18:00 17/03/2015 21:11	+00:03:40	23/03/2011 23:00:00 17/03/2015 12:02:10 pressure sensor failed during 09-11 deployment. Instrument redeployed before sensor failure had been detected, so pr data will not be usable.
9	4551	Releases: ORE 8242xs 33152 & 33147					33147 released. Both ranged, 33152 confirmed to work on deck following recovery

OP1 (2013-2015)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start/stop time, UTC (dd/mm/yyyy hh:mm:ss)	Clock drift (hh:mm:ss)	First good/Last good record/comments (times are instrument times – uncorrected for drift)
1847	1778	Novatech RF-700A1 Y07-010 VHF radio beacon (160.725 MHz)					
1847	1778	Novatech ST-400A Y07-011 Xenon flash beacon (daylight off)					
1827	1798	Aquadopp 5993	U, V, W, T, P	15	02/04/2013 11:30:00 23/03/2015 14:47:35	+00:00:28	02/04/2013 17:45:00 20/03/2015 16:15:00
1826	1799	SBE-39 4413	T	15	02/04/2013 11:30:00 23/03/2015 14:01:15	+00:02:33	02/04/2013 17:45:00 20/03/2015 16:15:00
1482	2143	Aquadopp 6180	U, V, W, T, P	15	02/04/2013 11:30:00 23/03/2015 14:38:10	+00:00:16	02/04/2013 17:45:00 20/03/2015 16:15:00
1481	2144	SBE-37SM 7386	T, C, P	15	02/04/2013 11:30:01 23/03/2015 12:21:30	+00:00:16	02/04/2013 17:45:01 20/03/2015 16:15:01
1062	2563	SBE-39 4713	T	15	02/04/2013 11:30:00 23/03/2015 13:22:50	+00:02:43	02/04/2013 17:45:00 20/03/2015 16:15:00
709	2916	Aquadopp 6236	U, V, W, T, P	15	02/04/2013 11:30:00 23/03/2015 14:37:00	+00:00:42	02/04/2013 17:45:00 20/03/2015 16:15:00
708	2917	SBE-37SM 7387	T, C, P	15	02/04/2013 11:30:01 23/03/2015 12:48:45	+00:00:14	02/04/2013 17:45:01 20/03/2015 16:15:01
51	3574	Aquadopp 6198	U, V, W, T, P	15	02/04/2013 11:30:00 23/03/2015 14:13:10	+00:01:32	02/04/2013 17:45:00 20/03/2015 16:15:00
20	3605	SBE-37SM 7385	T, C, P	15	02/04/2013 11:30:01 23/03/2015 11:50	+00:00:22	02/04/2013 17:45:01 20/03/2015 16:15:01
7	3618	Release: IXSEA AR861 564					

OP2 (2013-2015)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start/stop time, UTC (dd/mm/yyyy hh:mm:ss)	Clock drift (hh:mm:ss)	First good/Last good record/comments (times are instrument times – uncorrected for drift)
1539	1484	Novatech RF-700A1 W02-085 VHF radio beacon (159.480 MHz)					
1539	1484	Novatech ST-400A W02-087 Xenon flash beacon (daylight off)					
1513	1510	SBE-37SM 2956	T, C, P	15	01/04/2013 16:30:01 23/03/2015 13:04:45	+00:04:12	01/04/2013 22:00:00 20/03/2015 12:00:02
1407	1616	Aquadopp 6263	U, V, W, T, P	15	01/04/2013 18:30:00 23/03/2015 14:57:20	00:00:00 (!)	01/04/2013 22:00:00 20/03/2015 12:00:00
1117	1906	SBE-39 4897	T, P	15	01/04/2013 17:00:00 23/03/2015 16:07:45	+00:01:40	01/04/2013 22:00:00 20/03/2015 12:00:00
762	2261	RCM-11 521	U, V, T, C	60	01/04/2013 17:00:00 23/03/2015 17:05:39 DSU word count incremented from 195081 to 195088 at 16:53:43 Initially recorded three samples: word count was 27 at 17:01 on 01/04/2013	cannot be determined	01/04/2013 23:00 06/01/2014 11:00 DSU 14742; DSU clock failed, injecting invalid time stamps between every 1 or 2 measurements. DSU was apparently not recording data after Jan 2014. Battery voltage was 7.25 V. Missing records: • 16/07/2013 01:00-08:00 • 08/10/2013 15:00-16:00 • 09/10/2013 17:00 • 05/01/2014 09:00 • 06/01/2014 00:00
754	2269	SBE-37SM 7381	T, C, P	15	01/04/2013 16:30:01 23/03/2015 12:36:20	+00:00:57	01/04/2013 22:00:01 20/03/2015 12:00:01
53	2970	Aquadopp 6112	U, V, W, T, P	15	01/04/2013 18:30:00 23/03/2015 14:54	+00:01:09	01/04/2013 22:00:00 20/03/2015 12:00:00
21	3002	SBE-37SM 7380	T, C, P	15	01/04/2013 16:30:01 23/03/2015 13:00:50	+00:00:45	01/04/2013 22:00:01 20/03/2015 12:00:01
7	3016	Release: ORE 8242xs 32135					Released OK, but had white residue in bottom of pressure casing, possibly the result of a leak. Similar in appearance to 32134 in 2013.

OP3 (2013-2015)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start/stop time, UTC (dd/mm/yyyy hh:mm:ss)	Clock drift (hh:mm:ss)	First good/Last good record/comments (times are instrument times – uncorrected for drift)
530	1222	Novatech RF-700A1 Y07-009 VHF radio beacon (160.725 MHz)					Activated at 18:31, when on deck
530	1222	Novatech ST-400A W02-088 Xenon flash beacon (daylight off)					
508	1244	SBE-39 1311	T, P	15	01/04/2013 09:00:00 23/03/2015 12:04:55	+00:03:18	01/04/2013 11:00:00 24/06/2013 18:30:00 Indicated that it was still recording on recovery – but stopped actually saving data in June 2013. Sent back to LDEO for servicing/repairs.
303	1449	Aquadopp 6000	U, V, W, T, P	15	01/04/2013 11:00:00 23/03/2015 16:07:20	+00:01:25	01/04/2013 11:00:00 22/03/2015 15:00:00
302	1450	SBE-37SM 2707	T, C, P	15	01/04/2013 09:01:03 23/03/2015 12:06:00	+00:05:03	01/04/2013 11:01:03 22/03/2015 15:01:04 Cable guide showed shallow wear mark from coring warp – presumably damaged when dragging. Loose plastic was cut off and instrument redeployed.
51	1701	Aquadopp 6251	U, V, W, T, P	15			Not recovered
19	1733	SBE-37SM 7384	T, C, P	15			Not recovered
7	1745	Release: IXSEA AR861 434					Not recovered

OP4 (2013-2015)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start/stop time, UTC (dd/mm/yyyy hh:mm:ss)	Clock drift (hh:mm:ss)	First good/Last good record/comments (times are instrument times – uncorrected for drift)
1132	1817	Novatech RF-700A1 W02-086 VHF radio beacon (160.725 MHz)					
1132	1817	Novatech ST-400AY02-012 Xenon flash beacon (daylight off)					
1110	1839	Aquadopp 6226	U, V, W, T, P	15	03/04/2013 17:00:00 23/03/2015 16:29:40	+00:02:05	03/04/2013 20:45:00 21/03/2015 16:00:00
1109	1840	SBE-39 4716	T	15	03/04/2013 17:00:00 23/03/2015 13:20:35	+00:02:17	03/04/2013 20:45:00 21/03/2015 16:00:00
760	2189	RCM-11 532	U, V, T, C	60	03/04/2013 18:00 23/03/2015 18:17 DSU word count incremented from 125107 to 125119 at 18:15:25	-00:26:10	03/04/2013 22:00 21/03/2015 14:48 DSU 15239; Battery voltage was 7.24 V
753	2196	SBE-37SM 7382	T, C, P	15	03/04/2013 17:30:01 23/03/2015 13:10:22	+00:00:36	03/04/2013 20:45:01 21/03/2015 16:00:01
54	2895	RCM-11 592	U, V, T, C	60	03/04/2013 18:00 23/03/2015 18:18 DSU word count incremented from 156628 to 156635 at 18:17:30	-00:27:00	03/04/2013 22:00 04/07/2014 15:53 DSU 15236; DSU was apparently not recording data after Jul 2014. Battery voltage was 7.27 V
19	2930	SBE-37SM 7383	T, C, P	15	03/04/2013 17:00:01 23/03/2015 13:13:00	+00:00:16	03/04/2013 20:45:01 21/03/2015 16:00:01
7	2942	Release: IXSEA AR861 565					

OP5 (2013-2015)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start/stop time, UTC (dd/mm/yyyy hh:mm:ss)	Clock drift (hh:mm:ss)	First good/Last good record/comments (times are instrument times – uncorrected for drift)
424	2979	Novatech RF-700A1 W02-084 VHF radio beacon (154.585 MHz)					
424	2979	Novatech ST-400A W02-089 Xenon flash beacon (daylight off)					
399	3004	Aquadopp 8556	U, V, W, T, P	120	29/03/2013 19:00:00 30/03/2015 15:59:00	+00:01:50	29/03/2013 23:00:00 21/03/2015 13:00:00
398	3005	SBE-39 4409	T	15	29/03/2013 18:30:00 23/03/2015 13:18:08	+00:01:38	29/03/2013 22:15:00 21/03/2015 13:30:00
48	3355	Aquadopp 8479	U, V, W, T, P	15	29/03/2013 19:00:00 ??		Instrument flooded
18	3385	SBE-39 4418	T	15	29/03/2013 18:30:00 23/03/2015 13:28:13	+00:01:20	29/03/2013 22:15:00 21/03/2015 13:30:00
7	3396	Release: IXSEA AR861 562					

OP6 (2013-2015)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start/stop time, UTC (dd/mm/yyyy hh:mm:ss)	Clock drift (hh:mm:ss)	First good/Last good record/comments (times are instrument times – uncorrected for drift)
320	2020	Novatech ST-400A Y07-011 Xenon flash beacon (daylight off)					
299	2041	Aquadopp 9250	U, V, W, T, P	15	30/03/2013 16:30:00 23/03/2015 16:59:35	+00:01:46	30/03/2013 19:15:00 21/03/2015 11:00:00
43	2297	Aquadopp 9264	U, V, W, T, P	15	30/03/2013 16:30:16 23/03/2015 16:43:52	+00:01:23	30/03/2013 19:15:16 21/03/2015 11:00:16
19	2321	SBE-37SM 8267	T, C	15	30/03/2013 17:30:01 23/03/2015 14:07:07	+00:00:29	30/03/2013 19:15:01 21/03/2015 11:00:01
7	2333	Release: IXSEA AR861 1356					

