National Oceanography Centre

Cruise Report No. 09

RRS *Discovery* Cruise D359
17 DEC 2010-14 JAN 2011

RAPID moorings cruise report

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2011

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ABSTRACT

This cruise report covers scientific operations conducted during RRS *Discovery* Cruise D359. Cruise D359 departed from São Antonio, Cape Verde on Friday 17th December 2010 arriving Santa Cruz de Tenerife Friday 14th December 2011.

The purpose of the cruise was the refurbishment of an array of moorings on the mid-Atlantic Ridge and off the Moroccan Coast at a nominal latitude of 26.5°N. The moorings are part of a purposeful Atlantic wide mooring array for monitoring the Atlantic Meridional Overturning Circulation and Heat Flux. The array is a joint UK/US programme and is known as the RAPID-WATCH/MOCHA array. Information and data from the project can be found on the web site hosted by the National Oceanography Centre Southampton http://www.noc.soton.ac.uk/rapidmoc and also from the British Oceanographic Data Centre http://www.bodc.ac.uk.

The RAPID transatlantic array consists of 24 moorings of which 21 are maintained by the UK, and 20 bottom landers of which 16 are maintained by the UK. The moorings are primarily instrumented with self logging instruments measuring conductivity, temperature and pressure. Direct measurements of currents are made in the shallow and deep western boundary currents. The bottom landers are instrumented with bottom pressure recorders (also known as tide gauges), measuring the weight of water above the instrument.

The RAPID naming convention for moorings is Western Boundary (WB), Eastern Boundary (EB) and Mid-Atlantic Ridge (MAR) indicating the general sub-regions of the array. Numbering increments from west to east. An L in the name indicates a bottom lander, M indicates a mini-mooring with only one instrument, H indicates a mooring on the continental slope. During D359 we recovered: MAR0, MAR1L4, MAR1, MAR2, MAR3, MAR3L4, EB1, EB1L7, EBHi, EBH1, EBH1L7, EBH2, EBH3, EBH4, EBP2, EBH5, EBM5. We did not recover EBM1, EBM4, EBM6, EBH1 and MAR3. We deployed: MAR0, MAR1L7, MAR1, MAR2, MAR3, MAR3L6, EB1, EB1L7, EBHi, EBH1, EBH1L8, EBH2, EBH3, EBH4, EBP2, EBH5. A sediment trap mooring NOGST was also recovered and redeployed for the Ocean Biogeochemistry and Ecosystems Group at the NOCS.

CTD stations were conducted at convenient times throughout the cruise for purposes of providing pre and post deployment calibrations for mooring instrumentation and for testing mooring releases prior to deployment.

Shipboard underway measurements were systematically logged, processed and calibrated, including: waves (spectra of energy and significant wave height), surface meteorology (air pressure, temperature, wind speed and direction and radiation (total incident and photosynthetically active), 6m-depth sea temperatures and salinities, water depth, navigation (differential GPS measurements feeding two independent and different receivers, heading, pitch and roll from a four antenna Ashtec ADU5 receiver, gyro heading and ships speed relative to the water using an electro-magnetic log). Water velocity profiles from 15m to approximately 500m depth were obtained using a ship mounted 75 kHz acoustic Doppler current profiler. Sea-water samples from CTD stations and of the sea-surface were obtained for calibration and analysed on a salinometer referencing these samples against standard sea water. For velocity data (wind and currents) measured relative to the ship considerable effort was made to obtain the best possible earth-referenced velocities.

Four APEX argo floats supplied by the Met Office were deployed at pre-assigned locations, filling gaps in the network.

KEYWORDS

RAPID, RAPID-°©-WATCH, MOCHA, moorings, landers, eastern boundary, mid-Atlantic Ridge, western boundary, conductivity, temperature, pressure, velocity, bottom pressure, tide gauges, current meters, Interocean S4, Anderra RCM11, Sea-Bird, microcat, SBE37, SBE911, SBE26, SBE53

ISSUING ORGANISATION

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Table 1.1: Scientific and Technical Personnel. National Oceanography Centre Southampton (NOCS). Sensors and Moorings group (S&M).

Name	Role	Affiliation
Stuart A. Cunningham	Principal Scientist	NOCS, Marine Physics and Ocean Climate Group
Eleanor Frajka-Williams	Scientist	NOCS, Marine Physics and Ocean Climate Group
Steven G. Alderson	Scientist	NOCS, Marine Science and Modelling Group
Louis Clement	Ph.D. Student	University of Southampton, School of Ocean and Earth Science
Holly E. Pelling	Ph.D. Student	Bangor University, School of Ocean Sciences
Aïssa Benazzouz	Observer	Institut National de Recherche Halieutique (INRH), Casablanca, Morocco
Chris Barnard	Senior Technical Officer	NOCS, S&M
Steve Whittle	Technician	NOCS, S&M
Colin Hutton	Technician	NOCS, S&M
Christian Crowe	Technician	NOCS, S&M
David Childs	Technician	NOCS, S&M
Thomas Roberts	Technician	NOCS, Base Engineering

Table 1.2: Ship's Personnel

Rank	**Name**
Master	Peter Newton
Chief Officer	Mike Hood
2nd Officer	Nick Norrish
3rd Officer	Tom Hemphill
Chief Engineer	Mark Coultas
2nd Engineer	Mike Murray
3rd Engineer	John Harnett
3rd Engineer	Steve Sproul
Motorman	David Doutch
ETO	Karl Smith-Jaynes
CPO (Deck)	Stuart Cook
CPO (Scientific)	Mike Trevaskis
PO (Deck)	Steve Duncan
SG1A	Ian Cantlie
SG1A	Mark Moore
SG1A	Ian Mills
SG1A	Mark Throup
Purser	David Hartshorne
Chef	Peter Lynch
2nd Chef	Wally Link
Steward	Oliver Birch

2. Itinerary

Cruise D359 departed from São Antonio, Cape Verde on Friday 17th December 2010 at 1800 local and arrived in Santa Cruz de Tenerife, Tenerife on Friday 14th January 2011 at 1400.

This is the 22nd RAPID cruise since Spring 2004. The cruises to date are shown in Appendix J.

3. Introduction

The Atlantic Meridional Overturning Circulation (AMOC) at 26.5°N carries a northward heat flux of 1.3 PW. North of 26.5°N over the Gulf Stream and its extension much of this heat is transferred to the atmosphere and subsequently is responsible for maintaining UK climate about 5°C warmer than the zonal average at this latitude. Previous sparse observations did not resolve the temporal variability of the AMOC and so it is unknown whether it is slowing in response to global warming as suggested by recent model results (IPCC, 2007 #1559). In 2004 NERC, NSF and NOAA funded a system of observations in the Atlantic at 26.5°N to observe on a daily basis the strength and structure of the AMOC. Two papers (*Cunningham, et al.*, 2007 & *Kanzow, et al.*, 2007) demonstrated that not only does the system of observations achieve a mass balance for the AMOC, it reveals dramatic and unexpected richness of variability. In the first year the AMOC mean strength and variability is 18.7±5.6 Sv. From estimates of the degrees-of-freedom the year-long mean AMOC is defined with a resolution of around 1.5 Sv so abrupt changes would be readily identified and long-term changes will be measured relative to the 2004-2005 average.

The NERC contribution to the first four years of continuous AMOC observations was funded under the directed programme RAPID Climate Change. Following an international review NERC will continue funding to 2014 under the programme RAPID-WATCH. The NSF and NOAA have also continued funding and commitments so that the system can continue operating at the same level of activity to 2014.

The objectives of RAPID-WATCH are: To deliver a decade-long time series of calibrated and quality-controlled measurements of the Atlantic MOC from the RAPID-WATCH array and; To exploit the data from the RAPID-WATCH array and elsewhere to determine and interpret recent changes in the Atlantic MOC, assess the risk of rapid climate change, and investigate the potential for predictions of the MOC and its impacts on climate.

3.1 The AMOC system

The 26.5°N the Atlantic is separated into two regions: a western boundary region, where the Gulf Stream flows through the narrow (80km), shallow (800m) Florida Straits between Florida and the Bahamas, and a transatlantic mid-ocean region, extending from the Bahamas at about 77°W to Africa at about 15°W (Figure 3.1). Variability in Gulf Stream flow is derived from cable voltage measurements across the Florida Straits, and variability in wind-driven surface-layer Ekman transport across 26.5°N is derived from satellite-based observations. To monitor the mid-ocean flow we deployed an array of moored instruments along the 26.5°N section. The basic principle of the array is to estimate the zonally integrated geostrophic profile of northward velocity on a daily basis from time-series measurements of temperature and salinity throughout the water column at the eastern and western boundaries. Inshore of the most westerly measurement of temperature and salinity, the transports of the Antilles current and deep western boundary current are monitored by direct velocity measurements.

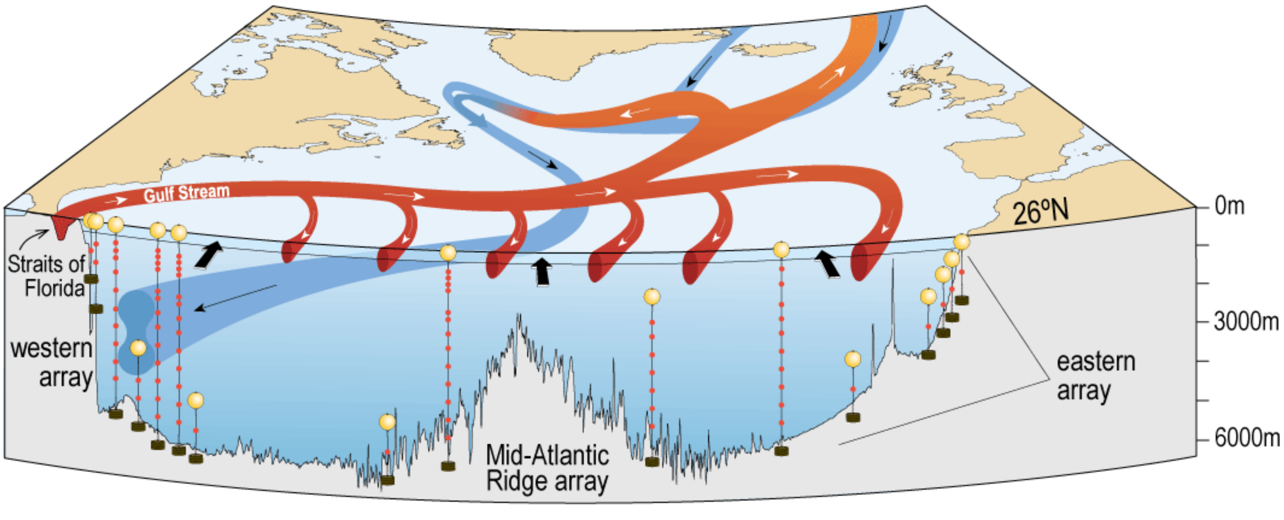


Figure 3.1: Schematic of the principal currents of the Atlantic meridional overturning circulation. The vertical lines across the Atlantic at 26.5°N indicate moorings instrumented to measure the vertical density profiles. The Gulf Stream (red) transport is measured by submarine cable in the Straits of Florida and the western boundary array includes current meters to directly measure transports of the shallow and deep western boundary currents (blue). Bottom pressure recorders are located at several sites across the Atlantic to measure depth- independent fluctuations of the basin-wide circulation.

3.2 Array Specification

The UK contribution to the array as deployed in 2010-2011 consists of a total of 21 moorings, 15 landers and two inverted echo sounders. Figures 3.2 and 3.3 show the eastern boundary and mid-Atlantic moorings as deployed on cruise D359. The western boundary moorings (Figure 3.4) were serviced in the Spring of 2010 during cruise OC459-1 and were be serviced again in Spring 2011 from the RV *Knorr* (NOC Cruise Report number 7). Moorings are named in three sub-arrays. Western boundary **WB**# with mooring number increasing to the east; Mid-Atlantic Ridge **MAR**#; Eastern Boundary **EB**#. The letter **H** is a historical reference to moorings originally intended to be HOMER profilers. **M** indicates a mini-mooring consisting of a 10m length mooring with one CTD instrument – some of this type of moorings were due for recovery on this cruise, but no replacements were deployed. Bottom landers instrumented with pressure recorders are indicated by **L** in the name. **ADCP** indicates an Acoustic Doppler Current Profiler mooring.

3.3 Eastern Boundary Sub-array

The Eastern Boundary sub-array currently consists of one tall mooring **EB1** consisting of eighteen CTDs and a series of shorter CTD moorings **EBHi**, **EBH1**, **EBH2**, **EBH3**, **EBH4,** and **EBH5** that step up the slope reducing the influence of bottom triangles when combined with the more offshore EB1 mooring. EBH4 and EBH5 are co-located and together they construct a single full depth density profile. Finally the Eastern sub-array includes six bottom pressure landers; two at the site of **EB1** – comprising two bottom pressure recorders (BPRS) each, two at the site of **EBH1** and two at the site of EBH4. The landers are serviced in alternate years so that each recovery provides a two-year record with a year's overlap with the previous lander to remove instrument drift. There are also two PIES deployed in the eastern boundary sub-array, **EBP1** at the site of EB1 and **EBP2** near the site of EBH4. Data from the PIES are downloaded annually through acoustic telemetry. EBP1 was serviced on cruise D334, but due to a firmware bug will need to be serviced again in 2011. EBP2 was deployed on this cruise following recovery on D344 where technical problems prevented the immediate re-deployment.

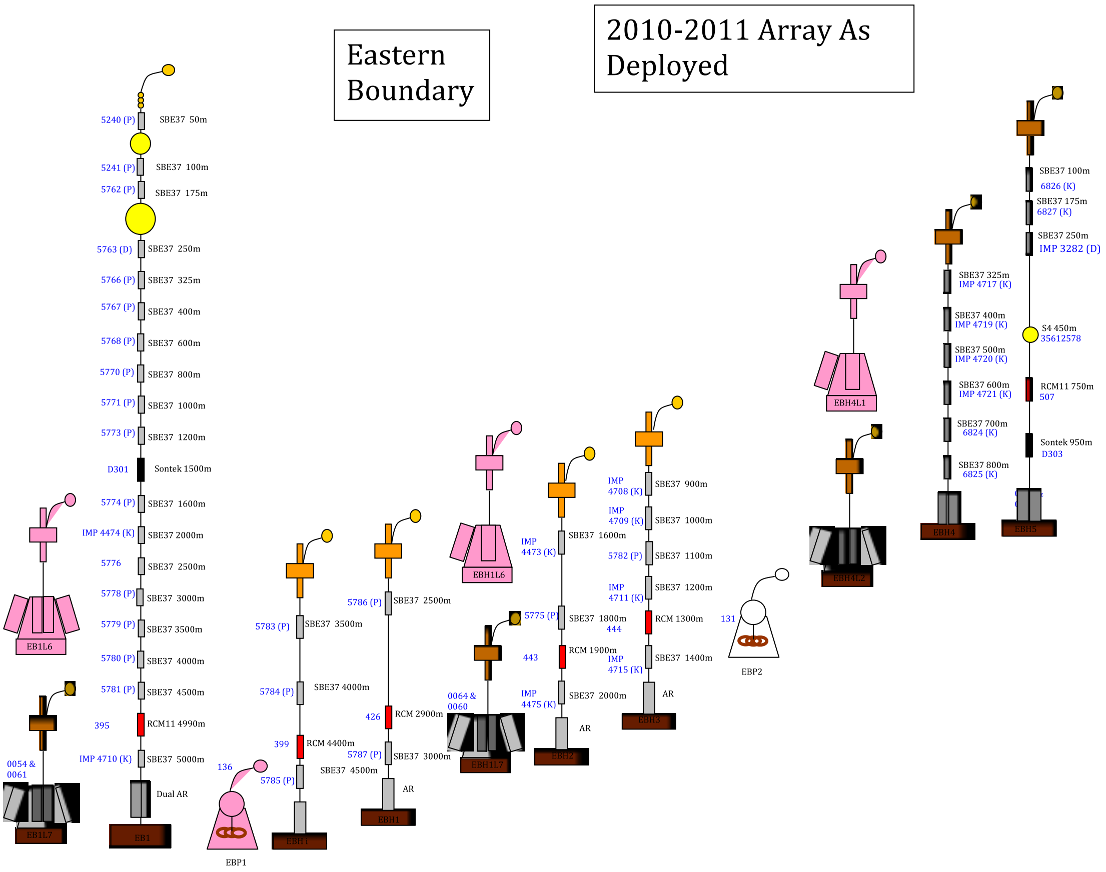


Figure 3.2 Eastern boundary sub-array as deployed after January 2011. The landers shaded pink were not serviced on this cruise.

3.4 Mid-Atlantic Ridge Sub-array

The sub-array at the Mid-Atlantic Ridge consists of one full depth mooring (**MAR1**), three shorter moorings (**MAR0**, **MAR2** and **MAR3**), and four landers (two at the site of **MAR1**, and two at the site of **MAR3**). **MAR0** consists of five CTDs and a BPR to capture the Antarctic Bottom Water (AABW) contribution to the MOC to the west of the ridge. **MAR1** provides a full depth density profile through nineteen CTDs, with **MAR2** acting as a backup to 1000m on the west of the ridge. **MAR3** is sited to the east of the ridge and allows separation of the eastern and western basin MOC contributions. The landers are deployed as per those for the Eastern Boundary, with two at the site of MAR1, and two at the site of MAR3.

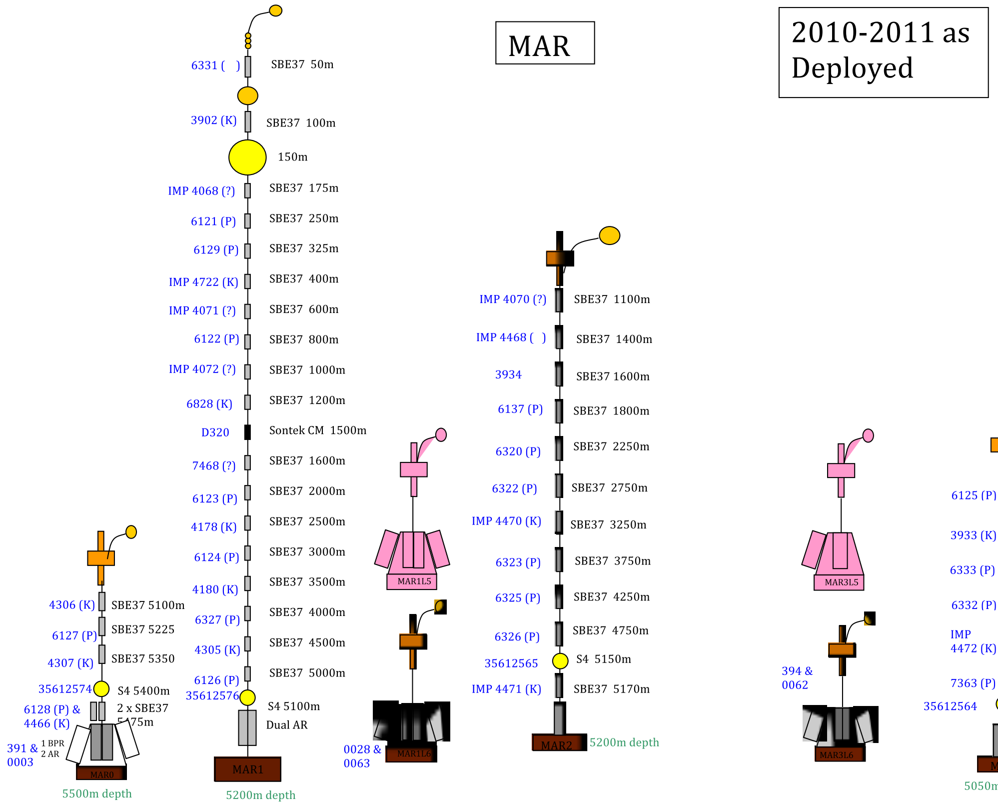


Figure 3.3 The Mid-Atlantic Ridge sub-array after January 2011. The landers shaded pink were not serviced on this cruise.