Deployments

M2 (2015-)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments
532	2492	Novatech RF-700A1 W08-053 VHF radio beacon (159.480 MHz)				On triangular McLane top float
532	2492	Novatech ST-400A V08-057 Xenon flash beacon (daylight off disabled)				
511	2513	Aquadopp 9380	U, V, W, T, P	10	01/04/2015 12:00:00	
466	2558	SBE-37SM 2678	T, C, P	10	02/04/2015 00:00:00	
341	2683	SBE-39 4602	T, P	10	02/04/2015 00:00:00	
239	2785	SBE-39 1235	T, P	10	02/04/2015 00:00:00	
164	2860	SBE-39 1231	T, P	10	02/04/2015 00:00:00	
19	3005	SBE-37SMP 6557	T, C, P	10	02/04/2015 00:00:00	
16	3008	Aquadopp 2807	U, V, W, T, P	10	01/04/2015 12:00:00	
8	3016	Release: ORE 8242xs 49027				

OP1 (2015-)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments
1800	1844	Aquadopp 6273	U, V, W, T, P	10	01/04/2015 12:00:00	
1799	1845	SBE-37SMP 7308	T, C, P	20	02/04/2015 00:00:00	
1725	1919	SBE-39 4716	T	10	02/04/2015 00:00:00	
1650	1994	Aquadopp 8351	U, V, W, T, P	10	01/04/2015 12:00:00	
1649	1995	SBE-37SMP 7309	T, C, P	20	02/04/2015 00:00:00	
1575	2069	SBE-39 4413	T	10	02/04/2015 00:00:00	
1500	2144	Aquadopp 12020	U, V, W, T, P	10	02/04/2015 12:00:00	
1499	2145	SBE-37SMP 9394	T, C, P	10	02/04/2015 00:00:00	
1425	2219	RBRsoloT 72251	T	10 s	02/04/2015 00:00:00	
1350	2294	Aquadopp 6182	U, V, W, T, P	10	02/04/2015 12:00:00	
1349	2295	SBE-37SMP 7313	T, C, P	20	02/04/2015 00:00:00	
1275	2369	RBRsoloT 72253	T	10 s	02/04/2015 00:00:00	
1200	2444	Aquadopp 8355	U, V, W, T, P	10	01/04/2015 12:00:00	
1199	2445	RBRsoloT 72252	T	10 s	02/04/2015 00:00:00	
1150	2494	RBRsoloT 72274	T	10 s	02/04/2015 00:00:00	
1116	2528	Novatech MMI-7500 M00QMQ Iridium beacon				IMEI: 300434060137070
1116	2528	RDI Longranger ADCP 22182	U, V, W (profile), T, P	60	05/04/2015 00:00:00	12 pings per ensemble, 48 16-m depth cells Mounted in MSI SB47-3000 buoy 10-14 SN 128
1100	2544	SBE-37SMP 7307	T, C, P	20	02/04/2015 00:00:00	
1050	2594	RBRsoloT 72265	T	10 s	02/04/2015 00:00:00	
1000	2644	Aquadopp 6178	U, V, W, T, P	10	01/04/2015 12:00:00	Hit transom during deployment
999	2645	SBE-37SMP 9379	T, C, P	10	02/04/2015 00:00:00	

950	2694	RBRsoloT 72266	T	10 s	02/04/2015 00:00:00	
900	2744	Aquadopp 5883	U, V, W, T, P	10	01/04/2015 12:00:00	
899	2745	RBRsoloT 72267	T	10 s	02/04/2015 00:00:00	
850	2794	RBRsoloT 72268	T	10 s	02/04/2015 00:00:00	
800	2844	Aquadopp 8088	U, V, W, T, P	10	01/04/2015 12:00:00	
799	2845	SBE-37SMP 7302	T, C, P	20	02/04/2015 00:00:00	
750	2894	RBRsoloT 72269	T	10 s	02/04/2015 00:00:00	
700	2944	Aquadopp 8352	U, V, W, T, P	10	02/04/2015 12:00:00	
699	2945	SBE-37SMP 7310	T, C, P	20	02/04/2015 00:00:00	
650	2994	RBRsoloT 72270	T	10 s	02/04/2015 00:00:00	
600	3044	Aquadopp 6275	U, V, W, T, P	10	01/04/2015 12:00:00	
599	3045	SBE-37SMP 8076	T, C, P	20	02/04/2015 00:00:00	
550	3094	RBRsoloT 72231	T	10 s	02/04/2015 00:00:00	
500	3144	Aquadopp 11997	U, V, W, T, P	10	01/04/2015 12:00:00	
499	3145	SBE-37SMP 7311	T, C, P	20	02/04/2015 00:00:00	
450	3194	RBRsoloT 72235	T	10 s	02/04/2015 00:00:00	
400	3244	Aquadopp 6244	U, V, W, T, P	10	01/04/2015 12:00:00	
399	3245	SBE-37SMP 7294	T, C, P	20	02/04/2015 00:00:00	
350	3294	RBRsoloT 72233	T	10 s	02/04/2015 00:00:00	
300	3344	Aquadopp 6203	U, V, W, T, P	10	02/04/2015 12:00:00	
299	345	SBE-37SMP 7299	T, C, P	20	02/04/2015 00:00:00	
250	3394	RBRsoloT 72234	T	10 s	02/04/2015 00:00:00	
200	3444	Aquadopp 11979	U, V, W, T, P	10	02/04/2015 00:00:00	
199	3445	SBE-37SMP 7314	T, C, P	20	02/04/2015 00:00:00	
150	3494	RBRsoloT 72273	T	10 s	02/04/2015 00:00:00	
100	3544	Aquadopp 6260	U, V, W, T, P	10	01/04/2015 12:00:00	

99	3545	SBE-37SMP 7297	T, C, P	20	02/04/2015 00:00:00	
20	3524	Aquadopp 8111	U, V, W, T, P	10	02/04/2015 12:00:00	
19	3625	SBE-37SMP 7316	T, C, P	20	02/04/2015 00:00:00	
7	3637	RBRsoloT 72248	T	10 s	02/04/2015 00:00:00	Mounted between releases using cable ties; bent sensor and shield
		Releases: IXSEA AR861 1615 & 1618				

OP2 (2015-)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments
1500	1536	Aquadopp 8362	U, V, W, T, P	10	02/04/2015 12:00:00	
1499	1537	SBE-37SM 7387	T, C, P	10	02/04/2015 00:00:00	
1350	1686	Aquadopp 6213	U, V, W, T, P	10	02/04/2015 12:00:00	
1349	1687	SBE-37SM 7382	T, C, P	10	02/04/2015 00:00:00	
1200	1836	Aquadopp 6242	U, V, W, T, P	10	02/04/2015 12:00:00	
1199	1837	SBE-37SMP 7303	T, C, P	10	02/04/2015 00:00:00	
1125	1911	SBE-39 4713	T	10	02/04/2015 00:00:00	
1050	1986	Aquadopp 8093	U, V, W, T, P	10	02/04/2015 12:00:00	
1049	1987	SBE-37SMP 8075	T, C, P	20	02/04/2015 00:00:00	
975	2061	RBRsoloT 72243	T	10 s	02/04/2015 00:00:00	
900	2136	Aquadopp 12053	U, V, W, T, P	10	02/04/2015 12:00:00	
899	2137	SBE-37SMP 7295	T, C, P	20	02/04/2015 00:00:00	
825	2211	RBRsoloT 72242	T	10 s	02/04/2015 00:00:00	
750	2219	Aquadopp 6181	U, V, W, T, P	10	02/04/2015 12:00:00	
749	2286	SBE-37SMP 7293	T, C, P	20	02/04/2015 00:00:00	

675	2287	RBRsoloT 72244	T	10 s	02/04/2015 00:00:00	
600	2361	Aquadopp 8360	U, V, W, T, P	10	02/04/2015 12:00:00	
599	2436	SBE-37SMP 7292	T, C, P	20	02/04/2015 00:00:00	
550	2437	RBRsoloT 72275	T	10 s	02/04/2015 00:00:00	
500	2486	Aquadopp 1404	U, V, W, T, P	10	02/04/2015 00:00:00	Hit transom during deployment
499	2536	RBRsoloT 72246	T	10 s	02/04/2015 00:00:00	
450	2537	RBRsoloT 72245	T	10 s	02/04/2015 00:00:00	
415	2586	Novatech RF-700A1 W02-085 VHF radio beacon (159.480 MHz)				
415	2621	Novatech ST-400A W02-089 Xenon flash beacon (daylight off disabled)				
415	2621	RDI Longranger ADCP 22183	U, V, W (profile), T, P	60	02/04/2015 00:00:00	12 pings per ensemble, 26 16-m depth cells Mounted in MSI SB47-3000 buoy 10-14 SN 119
399	2637	SBE-37SMP 7289	T, C, P	20	02/04/2015 00:00:00	
350	2686	RBRsoloT 72247	T	10 s	02/04/2015 00:00:00	
300	2736	Aquadopp 6262	U, V, W, T, P	10	01/04/2015 12:00:00	
299	2737	SBE-37SMP 7291	T, C, P	20	02/04/2015 00:00:00	
250	2786	RBRsoloT 72249	T	10 s	02/04/2015 00:00:00	
200	2836	Aquadopp 1415	U, V, W, T, P	10	02/04/2015 00:00:00	
199	2837	SBE-37SMP 7290	T, C, P	20	02/04/2015 00:00:00	
150	2886	RBRsoloT 72250	T	10 s	02/04/2015 00:00:00	
100	2936	Aquadopp 8097	U, V, W, T, P	10	02/04/2015 12:00:00	
99	2937	RBRsoloT 72232	T	10 s	02/04/2015 00:00:00	
17	3019	Aquadopp 1430	U, V, W, T, P	10	02/04/2015 00:00:00	
16	3020	SBE-37SMP 7288	T, C, P	20	02/04/2015 00:00:00	
7	3028	Releases: IXSEA AR861 565 & 1942				