3.5 Western Boundary Sub-array

At the western boundary, **WB2** is the pivotal mooring and provides a full depth density profile very close to the western boundary "wall". The resolution of the profile can be improved by merging data from the nearby **WB1**. As of Spring 2011, WB2 comprises sixteen CTDs and eight current meters, whereas WB1 comprises fifteen CTDs and four current meters. Inshore of WB1 there is **WBADCP** (sometimes referred to as WBA) that comprises a Longranger ADCP at a depth of 600m to measure the shallow Antilles current. East of WB2 is **WBH2** consisting of three CTDs and five current meters. At the normal offshore extent of the Deep Western Boundary Current (DWBC) is **WB4**, which comprises fifteen CTDs and nine current meters. Further offshore is **WB6** comprising five CTDs, one current meter and a bottom pressure recorder – which combined with MAR0 measures the contribution to the MOC of deep water below 5200m including the AABW. There are six landers in this sub-array; two inshore of WBADCP on the 500m depth contour; two at the site of **WB2**; and two at the site of **WB4**.

In addition to the moorings listed above, the western boundary sub-array also contains three full depth moorings and four landers from the University of Miami, which were serviced on D345, and most recently on cruise KN200-4 aboard the RV *Knorr* in Spring 2011 (NOC Cruise Report number 7). **WB0** comprises four CTDs and current meters and an upward looking ADCP. **WB3** is 22 km east of WB2 and so acts as a critical backup in case of loss of WB2. WB3 consists of seven CTDs and current meters. Combined with the other inshore moorings it provides the thermal-wind shear and measured velocities from the core of the DWBC. **WB5** is located 500 km offshore and is instrumented with seventeen CTDs and provides the thermal-wind shear across the full width of the boundary currents including any recirculation.

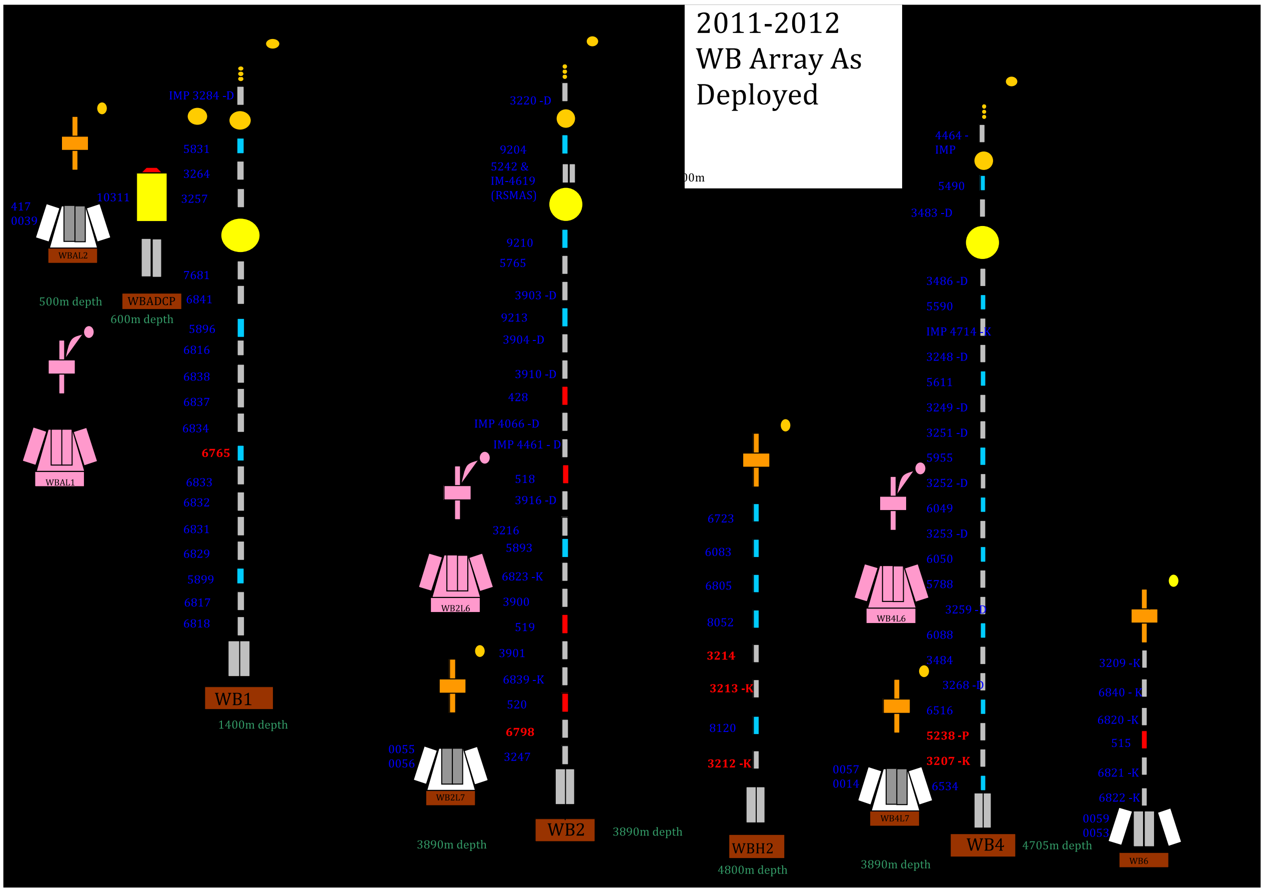


Figure 3.4 The Western Boundary sub-array after March 2011

3.6 Results and Data Policy

All data and data products from this programme are freely available. The NERC data policy may be found at http://www.bodc.ac.uk/projects/uk/rapid/data_policy/. Access to data and data products can be obtained via http://www.noc.soton.ac.uk/rapidmoc/. Data may also be obtained directly from http://www.bodc.ac.uk/.

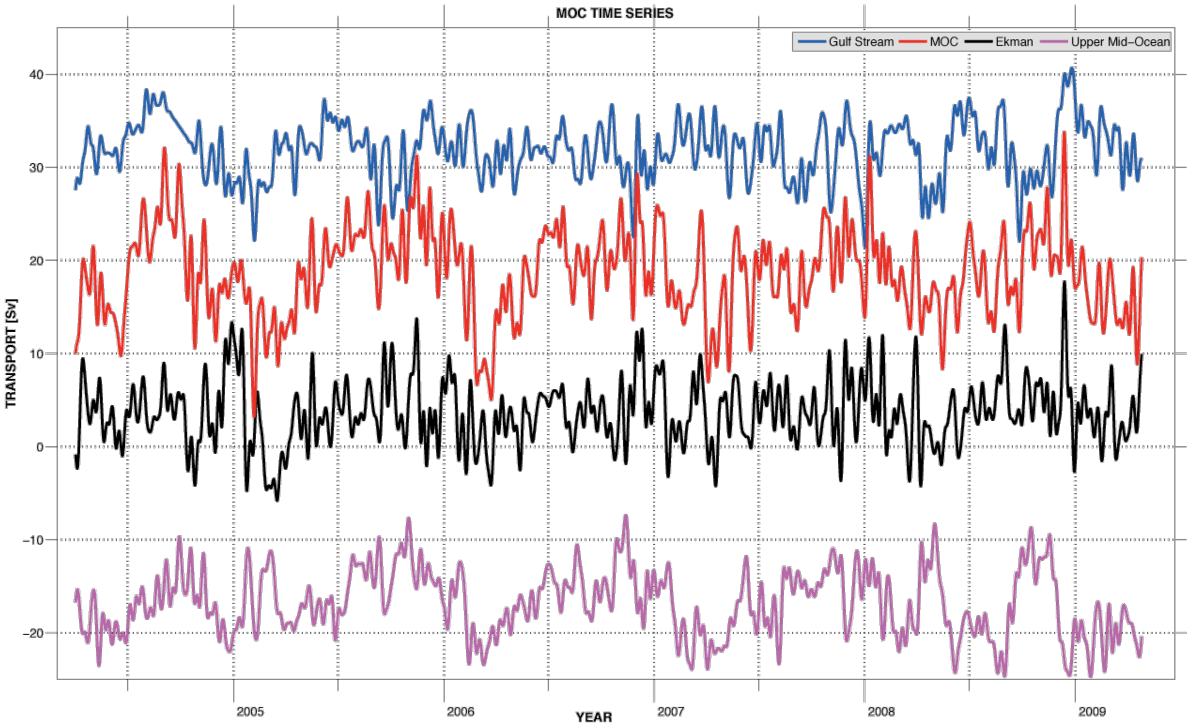


Figure 3.5: Five year-long time series of 10-day filtered Gulf Stream transport (blue), Ekman transport (black), upper mid-ocean transport (magenta) and overturning transport (red). Gulf Stream transport is based on electromagnetic cable measurements. Ekman transport is based on QuikScat winds. The upper mid-ocean transport is the vertical integral of the transport per unit depth down to the deepest northward velocity (~1100 m) on each day. Overturning transport is then the sum of the Florida Straits, Ekman and Upper Mid-Ocean transports and represents the maximum northward transport of upper layer waters on each day.