OP3 (2015-)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments
530	1208	Novatech RF-700A1 V08-056 VHF radio beacon (159.480 MHz)				On triangular McLane top float
530	1208	Novatech ST-400A W02-088 Xenon flash beacon (daylight off disabled)				
508	1230	SBE-39 4897	T, P	10	02/04/2015 00:00:00	
300	1438	Aquadopp 9392	U, V, W, T, P	10	02/04/2015 12:00:00	Has 13 mm hardware on clamp
299	1439	SBE-37SM 7383	T, C, P	10	02/04/2015 00:00:00	
50	1688	Aquadopp 9378	U, V, W, T, P	10	01/04/2015 12:00:00	Has 9/16" hardware on clamp
16	1722	SBE-37SM 7386	T, C, P	10	02/04/2015 00:00:00	
7	1731	Release: ORE 8242xs 32147				

OP4 (2015-)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments
1132	1840	Novatech RF-700A1 W02-086 VHF radio beacon (160.725 MHz)				On triangular McLane top float
1132	1840	Novatech ST-400A W02-087 Xenon flash beacon (daylight off disabled)				
1116	1856	RCM-11 521	U, V, T, C	60	05/04/2015 14:00:00	DSU 15236; battery pack consists of 6 new SAFT LSH 20 cells
1109	1863	SBE-37SM 2707	T, C, P	10	02/04/2015 00:00:00	
760	2212	RCM-11 532	U, V, T, C	60	05/04/2015 14:00:00	DSU 15238; battery consists of 5 new SAFT LSH 20 cells and 1 partly used Electrochem BCX85-LMS cell
753	2219	SBE-39 4418	T	10	02/04/2015 00:00:00	

54	2918	RCM-11 592	U, V, T, C	60	05/04/2015 14:00:00	DSU 15239; battery consists of 4 new SAFT LSH 20 cells and 2 partly used Electrochem BCX85-LMS cells
16	2956	SBE-37SM 2956	T, C, P	10	02/04/2015 00:00:00	
7	2965	Release: IXSEA AR861 562				

OP5 (2015-)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments
934	2489	Novatech RF-700A1 Y07-010 VHF radio beacon (160.725 MHz)				On rectangular McLane top float
934	2489	Novatech ST-400A Y07-011 Xenon flash beacon (daylight off disabled)				
900	2523	Aquadopp 6226	U, V, W, T, P	10	02/04/2015 00:00:00	
899	2524	SBE-37SMP 12473	T, C, P	10	02/04/2015 00:00:00	
825	2598	RBRsoloT 72225	T	10 s	02/04/2015 00:00:00	
750	2673	Aquadopp 6198	U, V, W, T, P	10	02/04/2015 00:00:00	
749	2674	SBE-37SMP 12475	T, C, P	10	02/04/2015 00:00:00	
675	2748	RBRsoloT 72224	T	10 s	02/04/2015 00:00:00	
600	2823	Aquadopp 6180	U, V, W, T, P	10	02/04/2015 00:00:00	
599	2824	SBE-37SMP 12476	T, C, P	10	02/04/2015 00:00:00	
550	2873	RBRsoloT 72221	T	10 s	02/04/2015 00:00:00	
500	2923	RBRsoloT 72272	T	10 s	02/04/2015 00:00:00	
450	2973	Aquadopp 6263	U, V, W, T, P	10	02/04/2015 00:00:00	
449	2974	SBE-37SMP 12469	T, C, P	10	02/04/2015 00:00:00	

400	3023	RBRsoloT 72220	T	10 s	02/04/2015 00:00:00	
350	3073	RBRsoloT 72223	T	10 s	02/04/2015 00:00:00	
300	3123	Aquadopp 6112	U, V, W, T, P	10	02/04/2015 00:00:00	
299	3124	SBE-37SMP 12464	T, C, P	10	02/04/2015 00:00:00	
250	3173	RBRsoloT 72227	T	10 s	02/04/2015 00:00:00	
200	3223	Aquadopp 5993	U, V, W, T, P	10	02/04/2015 00:00:00	
199	3224	SBE-37SMP 12455	T, C, P	10	02/04/2015 00:00:00	
150	3273	RBRsoloT 72226	T	10 s	02/04/2015 00:00:00	
100	3323	Aquadopp 6236	U, V, W, T, P	10	01/04/2015 12:00:00	
99	3324	SBE-37SMP 12456	T, C, P	10	02/04/2015 00:00:00	
50	3373	Aquadopp 6000	U, V, W, T, P	10	01/04/2015 12:00:00	
49	3374	RBRsoloT 72229	T	10 s	02/04/2015 00:00:00	
19	3404	SBE-37SMP 12458	T, C, P	10	02/04/2015 00:00:00	
7	3416	Release: IXSEA AR861 1356				

OP6 (2015-)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments
374	1964	Novatech RF-700A1 Y07-009 VHF radio beacon (160.725 MHz)				On triangular McLane top float
360	1978	Aquadopp 9250	U, V, W, T, P	10	02/04/2015 00:00:00	
50	2288	Aquadopp 9264	U, V, W, T, P	10	02/04/2015 00:00:00	
19	2319	SBE-37SM 8267	T, C	10	02/04/2015 00:00:00	
7	2331	Release: IXSEA AR861 1356				

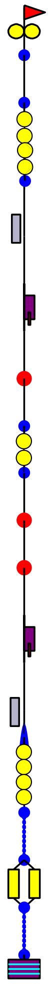
OP7 (2015-)

Height above bottom (m)	Nominal Depth (m)	Instrument/sn	Parameters measured	Sample interval (min)	Start time, UTC (dd/mm/yyyy hh:mm:ss)	Comments
1500	1560	Aquadopp 8059	U, V, W, T, P	10	02/04/2015 12:00:00	
1499	1561	SBE-37SMP 12463	T, C, P	10	02/04/2015 00:00:00	wire clamp damaged, taped
1350	1710	Aquadopp 8556	U, V, W, T, P	10	01/04/2015 12:00:00	
1349	1711	SBE-37SM 7380	T, C, P	10	02/04/2015 00:00:00	
1200	1860	Aquadopp 11992	U, V, W, T, P	10	02/04/2015 12:00:00	
1199	1861	SBE-37SMP 7315	T, C, P	10	02/04/2015 00:00:00	
1125	1935	SBE-39 4409	T	10	02/04/2015 00:00:00	
1050	2010	Aquadopp 6212	U, V, W, T, P	10	02/04/2015 12:00:00	
1049	2011	SBE-37SMP 7306	T, C, P	20	02/04/2015 00:00:00	
975	2085	RBRsoloT 72264	T	10 s	02/04/2015 00:00:00	
900	2160	Aquadopp 6225	U, V, W, T, P	10	02/04/2015 12:00:00	
899	2161	SBE-37SMP 7305	T, C, P	20	02/04/2015 00:00:00	
825	2235	RBRsoloT 72240	T	10 s	02/04/2015 00:00:00	
750	2310	Aquadopp 12010	U, V, W, T, P	10	02/04/2015 12:00:00	
749	2311	SBE-37SMP 7381	T, C, P	20	02/04/2015 00:00:00	
675	2385	RBRsoloT 72237	T	10 s	02/04/2015 00:00:00	
600	2460	Aquadopp 8080	U, V, W, T, P	10	02/04/2015 12:00:00	
599	2461	SBE-37SMP 7304	T, C, P	20	02/04/2015 00:00:00	
550	2510	RBRsoloT 72241	T	10 s	02/04/2015 00:00:00	
500	2560	Aquadopp 12047	U, V, W, T, P	10	02/04/2015 00:00:00	
499	2561	RBRsoloT 72230	T	10 s	02/04/2015 00:00:00	
450	2610	RBRsoloT 72271	T	10 s	02/04/2015 00:00:00	

415	2645	Novatech RF-700A1 W02-084 VHF radio beacon (154.585 MHz)				
415	2645	Novatech ST-400A Y07-012 Xenon flash beacon (daylight off disabled)				
415	2645	RDI Longranger ADCP 3301	U, V, W (profile), T, P	60	09/04/2015 01:00:00	12 pings per ensemble, 26 16-m depth cells Mounted in MSI SB47-3000 buoy 10-14 SN 120
399	2661	SBE-37SMP 7312	T, C, P	20	02/04/2015 00:00:00	
350	2710	RBRsoloT 72236	T	10 s	02/04/2015 00:00:00	
300	2760	Aquadopp 6224	U, V, W, T, P	10	01/04/2015 12:00:00	
299	2761	SBE-37SM 7385	T, C, P	10	02/04/2015 00:00:00	
250	2810	RBRsoloT 72239	T	10 s	02/04/2015 00:00:00	
200	2860	Aquadopp 12016	U, V, W, T, P	10	02/04/2015 12:00:00	
199	2861	SBE-37SMP 12462	T, C, P	20	02/04/2015 00:00:00	
150	2910	RBRsoloT 72222	T	10 s	02/04/2015 00:00:00	
100	2960	Aquadopp 11990	U, V, W, T, P	10	02/04/2015 12:00:00	
99	2961	RBRsoloT 72238	T	10 s	02/04/2015 00:00:00	
20	3040	Aquadopp 6276	U, V, W, T, P	10	02/04/2015 12:00:00	
19	3041	SBE-37SMP 7298	T, C, P	20	02/04/2015 00:00:00	
7	3053	Releases: IXSEA AR861 1616 & 1617				