Table 3.1: Mean and standard deviation of MOC and components

Component	**Mean [Sv]**	**Standard deviation [Sv]**
Gulf Stream	31.8	3.1
MOC	18.6	4.7
Ekman	3.6	3.4
Upper mid-ocean	-16.8	3.5

3.7 References

Cunningham, S. A., T. Kanzow, D. Rayner, M. O. Baringer, W. E. Johns, J. Marotzke, H. R. Longworth, E. M. Grant, J. J-M. Hirschi, L. M. Beal, C. S. Meinen, and H. L. Bryden. (2007). "Temporal Variability of the Atlantic Meridional Overturning Circulation at 26.5°N." *Science* **317**: 935.

Kanzow, T., S. A. Cunningham, D. Rayner, J. J-M. Hirschi, W. E. Johns, M. O. Baringer, H. L. Bryden, L. M. Beal, C. S. Meinen, and J. Marotzke. (2007). "Observed Flow Compensation Associated with the MOC at 26.5°N in the Atlantic." *Science* **317**: 938.

4. Cruise Bridge Log

Peter Newton

Start		End		Comment
Date	**Time**	**Date**	**Time**	**All times GMT**
14/12/2010	09:36	17/12/2010	18:36	Mobilisation
17/12/2010	18:36	18/12/2010	04:40	Passage to Argo 1 deployment position
18/12/2010	04:40	18/12/2010	05:13	Preparation
18/12/2010	05:13	18/12/2010	05:23	Deployed Argo 1
18/12/2010	05:13	18/12/2010	11:50	Transit
18/12/2010	11:50	18/12/2010	11:54	CTD op
18/12/2010	11:54	18/12/2010	12:06	Sheave problem on hangar top, recovering CTD
18/12/2010	12:06	18/12/2010	14:40	Transit
18/12/2010	14:40	18/12/2010	14:48	Preparation for CTD
18/12/2010	14:48	18/12/2010	14:52	CTD op. **1615LT - Emergency muster & Boat muster**
18/12/2010	14:52	18/12/2010	14:56	Sheave problem on hangar top, recovering CTD
18/12/2010	14:56	18/12/2010	15:32	Transit
18/12/2010	15:32	18/12/2010	18:43	CTD op
18/12/2010	18:43	18/12/2010	19:50	Transit
18/12/2010	19:50	18/12/2010	19:56	Deployed Argo 2
18/12/2010	19:56	19/12/2010	11:32	Transit
19/12/2010	11:32	19/12/2010	15:15	CTD op
19/12/2010	15:15	20/12/2010	11:07	Transit
20/12/2010	11:07	20/12/2010	15:57	CTD op
20/12/2010	15:57	21/12/2010	10:30	Transit
21/12/2010	10:30	21/12/2010	10:47	Preparing for CTD
21/12/2010	10:47	21/12/2010	15:45	CTD op
21/12/2010	15:45	24/12/2010	11:57	Transit
24/12/2010	11:57	24/12/2010	12:32	Recovery of top part of MAR1 mooring
24/12/2010	12:32	24/12/2010	12:43	Securing aft deck
24/12/2010	12:43	24/12/2010	18:04	Transit
24/12/2010	18:04	24/12/2010	23:20	CTD op
24/12/2010	23:20	25/12/2010	09:00	Transit
25/12/2010	09:00	25/12/2010	09:37	Attempting to communicate with MAR1
25/12/2010	09:37	25/12/2010	11:32	Preparing for recovery of MAR2
25/12/2010	11:32	25/12/2010	14:07	Recovery of mooring MAR2
25/12/2010	14:07	25/12/2010	15:00	Repositioning to lander MAR1L4 for recovery.
25/12/2010	15:00	25/12/2010	19:25	Waiting for Lander to surface
25/12/2010	19:25	25/12/2010	19:41	Lander recovered
25/12/2010	19:41	25/12/2010	20:06	deploying lander MAR1L4
25/12/2010	20:06	25/12/2010	20:45	Repositioning
25/12/2010	20:45	25/12/2010	21:12	Preparing to commence search pattern for missing MAR1
25/12/2010	21:12	26/12/2010	10:15	Searching for MAR1
26/12/2010	10:15	26/12/2010	11:33	Waiting for MAR1 to surface
26/12/2010	11:33	26/12/2010	15:02	Recovery of MAR1
26/12/2010	15:02	26/12/2010	16:15	Repositioning to MAR1 redeployment position
26/12/2010	16:15	26/12/2010	17:06	Preparations
26/12/2010	17:06	26/12/2010	22:06	Deployment of mooring MAR1
26/12/2010	22:06	26/12/2010	22:56	Watching mooring decend to seabed
26/12/2010	22:56	27/12/2010	12:35	Transit
27/12/2010	12:35	27/12/2010	14:06	Waiting for MAR0 to surface
27/12/2010	14:06	27/12/2010	14:39	Recovery of MAR0
27/12/2010	14:39	27/12/2010	15:48	Preparations

27/12/2010	15:48	27/12/2010	16:22	Deployment of mooring MAR0
27/12/2010	16:22	27/12/2010	18:06	Repositioning and preparations for CTD
27/12/2010	18:06	27/12/2010	22:45	CTD op
27/12/2010	22:45	27/12/2010	23:14	Sampling
27/12/2010	23:14	28/12/2010	12:52	Transit
28/12/2010	12:52	28/12/2010	15:28	Deployment of Mooring MAR2
28/12/2010	15:28	28/12/2010	19:05	Triangulating MAR1 & MAR2
28/12/2010	19:05	28/12/2010	23:30	CTD op
28/12/2010	23:30	28/12/2010	23:40	Securing deck and removing samples
28/12/2010	23:40	30/12/2010	12:03	Transit **29/12/10 - 1615LT** **Emergency drill**
30/12/2010	12:03	30/12/2010	15:35	CTD op
30/12/2010	15:35	31/12/2010	05:25	Transit
31/12/2010	05:25	31/12/2010	08:58	Waiting for daylight
31/12/2010	08:58	31/12/2010	10:20	Waiting for Lander to surface
31/12/2010	10:20	31/12/2010	10:29	Recovery of lander MAR3L4
31/12/2010	10:29	31/12/2010	11:15	Preparing to deploy lander MAR3L6
31/12/2010	11:15	31/12/2010	11:33	Deployment of Lander MAR3L6
31/12/2010	11:33	31/12/2010	12:10	Repositioning
31/12/2010	12:10	31/12/2010	13:45	Attempting to communicate with MAR3 – nothing heard
31/12/2010	13:45	31/12/2010	15:11	Repositioning to new MAR3 position and preparations for deployment
31/12/2010	15:11	31/12/2010	17:47	Deployment of mooring MAR3
31/12/2010	17:47	31/12/2010	18:25	Watching mooring decend to seabed
31/12/2010	18:25	31/12/2010	19:06	Relocating/preparations for CTD
31/12/2010	19:06	31/12/2010	22:31	CTD op
31/12/2010	22:31	01/01/2011	01:05	Survey/search for old MAR3
01/01/2011	01:05	01/01/2011	05:00	Transit
01/01/2011	05:00	01/01/2011	11:40	Waiting for daylight
01/01/2011	11:40	01/01/2011	12:50	Recovery of NOGST
01/01/2011	12:50	01/01/2011	13:50	Repositioning
01/01/2011	13:50	01/01/2011	15:00	Deployment of NOGST
01/01/2011	15:00	01/01/2011	15:44	Watching mooring decend to seabed
01/01/2011	15:44	02/01/2011	08:20	Transit
02/01/2011	08:20	02/01/2011	08:28	Deployment of ARGO4
02/01/2011	08:28	02/01/2011	20:15	Transit
02/01/2011	20:15	02/01/2011	20:18	Deployment of ARGO3
02/01/2011	20:18	03/01/2011	17:38	Transit
03/01/2011	17:38	03/01/2011	22:18	CTD op
03/01/2011	22:18	04/01/2011	00:05	Transit
04/01/2011	00:05	04/01/2011	04:25	Bathymetry survey
04/01/2011	04:25	06/01/2011	03:00	Transit **05/01/10 - 1615LT** **Emergency drill**
06/01/2011	03:00	06/01/2011	08:59	Waiting for daylight
06/01/2011	08:59	06/01/2011	12:25	Recovery of EB1
06/01/2011	12:25	06/01/2011	14:40	Preparations for recovery of Lander EBL1
06/01/2011	14:40	06/01/2011	14:56	Recovery of Lander EBL1
06/01/2011	14:56	06/01/2011	15:23	Repositioning
06/01/2011	15:23	06/01/2011	15:29	Deployment of Lander EB1L7
06/01/2011	15:29	06/01/2011	15:47	Listening to Lander as it descends
06/01/2011	15:47	06/01/2011	21:04	PIES 1 acoustic data download
06/01/2011	21:04	07/01/2011	01:29	CTD op
07/01/2011	01:29	07/01/2011	09:15	Waiting for daylight
07/01/2011	09:15	07/01/2011	13:14	Deployment of mooring EB1
07/01/2011	13:14	07/01/2011	15:46	Triangulation survey of EB1