Appendix E: Mooring diagrams

JR252 MOORING M3 2011 DEPLOYMENT



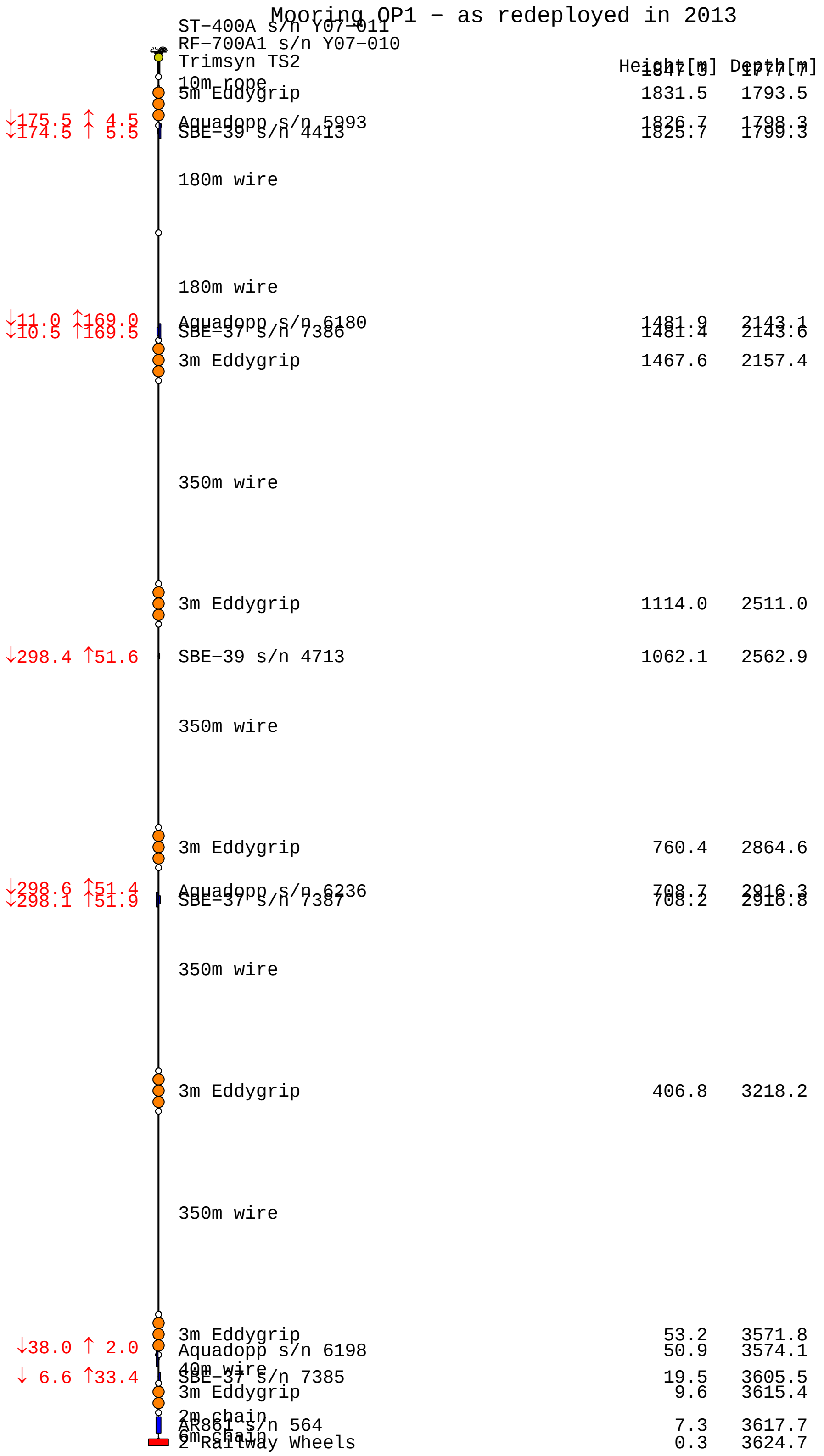
Depth	Element	Serial Number	Distance between elements	Wire marker	Line length/ type
4023 m	McLane Top w/ radio ch 71 156.575 MHz	J05-055			
			srs 10 m		poly rope, 10 m
4034 m	17" glass x 4 on 2x 2 m 3/8" chain		srs 88319, 88451 88458, 88464 srs		
			5 m	5	
4041 m	Aquadopp 6k	2317			
			45 m		3/16 wire, 250 m
4087 m	Microcat T,C,P	1351		50	
			125 m		
4213 m	SBE39 TP	1247		175	
			75 m		
4288 m	17" glass x 2 on 2 m 3/8" chain		srs 88463, 88447 srs		
			25 m		
4315 m	SBE39 Trec	0229		25	
			125 m		3/16 wire, 250 m
4441 m	SBE39 Trec	0083		150	
			95 m		
4536 m	Microcat T,C,P	4119		245	
			3 m		
4542 m	Aquadopp 6k	1752		248	
			2 m		
4545 m	17" glass x 4 on 2x2m 3/8" chain		srs 88457, 88459 88318, 88444 srs		
			2 m		3/8" chain
4551 m	8242 release(2)	33152 33147	Srs Srs		
			6 m		3/8" chain
4560 m	anchor 350 kg		Srs		

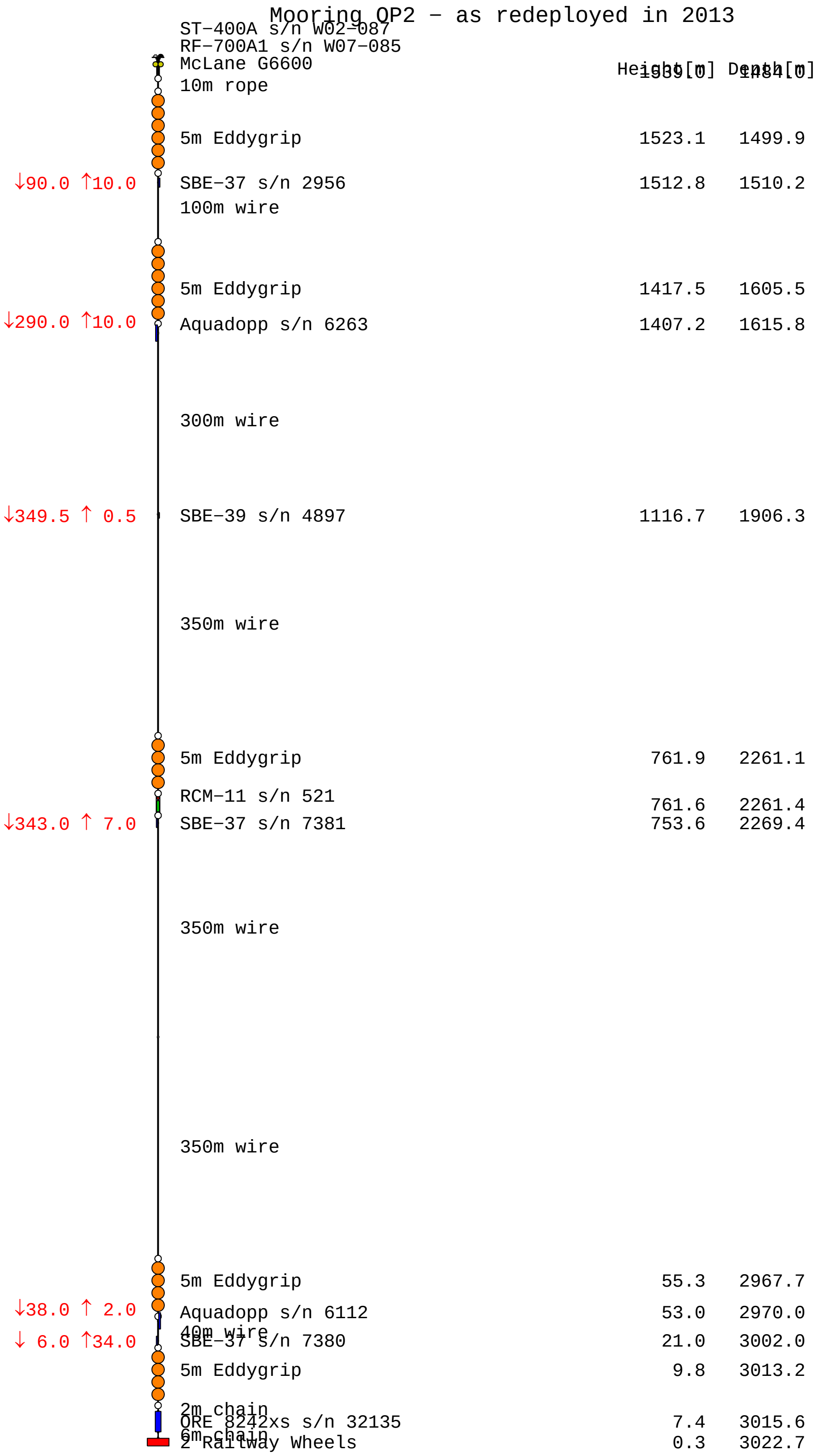
Anchor Drop: Lat S: 63 31.35' S Lon W: 041 46.197' W Depth: 4547 m

Date/Time (GMT): 23 March 2011 2147 Z

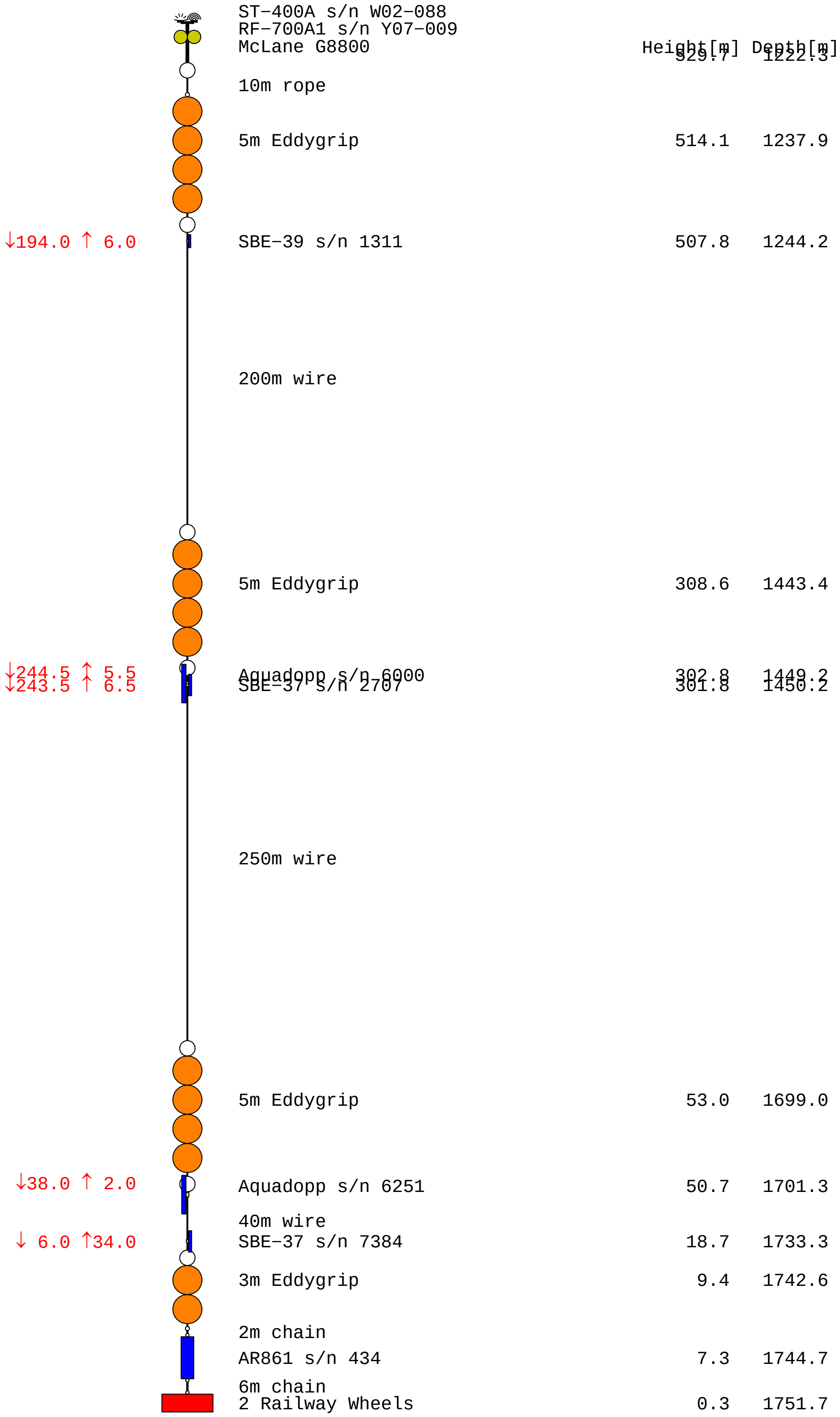
Triangulated Position: 63 31.303' S 041 45.998' W