07/01/2011	15:46	08/01/2011	11:45	Transit
08/01/2011	11:45	08/01/2011	12:57	Waiting for mooring to surface
08/01/2011	12:57	08/01/2011	13:41	Recovery of EBHi
08/01/2011	13:41	08/01/2011	14:18	Preparing to deploy EBHi
08/01/2011	14:18	08/01/2011	14:39	Deployment of EBHi
08/01/2011	14:39	08/01/2011	14:57	Remaining on station while mooring descends
08/01/2011	14:57	08/01/2011	15:17	Repostioning for CTD
08/01/2011	15:17	08/01/2011	18:39	CTD op
08/01/2011	18:39	08/01/2011	19:43	Removing bottle samples from CTD
08/01/2011	19:43	10/01/2011	10:00	Transit
10/01/2011	10:00	10/01/2011	11:05	Attempting to communicate with EBH1 – nothing heard
10/01/2011	11:05	10/01/2011	12:02	Waiting for Lander to surface
10/01/2011	12:02	10/01/2011	12:15	Recovery of Lander EBH1L5
10/01/2011	12:15	10/01/2011	13:21	Repositioning
10/01/2011	13:21	10/01/2011	14:00	Deployment of EBH1L7
10/01/2011	14:00	10/01/2011	14:28	Repositioning
10/01/2011	14:28	10/01/2011	15:02	Deployment of EBH1
10/01/2011	15:02	10/01/2011	15:33	Remaining on station while mooring descends
10/01/2011	15:33	10/01/2011	22:45	Transit
10/01/2011	22:45	11/01/2011	07:57	Waiting for daylight
11/01/2011	07:57	11/01/2011	08:54	Recovery of mooring EBH2
11/01/2011	08:54	11/01/2011	09:33	Repositioning
11/01/2011	09:33	11/01/2011	09:48	Deployment of mooring EBH2
11/01/2011	09:48	11/01/2011	10:15	Watching mooring decend to seabed
11/01/2011	10:15	11/01/2011	13:22	Transit
11/01/2011	13:22	11/01/2011	13:57	Waiting for mooring to surface
11/01/2011	13:57	11/01/2011	14:26	Recovery of mooring EBH3
11/01/2011	14:26	11/01/2011	15:02	Repositioning
11/01/2011	15:02	11/01/2011	15:30	Deployment of EBH3
11/01/2011	15:30	11/01/2011	15:45	Remaining on station while mooring descends
11/01/2011	15:45	11/01/2011	17:19	Transit
11/01/2011	17:19	11/01/2011	17:56	Preparing for CTD
11/01/2011	17:56	11/01/2011	20:47	Testing releases on CTD frame
11/01/2011	20:47	12/01/2011	04:13	ADCP survey
12/01/2011	04:13	12/01/2011	08:21	Relocating back to EBH4 & waiting for mooring to surface
12/01/2011	08:21	12/01/2011	09:00	Recovery of mooring EBH4
12/01/2011	09:00	12/01/2011	10:24	Preparations
12/01/2011	10:24	12/01/2011	11:05	Recovery of EBH5
12/01/2011	11:05	12/01/2011	12:34	Preparations and repositioning
12/01/2011	12:34	12/01/2011	13:36	Deployment of mooring EBH4
12/01/2011	13:36	12/01/2011	14:00	Watching mooring decend to seabed
12/01/2011	14:00	12/01/2011	14:39	Repositioning
12/01/2011	14:39	12/01/2011	15:48	Deployment of mooring EBH5
12/01/2011	15:48	12/01/2011	16:32	Repositioning
12/01/2011	16:32	12/01/2011	16:36	Deployment of Lander
12/01/2011	16:36	12/01/2011	17:36	Transit
12/01/2011	17:36	12/01/2011	21:08	Survey of moorings EBM1,EBM4,EBM5,EBM6
12/01/2011	21:08	12/01/2011	22:30	Transit
12/01/2011	22:30	13/01/2011	04:36	ADCP survey
13/01/2011	04:36	13/01/2011	08:29	Transit
13/01/2011	08:29	13/01/2011	08:30	Recovery of EBM5
13/01/2011	08:30	13/01/2011	09:15	Transit
13/01/2011	09:15	13/01/2011	14:33	Searching for EBM1,EBM2,EBM4 & EBM6
13/01/2011	14:33	13/01/2011	14:36	Deployment of mooring EBP2

13/01/2011	14:36	13/01/2011	16:05	Triangulation survey of EBP2
13/01/2011	16:05	14/01/2011	04:20	Transit
14/01/2011	04:20	14/01/2011	05:01	Preparing for CTD
14/01/2011	05:01	14/01/2011	05:34	CTD op
14/01/2011	05:34	14/01/2011	05:53	Cease CTD - drive suite ac topped up with refrigerant
14/01/2011	05:53	14/01/2011	08:33	CTD op
14/01/2011	08:33	14/01/2011	08:42	Securing deck
14/01/2011	08:42	14/01/2011	12:42	Passage to Tenerife
14/01/2011	12:42	14/01/2011	13:36	Pilotage
14/01/2011	13:36	14/01/2011	13:54	First line to all fast
14/01/2011	13:54	15/01/2011	08:00	Alongside
15/01/2011	08:00	16/01/2011	12:00	Demob - provisional end time

5. Ship's Fitted Instrumentation and Computing

Chris Barnard

5.1 RVS LEVEL C System

The level C system is a Sun Solaris 10 UNIX Workstation *discovery1* also known as ABCGATE. The RVS software suite is available on this machine. This suite of software allows the processing, editing and viewing of all data within the RVS data files. This system also has monitors that allow us to ensure that the level C is receiving data from the TECHSAS System allowing real time data processing.

5.2 Ifremer Techsas System

The Ifremer data logging system will eventually fully replace the existing Level A+B system while for the most part the Level C will remain as the main system for outputting, viewing and editing the acquired data.

The Techsas software is installed on an industrial based system with a high level of redundancy. The operating system is Red Hat Enterprise Linux Edition 3. The system itself logs data on to a RAID 0 disk mirror and is also backed up from the Level C using a 200GB/400GB LTO 2 Tape Drive. The Techsas interface displays the status of all incoming data streams and provides alerts if the incoming data is lost. The ability exists to broadcast live data across the network via NMEA.

The storage method used for data storage is NetCDF (binary) and also pseudo-NMEA (ASCII). At present there are some issues on some data streams with file consistency between the local and network data sets for the ASCII files. NetCDF is used as the preferred data type as it does not suffer from this issue.

The Techsas data logging system logged the following instruments:

1) Trimble GPS 4000 DS Surveyor (converted to RVS format as gps_4000)
2) Chernikeef EM speed log (converted to RVS format as log_chf)
3) Ships Gyrocompass (converted to RVS format as gyro)
4) Simrad EA500 Precision Echo Sounder (ea500)
5) NMFD Surface-water and Meteorology (surfmet) instrument suite
6) ASHTECH ADU-2 Altitude Detection Unit (gps_ash)
7) NMFD Winch Cable Logging And Monitoring CLAM (winch)
8) Fugro Seastar 9200 G2 XP Differential (gps_g2)
9) Seabird SBE45 MicroTSG (seabird)