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

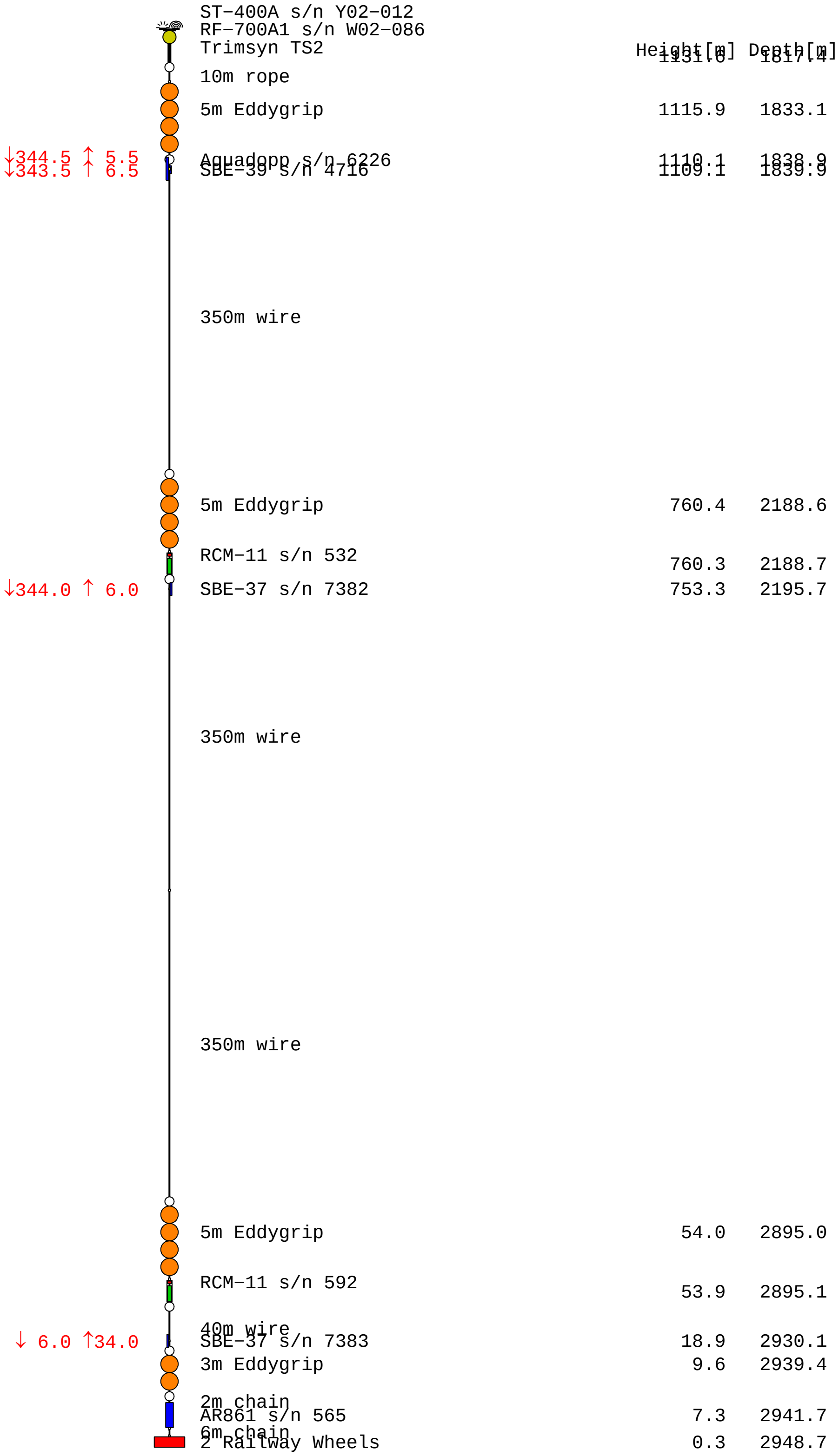

Mooring OP1 − as redeployed in 2013
ST−400A s/n Y07−011
RF−700A1 s/n Y07−010
Trimsyn TS2
Height[m] Depth[m]
1847.3 1777.7
10m rope
5m Eddygrip 1831.5 1793.5
↓175.5 ↑ 4.5 Aquadopp s/n 5993 1826.7 1798.3
↓174.5 ↑ 5.5 SBE−39 s/n 4413 1825.7 1799.3
180m wire
180m wire
↓11.0 ↑169.0 Aquadopp s/n 6180 1481.9 2143.1
↓10.5 ↑169.5 SBE−37 s/n 7386 1481.4 2143.6
3m Eddygrip 1467.6 2157.4
350m wire
3m Eddygrip 1114.0 2511.0
↓298.4 ↑51.6 SBE−39 s/n 4713 1062.1 2562.9
350m wire
3m Eddygrip 760.4 2864.6
↓298.6 ↑51.4 Aquadopp s/n 6236 708.7 2916.3
↓298.1 ↑51.9 SBE−37 s/n 7387 708.2 2916.8
350m wire
3m Eddygrip 406.8 3218.2
350m wire
3m Eddygrip 53.2 3571.8
↓38.0 ↑ 2.0 Aquadopp s/n 6198 50.9 3574.1
40m wire
↓ 6.6 ↑33.4 SBE−37 s/n 7385 19.5 3605.5
3m Eddygrip 9.6 3615.4
2m chain
AR861 s/n 564 7.3 3617.7
6m chain
2 Railway Wheels 0.3 3624.7


Mooring OP2 - as redeployed in 2013
Height[m] Depth[m]
ST-400A s/n W02-087
RF-700A1 s/n W07-085
McLane G6600 1539.0 1484.0
10m rope
5m Eddygrip 1523.1 1499.9
↓90.0 ↑10.0 SBE-37 s/n 2956 1512.8 1510.2
100m wire
5m Eddygrip 1417.5 1605.5
↓290.0 ↑10.0 Aquadopp s/n 6263 1407.2 1615.8
300m wire
↓349.5 ↑ 0.5 SBE-39 s/n 4897 1116.7 1906.3
350m wire
5m Eddygrip 761.9 2261.1
RCM-11 s/n 521 761.6 2261.4
↓343.0 ↑ 7.0 SBE-37 s/n 7381 753.6 2269.4
350m wire
350m wire
5m Eddygrip 55.3 2967.7
↓38.0 ↑ 2.0 Aquadopp s/n 6112 53.0 2970.0
40m wire
↓ 6.0 ↑34.0 SBE-37 s/n 7380 21.0 3002.0
5m Eddygrip 9.8 3013.2
2m chain
ORE 8242xs s/n 32135 7.4 3015.6
6m chain
2 Railway Wheels 0.3 3022.7

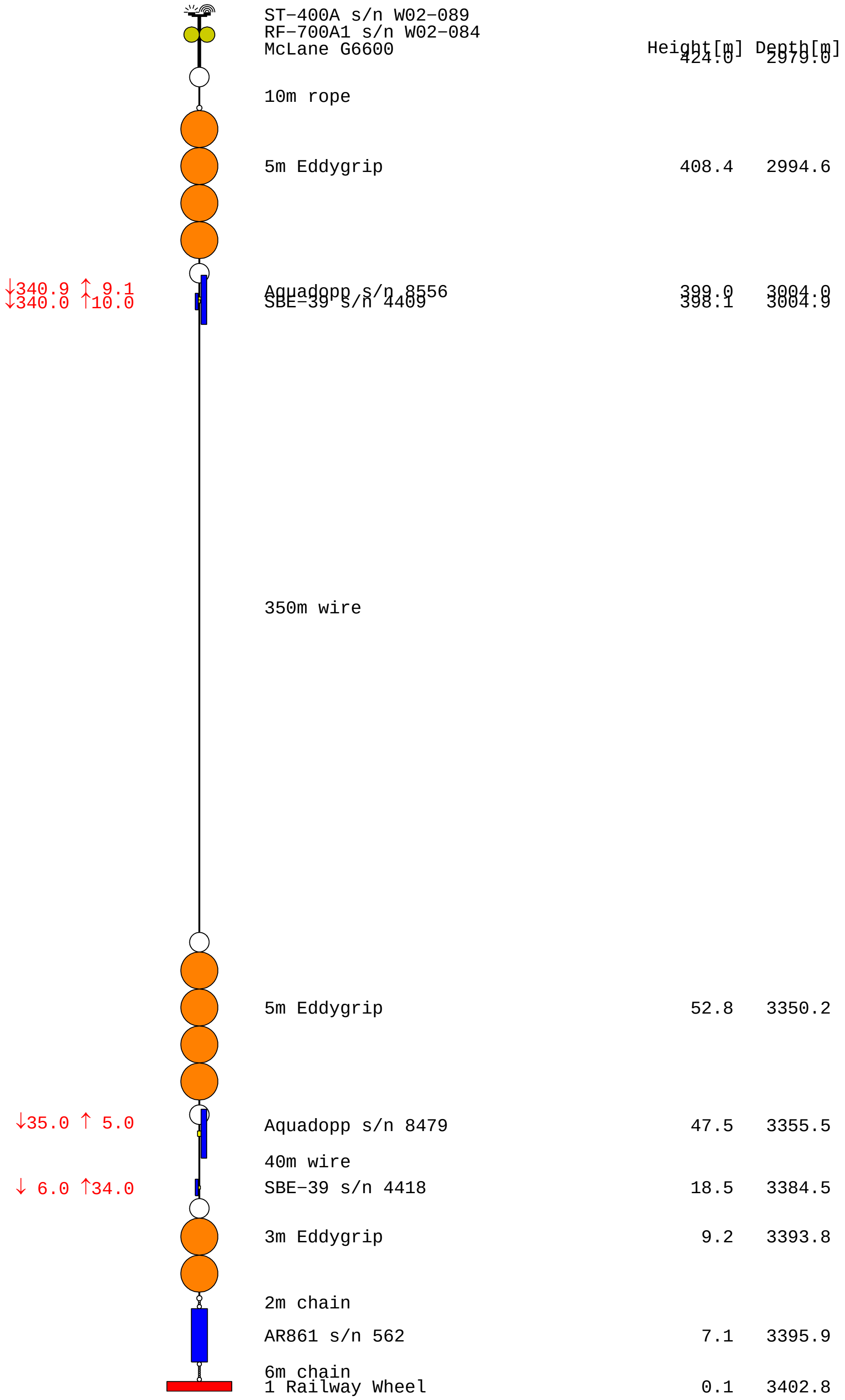
Mooring OP3 – as redeployed in 2013



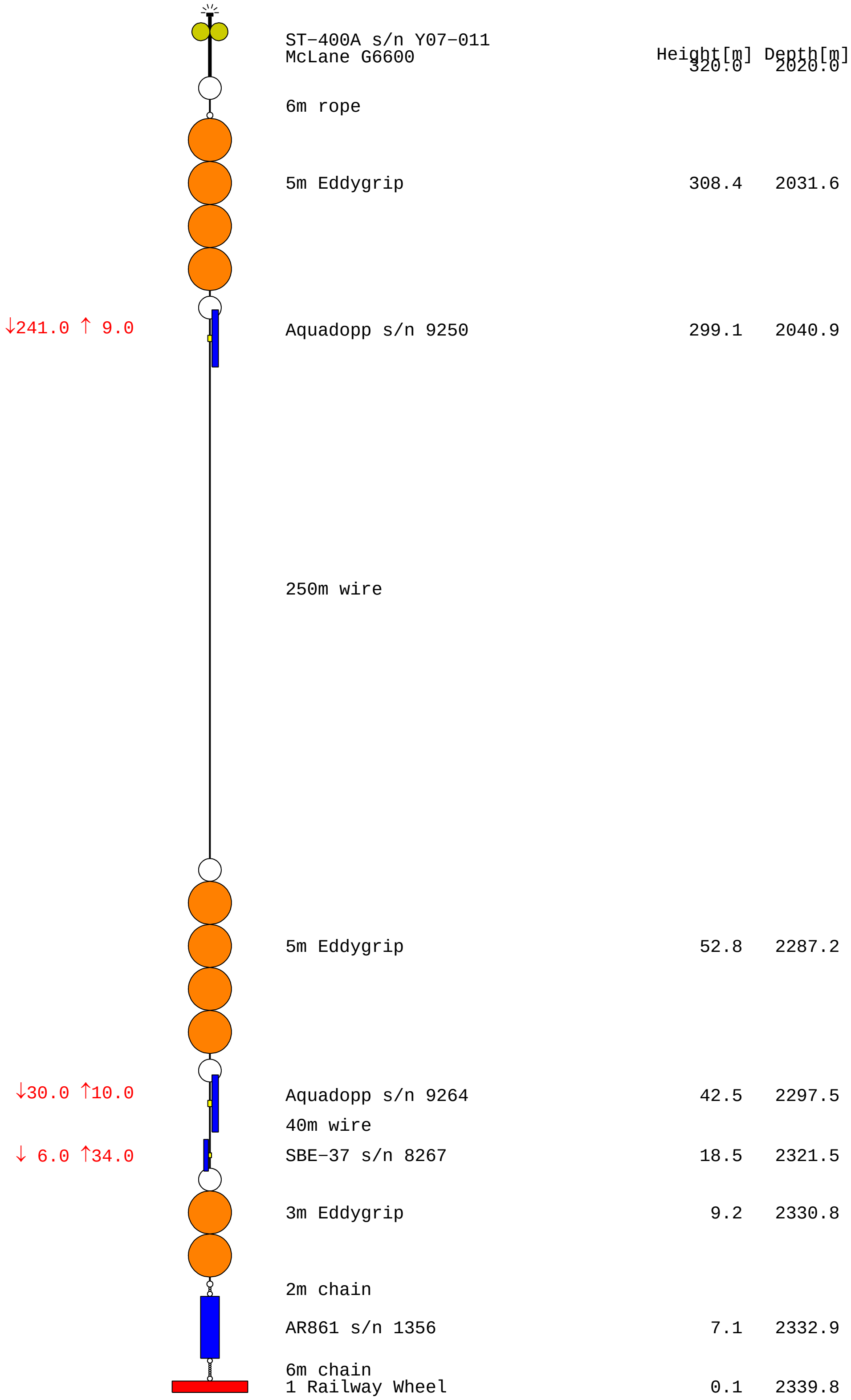
Mooring OP4 – as redeployed in 2013



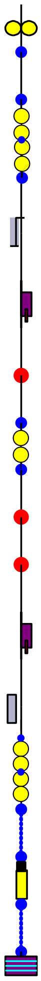
Mooring OP5 - as redeployed in 2013



Mooring OP6 – as redeployed in 2013



Weddell Orkney Plateau Moorings   Mooring ID: **M2**   Cruise: JR272D/310



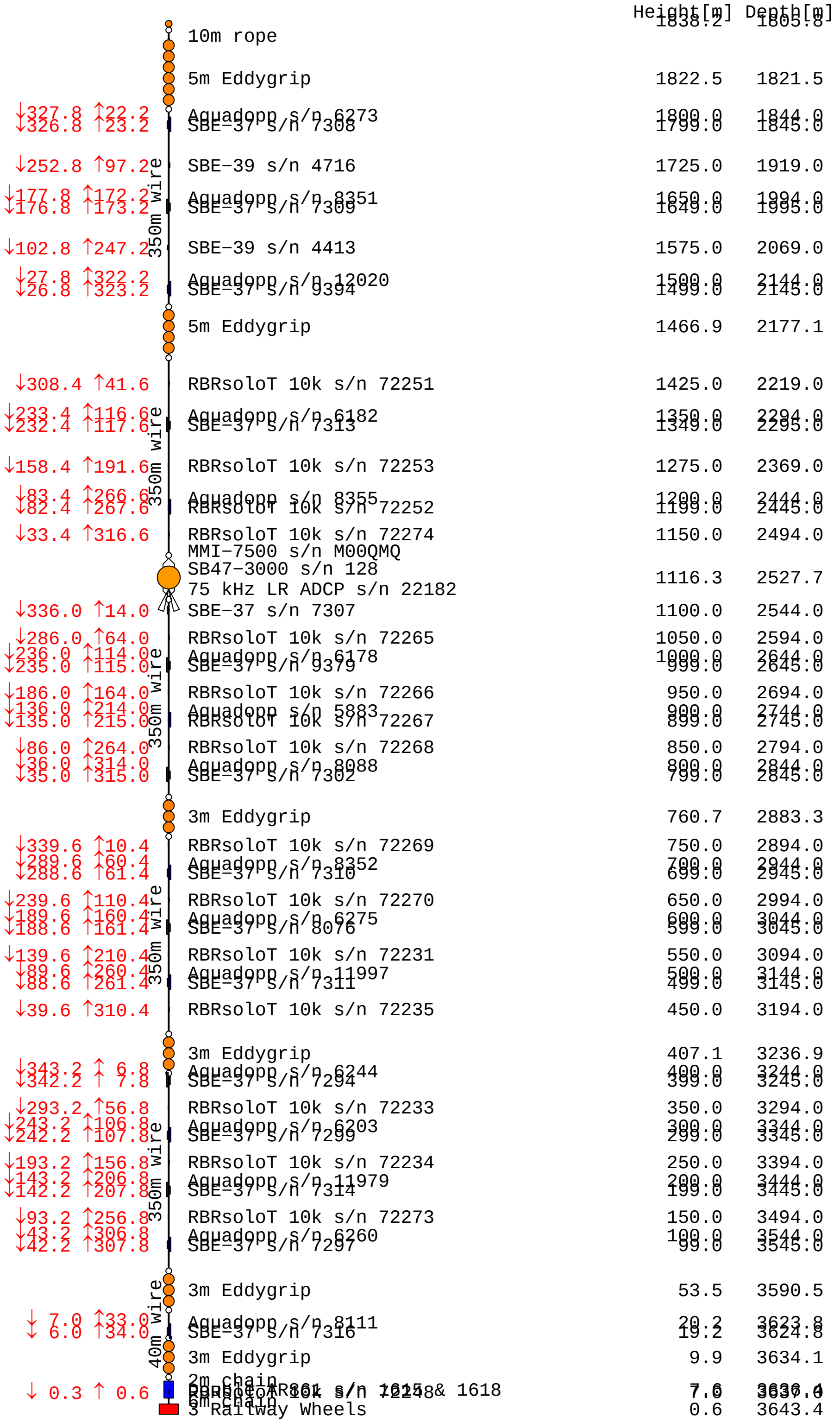
Nom Depth	Element	Serial Number		Distance between elements	Time in water	Line length/ type
2492 m	McLane Top[2] Beacon 159.480 MHz	W08-053	srs	10 m		poly rope, 10 m
	Flasher	V08-057	srs			
2504 m	17" glass x 4 on 2x 2 m 3/8" chain		srs	RIBBED HARD HATS		
			srs	5m		
2513 m	Aquadopp 6k	9380			20:26	**3/16 wire, 250 m**
2558 m	Microcat T,C,P	2678		45m	20:06	
				125 m		
2683 m	SBE39 T, P	4602		75 m	20:02	
2758 m	17" glass x 2 on 2 m 3/8" chain		srs	RIBBED HARD HATS	19:58	
			srs	25 m		
2785 m	SBE39 T,P	1235		75m		
2860 m	SBE39 T,P	1231		140m	19:43	**3/16 wire, 250 m**
3005 m	Microcat T,C,P SMP	6557		3 m	19:36	
3008 m	Aquadopp 6k	2807		2 m	19:32	
3010 m	17" glass x 4 on 2x2m 3/8" chain		srs	OCTAGONAL HARD HATS FROM M3 RECOVERY-INSPECTED, NEW CH/SH		
			srs			
			srs	2 m		3/8" chain
3016 m	8242 release enable 611400 disable 611446 RELEASE: 630044	49027	Srs			
			Srs	7 m		3/8" chain
3024 m	anchor 350 kg		Srs		19:26	