5.3 GPS and Logging layout RRS Discovery

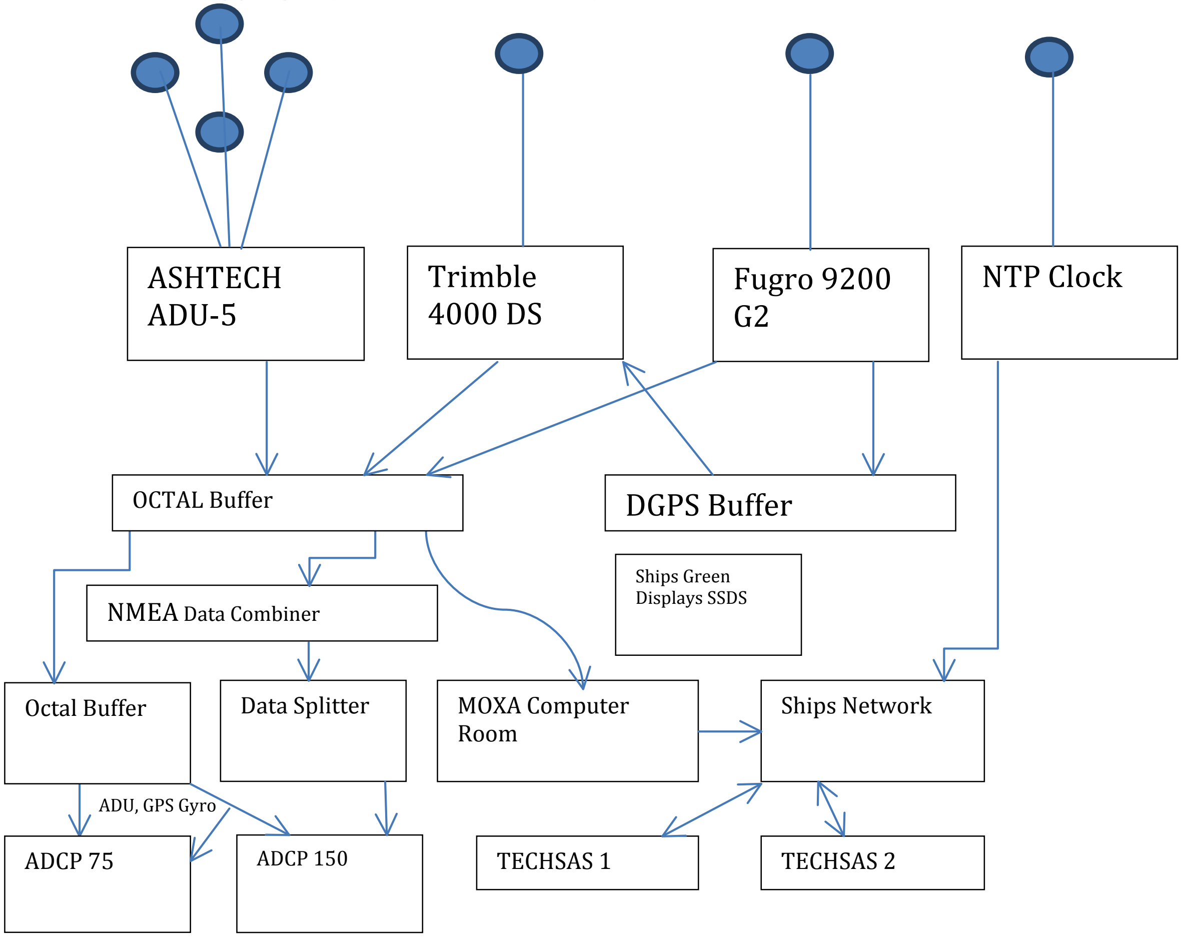


Figure 5.1: Schematic of the GPS and logging on RRS Discovery.

5.4 Fugro Seastar DGPS Receiver

The Fugro Seastar G2 is a Glonass and GPS receiver that is used to provide 10cm accuracy and also receives differential from the Fugro differential system. This signal is then buffered out to multiple systems including the Trimble 4000 DS. The Seastar was purchased as an upgrade to the old Seastar and G12 combination. The system is designed to cope with the future expected solar activity that is expected to disable part of the existing GPS network. The system is also capable of receiving corrections via Internet if necessary.

The Fugro Seastar was found to have a problem in its TECHSAS recording module in that the message did not process through a part of code that normally all Lat and Lon variables go through. This meant that all data were recorded in Degrees, Minutes and Seconds rather than in Decimal Degrees. The module was repaired and the data in the NetCDF Files repaired later.

NetCDF files for this system s9200G2s-FUGRO.gps
RVS Stream *gps_g2*
Forms part of the bestnav stream

5.5 Trimble 4000 DS Surveyor

The Trimble 4000DS is a single antenna survey-quality advanced GPS receiver with a main-masthead antenna. It uses differential corrections from the Fugro Seastar unit to produce high quality differential GPS (DGPS) fixes. It is the prime source of scientific navigation data aboard RRS Discovery and is used as the data source for navigation on the ships display system (SSDS). This antenna is directly on top of the mast and suffers negligible interference from other items on the mast. It is also almost directly at the centre point of the ship making it an ideal navigation system.

At DOY 360 2050 the Trimble 4000 DS stopped outputting good data. This was visible on the SSDS: The Trimble was not receiving data from any satellites. The original thought was that it was due to the lack of Differential Corrections causing the unit to repeat its data output when no differential is received. The issue was not due to this. Several options were checked at which point it was decided that the problem was on the main mast. The antenna was unplugged from the cable and the cable traced through. Each segment had an insulation test performed on it to ensure that there was no short circuit. Each piece of cable was short circuited out and had a continuity test performed and continuity across all pieces of cable was confirmed. A filter/amplifier was found between two sections of cable. This had a continuity test performed showing that it was passing signal through it. A spare antenna for the ASHTECH ADU-5 System was located and installed on the deck using a new length of URM 67 COAX. The Trimble 4000 responded immediately to this and satellites were seen. Several tests were then performed to find out what part of the old wiring was still usable and whether it was a cabling or antenna fault. It was eventually discovered that the antenna and the cable from the top of the mast into the monkey island on the antenna side of the filter was not working. The system was left with an ADU-5 antenna cable-tied atop the main mast as there was no spare mounting points and no way to remove the dead Trimble antenna without destroying it. A cable was run from the antenna and the antenna end of the filter/amp. It is recommended that a permanent repair and replacement of the antenna is made as the antenna will not survive just cable tied forever.

The TECHSAS NetCDF File ends with the following extensions:
Position-4000.gps
Satelliteinfo-4000.hps
RVS Stream *gps_4000*
Forms part of the bestnav stream

5.6 Ashtech ADU-5

This is a four antenna GPS system that can produce attitude data from the relative positions of each antenna and is used to correct the VMADCP for ship motion. Two antennae are on the bridge top and two on the boat deck.

The Ashtech was replaced prior to the cruise with a newer ADU-5 in its place. The ADU-5 was calibrated in November in Cape Town and then used throughout the trials cruise. The data appeared to be correct at this point. The ADU-5 was not completely secured during the passage leg to Cape Verde and was later secured. At this point the cables were attached the wrong way around. It was thought initially that the calibration was entered incorrectly but then found to be the antenna cables in the wrong position. There is no Heave, Pitch and Roll data of any meaningful quality until 23/12/2010 at 224820. Data for the GPS of the system would not be affected by this.

The TECHSAS NetCDF File ends with the following extensions :
ADUPOS-PAPOS.gps
gppat-GPPAT.att

RVS stream *gps_ash*
Forms part of the bestnav stream

5.7 Gyronmea

The gyronmea file receives data from the ship's gyro-compass located on the bridge. There are two gyros on the bridge and either can be used as a source of heading. The selected gyro is logged by the TECHSAS system and is used as part of the bestnav calculation.

The NetCDF File for TECHSAS ends with gyro-GYRO.gyr
RVS data stream *gyro*

5.8 Teledyne RD Instruments Ocean Surveyor 75 kHz Vessel Mounted Acoustic Doppler Current Profiler

The Teledyne RDI Ocean Surveyor 75 kHz vessel mounted acoustic Doppler current profiler (VMADCP) was setup by the science party at the start of the cruise with a bottom track and water track file that is included with the dataset. The Ocean surveyors are fed with data from the ships GPS, Gyro and ADU systems in order so that the system can calculate true speeds and direction of the currents below the ship.

5.9 Teledyne RD Instruments 150 kHz VMADCP

The 150kHz was not available for this cruise due to damage incurred during D357.

5.10 Chernikeef Electromagnetic Log

The EM log is a 2-axis electromagnetic water speed log. It measures both longitudinal (forward-aft) and transverse (port–starboard) ships water speed. The EM log was not calibrated prior to the cruise.

The system was logged by the TECHSAS logging system.
DYLog-LOGCHF-DYLog
RVS stream *log_chf*

5.11 Simrad EA500 Precision Echo Sounder

The Simrad EA500 precision echo sounder (PES) system was used throughout the cruise, alternating between transducers mounted in a towed fish or in hull. The PES was deployed on the fish as soon as we stopped to deploy the first CTD. The fish mounted transducers usually returns cleaner data than the hull transducers as the fish is below the hull and is also decoupled from the noise of the ship. The PES fish was replaced during D355 to a different 10 kHz fish. This fish uses a new cable and new fairing, but also has an extra 10 kHz dunker in the nose of the fish and the weight distributed around the fish is different from the old fish. During the cruise the fish began to strum violently and was recovered. Around 75% of the first fairing pieces were missing. All fairing clips were intact but the rubber fairing had been ripped from the wire. It is possible that the fish was moving erratically and that the fairing was not able to compensate and was damaged by the fish movement.

The PES outputs its data to a stream called ea500 on the Level C System.

5.12 Surfmet System

This is the National Marine Facilities Division (NMFD) surface water and meteorology instrument suite. The surface water component consists of a flow through system with a pumped pickup at approximately 5m depth. Flow rate through the temperature and salinity sensors is approximately 25 l/min whilst fluorometer and transmissometer flow is approximately 3 l/min. Flow to instruments is degassed using a debubbler with 40 l/min inflow and 10 l/min waste flow. The SBE45 unit was changed prior to sailing as another unit had just been returned from calibration at Seabird and was available for the cruise while the existing unit was out of calibration. The transmissometer and fluorometer were also changed prior to sailing for this reason. The non-toxic system was enabled as soon as we were far enough away from land. Surfmet npm-toxic on at 120151 on 15th Dec 2010 and off at 085400 on 14th Jan 2011.

The meteorology component consists of a suite of sensors mounted on the foremast at a height of approximately 10m above the waterline. Parameters measured are wind speed and direction, air temperature, humidity and atmospheric pressure. Optical sensors are mounted on gimbals on each side of the ship. These measure total irradiance (TIR) and photo-synthetically active radiation (PAR).

TECHSAS NetCDF Files for Surfmet

Surf-SURFMET.SURFMETv2
MET-SURFMET.SURFMETv2
Light-SURFMET.SURFMETv2
SBE45-SBE45.TSG

The Surfmet RVS stream is the raw data captured from the TECHSAS system. Surftmp is the RVS stream containing the same variables as surfmet but with spikes removed. The temp_h, temp_m and cond data in the surfmet file are a copy of the seabird data *however they can be delayed in time due to the timestamping of the surftmp stream*. For that reason, always use the data from the Seabird instead of the surfmet for protsg and salinity calibrations.

These files contain :
Temp_h (Housing Temperature from the SBE45 in the wetlab)
Temp_m (Marine Temperature from the Hull intake)
Cond (Conductivity from the SBE45 in the wet lab)
Trans (Raw Voltage from Transmissometer)
Fluo (Raw Voltage from Fluorometer)

Speed (Wind Speed from Gill Windsonic Anemometer)
Direct (Wind Direction from Gill Windsonic Anemometer)
Airtemp (Air Temperature from Vaisala HMP45A)
Humid (Air Temperature from Vaisala HMP45A)

Pressure (Air Pressure from Vaisala PTB100)
PPAR (Photosynthetic Active Radiation from SKE510 PAR Sensor on PORT Gimbal)
SPAR (Photosynthetic Active Radiation from SKE510 PAR Sensor on STBD Gimbal)
PTIR (Total Incidental Radiation from CM6B TIR Sensor on PORT Gimbal)
STIR (Total Incidental Radiation from CM6B TIR Sensor on STBD Gimbal)

Seabird is the raw log of the SBE45 and SBE38 through the SBE45 junction box.
Temp_h (Housing Temperature of SBE45 TSG)
Temp_m (Remote or Marine Temperature from Inlet pipe)
Cond (Conductivity in SBE45 TSG)

Salin (Calculated Salinity from Instrument)
Sndspeed (Calculated Sound Velocity from Instrument)

5.13 Seabird 45 and Seabird 38 with junction box Interface

The SBE-45 is connected to a junction box that connects it to the SBE-38. The two instruments are combined here and the junction box forwards the output message at a rate of 1Hz to the TECHSAS system. At this point it is time tagged. The SBE-45 has had issues over the last several months that could not be traced to a particular sensor. During logging the junction box would unpredictably send an NMEA output message with an incorrect or missing character. Data in the message was complete but the TECHSAS system could not interpret the message format and this would then cause a crash of the module. The issue was resolved by recoding the parsing section of the TECHSAS code to use an *sscanf* function. This function outputs the number of fields successfully parsed, and the module was told to exit if it could not correctly parse all fields. The data for that second is then lost: however a lot more data would be lost with the previous module as it required someone to restart it.

A combined RVS data stream was created between the two running TECHSAS systems (TECHSAS 2 was running another attempt at solving the issue which crashed at different times) called defsbe45. This data stream still contains some issues however most data gaps were refilled.

5.14 SG Brown TSS Meridian Attitude and Heading Reference System

The TSS meridian attitude and heading reference system (MAHRS) is a motion reference unit using a dynamically tuned gyro and the effect of gravity and the earth's rotation to produce a true north reference and also providing pitch, roll and heave data. The data logging module was activated a few days into the cruise. Data are output at 10Hz. There are two separate files recorded from this instrument:
GYRO-MAHRS.gyr
YY-YY.YY

5.15 Processed Data files

1. **Relmov –** *relmov* is the relative motion file for this cruise. This is generated using the ships gyro and Chernikeef EM Log data to extract a movement in a given direction. This is then used by *bestnav* when and where necessary to calculate fixes if GPS fixes were not available.
2. **Bestnav** – *bestnav* uses all three GPS systems logged, *gps_4000*, *gps_g2*, *gps_ash* and creates a best position data stream by providing an as complete account of the ships track as possible. The order of use for the GPS data is *gps_4000* primary, *gps_g2* secondary and *gps_ash* tertiary. The system looks for gaps of a certain length in the primary and when it finds those gaps it requests that the next GPS down fill in the gaps. If no GPS data are available *bestnav* uses r*elmov* data to fill in until data is available again. Then the system calculates back over itself to ensure that the extrapolated positions are correct using the GPS data available around the gap.
3. **Bestdrf –** *bestdrf* is a product of *bestnav*. When run *bestnav* uses the *relmov* data containing a predicted velocity north and velocity east based upon direction and speed through the water. The *bestdrf* file is the drift velocity based on the GPS changes between each record.

4. **Protsg** - Protsg is the processed thermosalinograph data. Raw data are taken from the *seabird* stream or *seatemp* stream if cleaned and salinity calculated. The data varies slightly from the raw seabird salin variable as *Protsg* uses a different algorithm for the calculation of salinity.
5. **Pro_wind –** This program is designed to remove the relative ship's motion from the wind data logged by *surfmet*.
6. **Intdep** – *Intdep* is an interpolated data set that extrapolates data where none was logged based on a two minute band pass filter. *Intdep* is then passed to *Prodep*, which computes true depth using Carters tables.
7. **Prodep** – *Prodep* is an automated process that access the *bestnav* position fix data and then uses a Carter tables data base and corrects the echo sounder data assuming a sound speed of 1500 m/s to the true sound speed for the given position.

5.16 Data Storage

Data storage used a Dell R510 with 10TB of RAID10 storage. Backups were run on an eight hour schedule of running systems (ADCP's, Level C, SBWR, TECHSAS and nominated scientific areas). The backups were transferred to the Data Archive Portable Hard Drives once every 24 hours. The CTD logging computers were backed up on a per deployment basis using SyncToy to sync the CTD folder to the network drive shared from the server. This was then automatically backed up to the portable hard disks. Level C data were logged to *discovery1* internal disk from where the TECHSAS data are accessible and are in turn backed up to tape under /RVS/pro_data/TECHSAS. Backups of the Level C data were performed twice daily as a tar file to DLT tape and LTO tape. The following paths were included in the tar file: /RVS/raw_data, /RVS/pro_data, /RVS/def7/control, /RVS/users.

5.17 Data Archiving

The Data archive will be provided on 4 x 320GB USB Hard Drive. 1 x HDD to BODC, disk to be returned once data extracted. 2 x HDD to PSO. 1 x HDD to NOCS held by NMFSS for six months.

6. Underway Data Processing and Calibration

Holly Pelling & Steven Alderson

The mexec processing suite based on MATLAB was the primary data processing tool. Mexec consists of a number of matlab executables, often linked together in scripts. Data are read and stored in NetCDF format. The matlab executables and scripts are archived as part of the processed data. They are found in the directory mexec_processing_scripts.

Data files were downloaded daily from the following TECHSAS streams and the time variable converted to seconds after 2010-01-01 0:00. File names follow a convention of *streamname_di359_dnnn_raw.nc* where stream name reflects the TECHSAS data stream (e.g. gyr, posg2 etc), di359 is the cruise, *nnn* is the day of year number for that data file, *raw* indicates *raw* data and .nc indicates a NetCDF file type. Master files are appended daily files and are typically named *streamname_di359_01.nc*.

Programs used for the daily data processing are as follows:
mday_00_get_all(day) - Retrieves data from TECHSAS files for all underway data streams.

mgyr_01- Post-processing gyro data.
mash_01 - Post-processing Ashtech data.
mtruewind_01 - Calculate true wind data.
mday_02_run_all(day) - Appends daily files into a master file.
strip_pos – checks for repeated data entries, used for GPS data
mmetlight_01 – Post-processing surface light and pressure data.
mmetlight_02 – Appends processed metlight data.
mmetlight_03 - Produces plots
mhisto, *medita* and *mplxyed* – Edit bathymetery data
msim_01 – Processing edited bathymetric data
msim_02 – Merges sim with ETOPO data
getRVS and *mbse*– retrieves additional tsg data from TECHSAS and converts to pstar.
sbwr.awk and *msbwr_01*– programs to read in and convert wave recorder data.
sbwr_spec.awk and *,msbwr_02*-programs to read in and convert wave spectrum data.

6.1 Appending data files

Master files for each data stream are updated daily using the *mday_02* command. The files must be added sequentially in order and it is possible to check what order the files have been logged by checking the header using *mlisth*.

6.2 File naming across the 2010 to 2011 year boundary

The change from 2010 to 2011 caused some problems to some of the underway data logging. It was decided that the day numbering system will follow the day-of-year i.e. the 1st Jan = day-of-year 001. A number of scripts have been amended to allow this.

6.3 Bathymetery

Bathymetery data were obtained from a Simrad EA500 hydrographic echosounder with precision echosounding transducers mounted in the hull and a towed fish. Daily data files were obtained from the TECHSAS system and named `sim_di359_dnnn_raw.nc` where `nnn` is the day-of-year number. The following procedure (based on the D344 procedure, but with some significant additions) was then used:

1. Daily file is copied to create a file for editing and named `sim_di359_dnnn_edit.nc`.
2. Mexec routine `mhisto` is run to identify any zeros in the depth data (variable named snd in the NetCDF fie) .
3. Routine `medita` is then used to remove the zeros.
4. Run `msim_01,` which uses the edited output file from `medita`, merges it with the concatenated navigation file (for this cruise the GPS g2 feed was used) and applies a Carter correction to the raw depth data producing a file called `sim_di359_dnnn.nav`. It also produces a five minute averaged file called `sim_di359_dnnn.5min`.
5. If necessary run `mintrp` to extrapolate over the end of the file.
6. Run `msim_02` which finds the relevant etopo data and merges it along with an addition copy of the edited bathymetery – ready for further editing (only for areas that lie more northerly than 20°N).

7. Next the routine `mplxyed` was used to remove further bad points, the independent variable used was time and the dependant variable was depth. This routine allows the user to manually remove dad data points and replace with NaNs.
8. `msim_03` appends the final edited files and applies a 5min mavg. Output file: sim_di359_cor_01.nc and sim_di359_cor_01_5min.nc
9. `msim_04` plots both the pre etopo and post etopo data sets.