Target Position: Lat S 62 36.924' Lon W 043 14.618' Target Depth 3049m

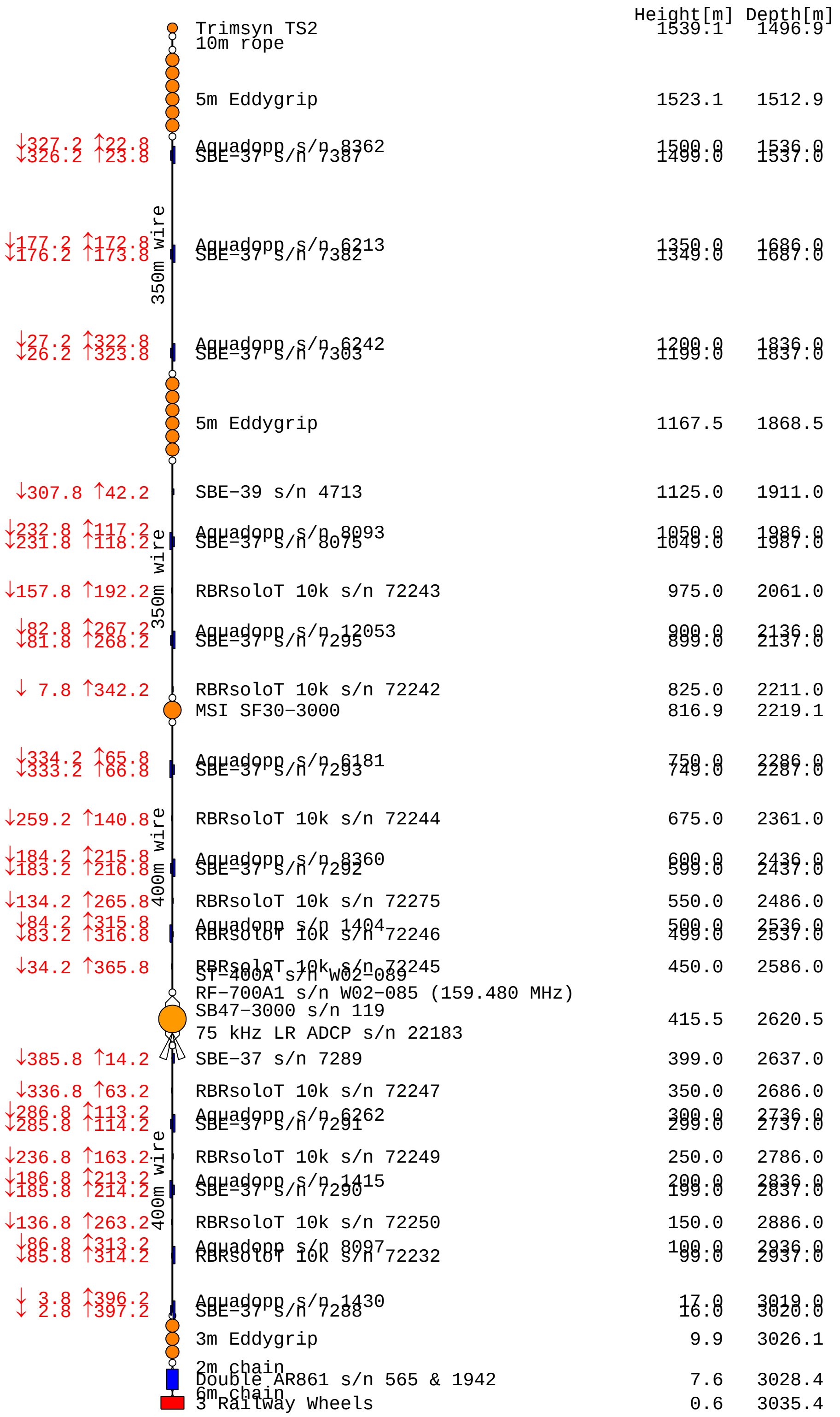
Anchor Drop: Lat S: 62 33.390 Lon W: 042 57.556 Depth: 3031 (EM122)
Date/Time (GMT): 18 MAR 2015 20:35 On Bottom: 21:08

Triangulated Pos: Lat S: 62 33.320' Lon W: 042 57.353' Depth: 3024 m

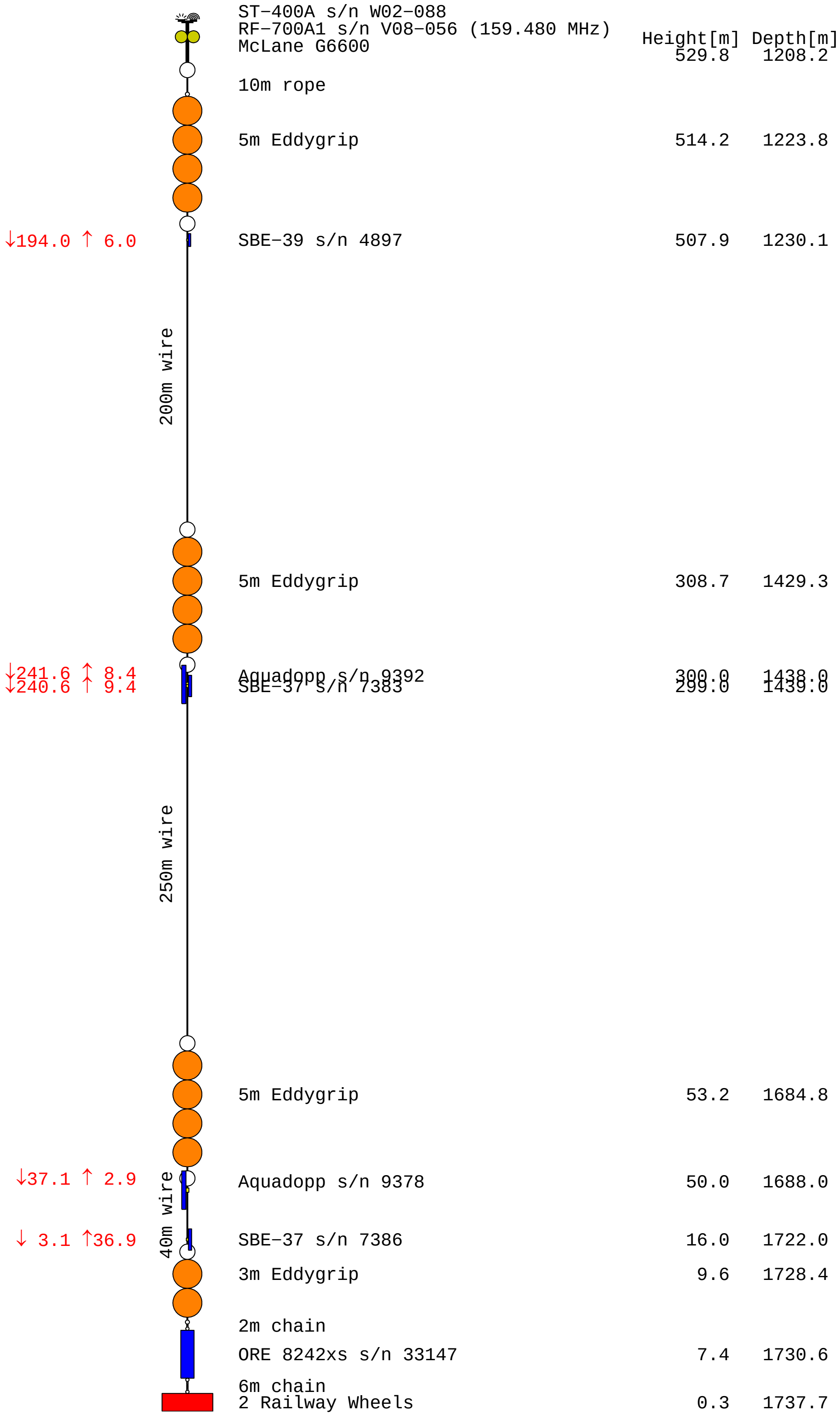
Mooring OP1 − as deployed in 2015

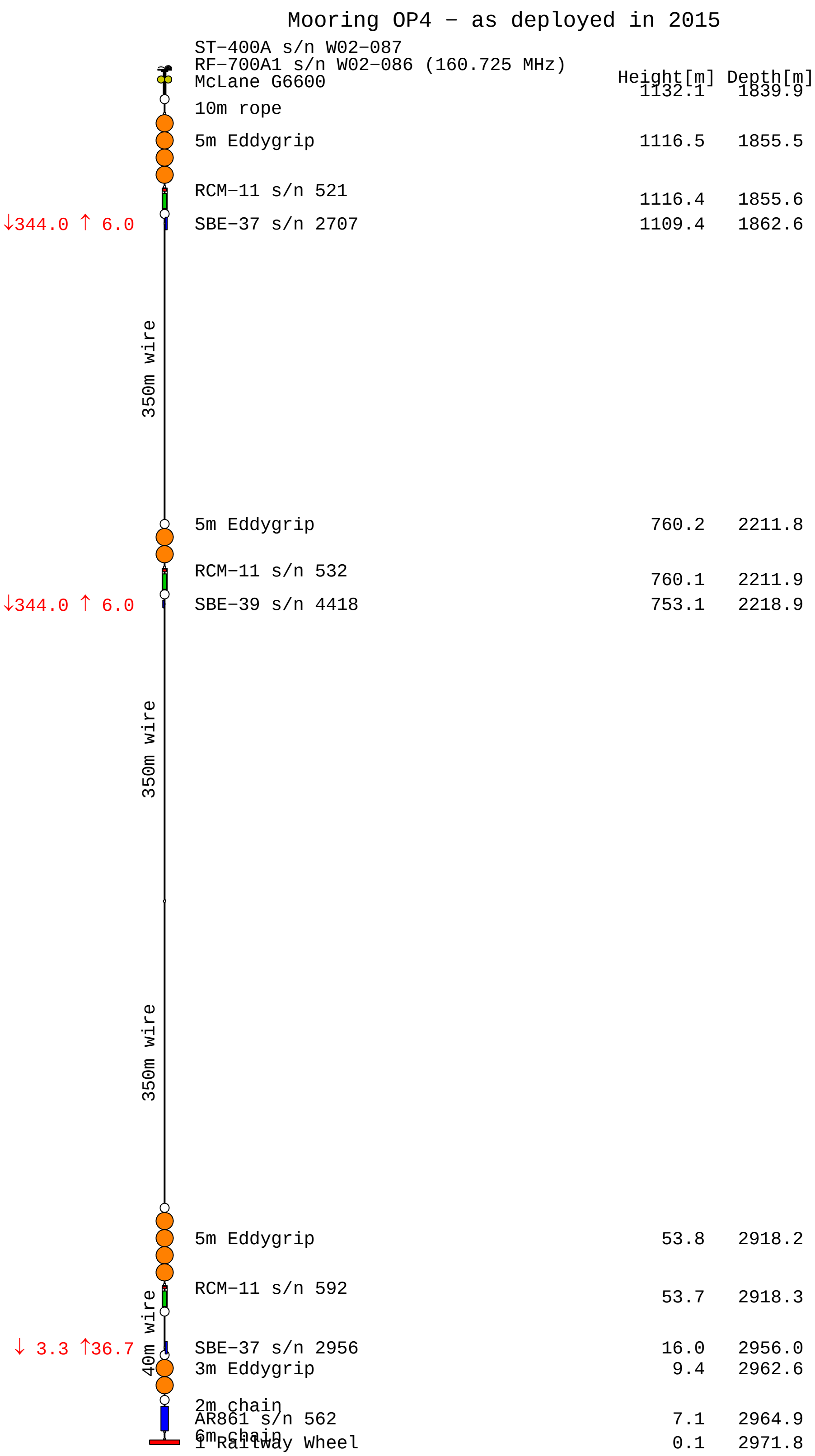


Mooring OP2 – as deployed in 2015



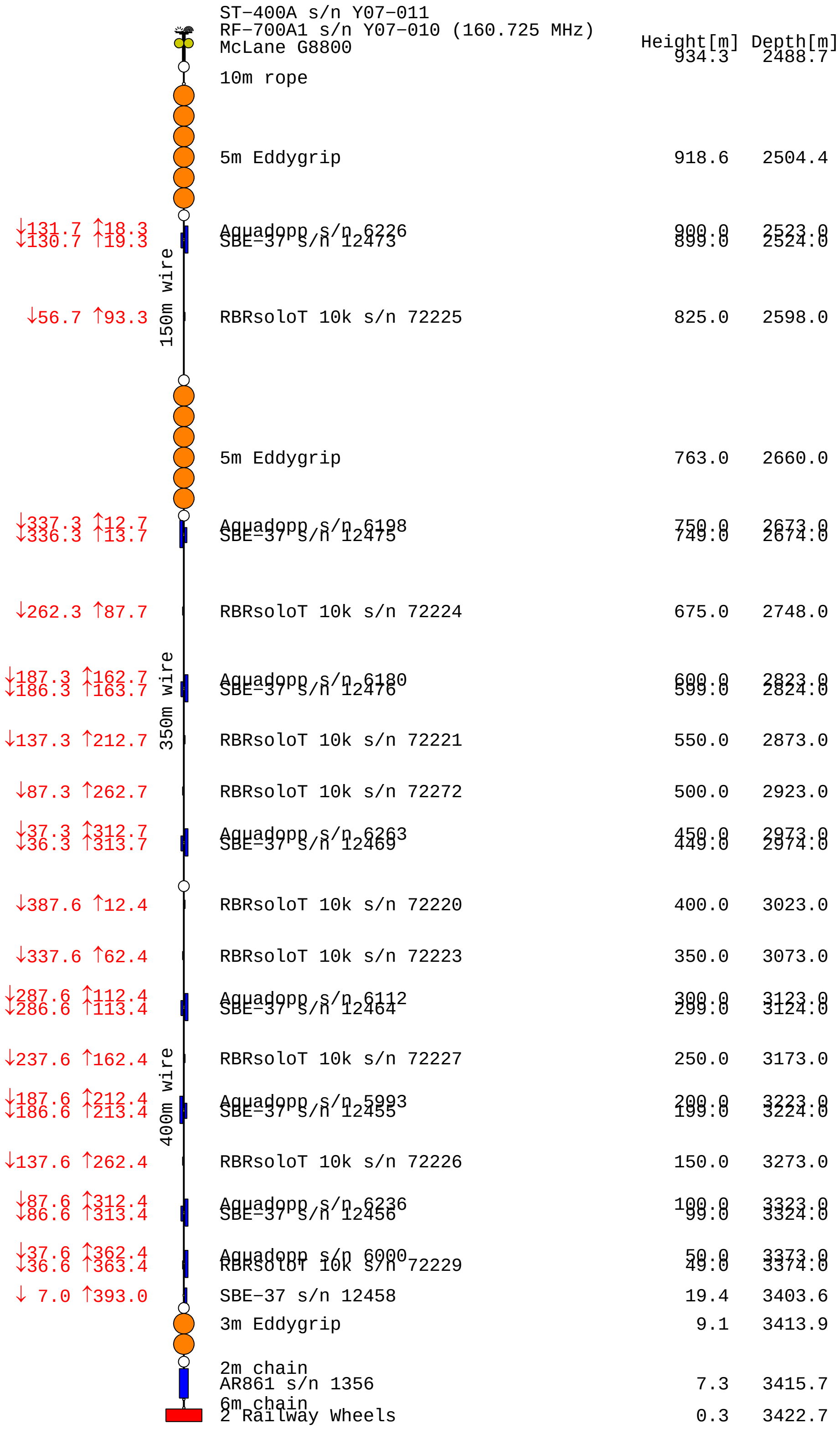
Mooring OP3 – as deployed in 2015



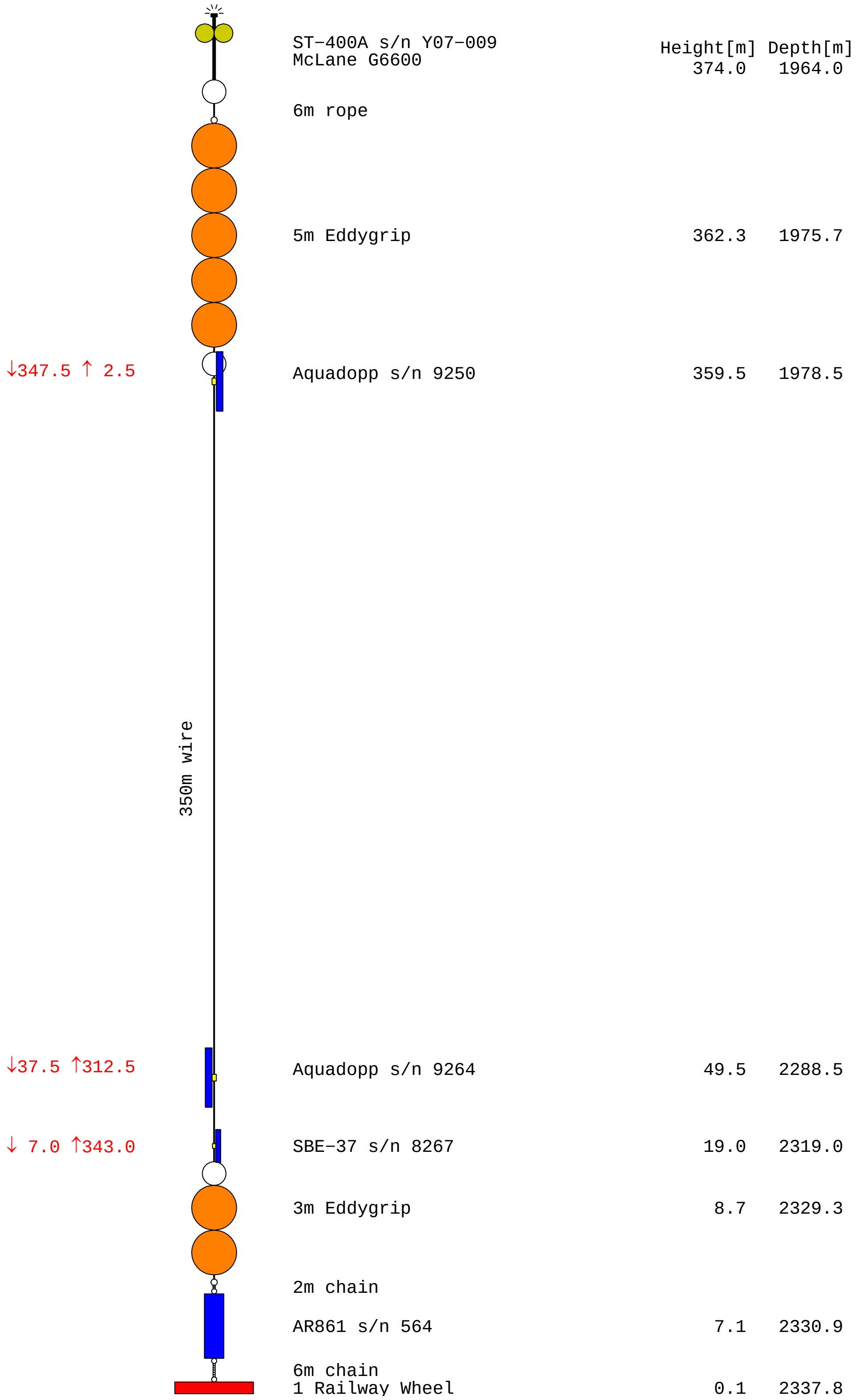


Mooring OP4 - as deployed in 2015
ST-400A s/n W02-087
RF-700A1 s/n W02-086 (160.725 MHz)
McLane G6600
Height[m] Depth[m]
1132.1 1839.9
10m rope
5m Eddygrip 1116.5 1855.5
RCM-11 s/n 521 1116.4 1855.6
↓344.0 ↑ 6.0
SBE-37 s/n 2707 1109.4 1862.6
350m wire
5m Eddygrip 760.2 2211.8
RCM-11 s/n 532 760.1 2211.9
↓344.0 ↑ 6.0
SBE-39 s/n 4418 753.1 2218.9
350m wire
350m wire
5m Eddygrip 53.8 2918.2
RCM-11 s/n 592 53.7 2918.3
40m wire
↓ 3.3 ↑36.7
SBE-37 s/n 2956 16.0 2956.0
3m Eddygrip 9.4 2962.6
2m chain
AR861 s/n 562 7.1 2964.9
6m chain
1 Railway Wheel 0.1 2971.8

Mooring OP5 – as deployed in 2015



Mooring OP6 − as deployed in 2015



Mooring OP7 − as deployed in 2015