6.31 Problems

The Simrad EA500 requires user input of the maximum and minimum water depth expected in order to help it find the correct water depth. For sections of the first half of this cruise the maximum depth was set shallower than the correct depth and this caused data to be truncated at this maximum set depth.

The Simrad EA500 also had problems finding the minimum water depth - which also resulted truncated data. To help with this problem the echo sounder was switched from the transducer on the fish to the hull. This switch was made on 29th December 2010 (JD 363) at 13:15 GMT.

Occasionally when the `mmerg` command was used in `msim_02` a NaN was introduced at the end of the lat and lon vectors. This was due to rounding error. When this happened it was necessary to run `mintrp` over the lat and lon data to extrapolate the end of the data set.

6.32 Comparison of Simrad EA500 data with saltellite altimeter derived depths (ETOPO2)

Further editing was conducted on the corrected depth data (at latitudes greater than 20°N) with the aid of data from the ETOPO2 database. The relevant data were loaded (*topo*), merged and a copy of the corrected depth (cordep) was made for editing (*edt_cordep*). `mplotyx` was used to generate a *pdf* file of both *topo* and *edt_cordep*.

6.4 Navigation

RSS Discovery has three GPS receivers: the Trimble 4000 (*gps_4000*) which is a differential GPS, the Ashtech (*gps_ash*), and the Seastar 9200-G2 (*gps_g2*). The ship also uses a gyrocompass (*gyro*) and Chernikeef Doppler log (*chf*) to measure speed and heading.

6.41 Processing

All navigational data were downloaded daily from the TECHSAS data logging system using *mday_00* and appended using *mday_02*. Post processing was conducted on the *gyro* and *ashtech* using the procedure described in D344.

6.42 Problems

On day-of-year 360 it was noticed that the default GPS system (Trimble 4000) was logging repeating data, i.e. for portions of the day the output from the GPS would be repeated. It was found that for an unidentified reason the GPS could not find satellites (although there were plenty present) and therefore got ‘stuck’ on its last known position. First we switched to using the gps_g2 system and the following programs were adapted/written to use positions from this instead of the Trimble 4000:

```
mmetlight_01
msim_01
mtruewind_01
mtsg_04
mmetsurf_01
```

`strip_pos` was written to identify repeated data in both GPS feeds.

The *gps_g2* contained a repeated data point on day 009: this data point was removed in the continuous file and daily file (*posg2_di359_01.nc* and *posg2_di359_d009_raw.nc* respectively). Files *posg2_di359_01_1badrec.nc* and *posg2_di359_d009_raw_1badrec.nc* contains the continuous data file up to and including day-of-year 009 with the bad data point remaining and the daily file with bad data point remaining.

At the beginning of the cruise there were some problems with the data logged by the gps_gs. This was rectified during the cruise and appropriate data added to the beginning of the appended file (*posg2_d359_01.nc*). The new daily files are called *posg2_di359_dXXX_newpos.nc*.

6.43 Comparison of positions reported by the Trimble 4000 and Seastar GPS receivers

As it was necessary to use the data produced from the Seastar instead of the Trimble 4000, a comparison between the two systems was made. The manufacture states that the *Seastar* has an accuracy of 0.1 m whereas the Trimble 4000 has an accuracy of approximately 1.5 m. Figure 6.1 shows the positions made by both systems on day 350, when the ship was moored alongside and therefore not moving. The spread of data are significantly larger for the Trimble 4000, displaying its lower accuracy (Table 6.1).

Table 6.1: Standard deviation in meters of Trimble 4000 and Seastar positions obtained alongside in Mindalo harbour on day-of-year 350 2010.

Instrument (direction)	SD (m)
Trimble (x)	0.896
Trimble (y)	1.255
Seastar (x)	0.399
Seastar (y)	0.237

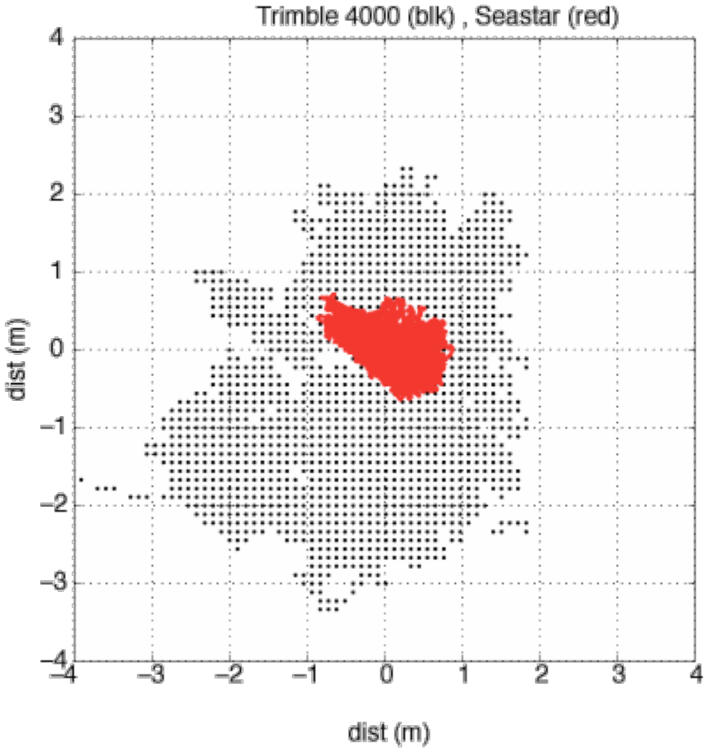


Figure 6.1: GPS position observed from the Trimble 4000 and Seastar (red) from day-of-year 350, when the ship was moored alongside in Mindelo, São Antonio, Cape Verde.

6.5. Meteorology

6.5.1 Wind

Wind data were collected using a Gill Windsonic anemometer mounted on the port foremast. This measured the apparent wind speed and direction for the duration of the cruise. The algorithms used to calculate true wind were based on Smith et al. (1999). Due to problems with the *Ashtech* data true wind data for days 350-357 were calculated without the information from *Ashtech* (file name: `wind_di359_01.nc`). The Ashtech system was fixed on day 358 and subsequent data used this information (file name: `wind_di359_02.nc`). The processing procedure was the same as D344. With the exception that mtruewind_01 merges latitude and longitude from the *gps_gs2* feed instead of the *gps_4000*.

Two new files were then used:

`mtruewind_02` – produces a 5 min average. Output file wind_di359_dnnn_5min.nc.

`plottruewind` – plots time verses true wind speed and direction.

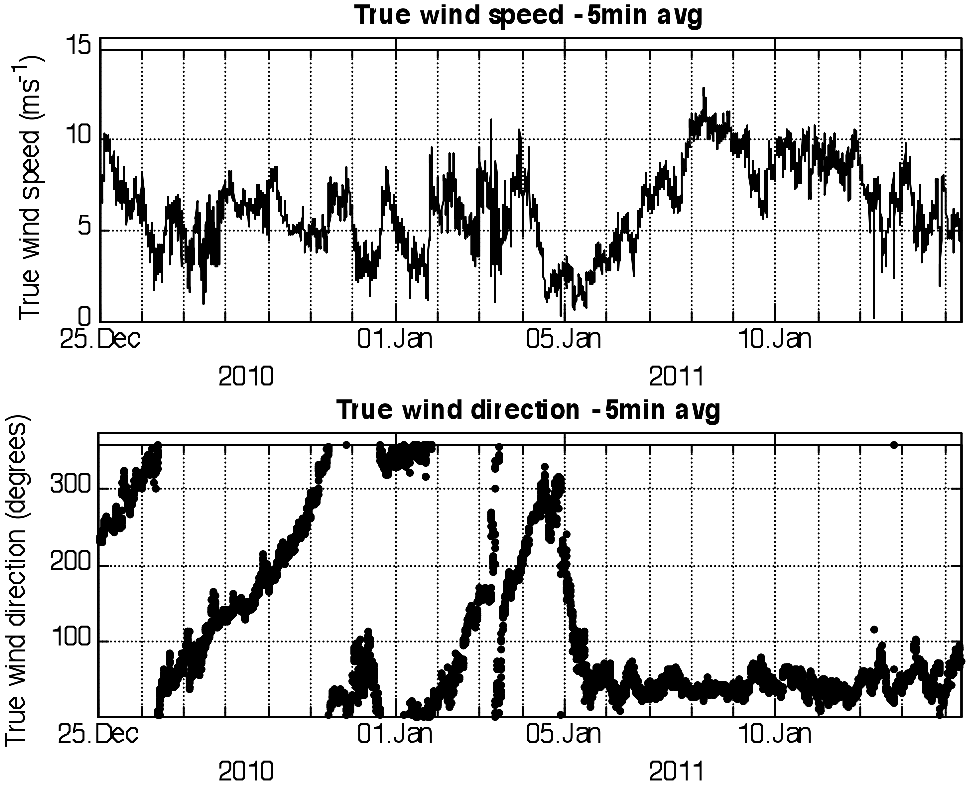


Figure 6.2: time series of wind speed and direction, corrected from observations using *mtruewind*. Only data from after the *Ashtech* was fixed are shown.

6.5.2 Comparison with Prowind

Prowind is a TECHSAS stream that contains processed wind data. It calculates truewind based on the observed winds from *surfmet* and navigation data from *bestnav*. In order to evaluate the accuracy of *prowind* a comparison was made between the output of *mtruewind* and *prowind*. Figure 6.3 shows that for the period evaluated (1st Jan 2011), some of the ship's movement remains in the *prowind* data set: this is not the case with the output from *mtruewind*. Thus we would suggest that caution should be taken when using *prowind* data.

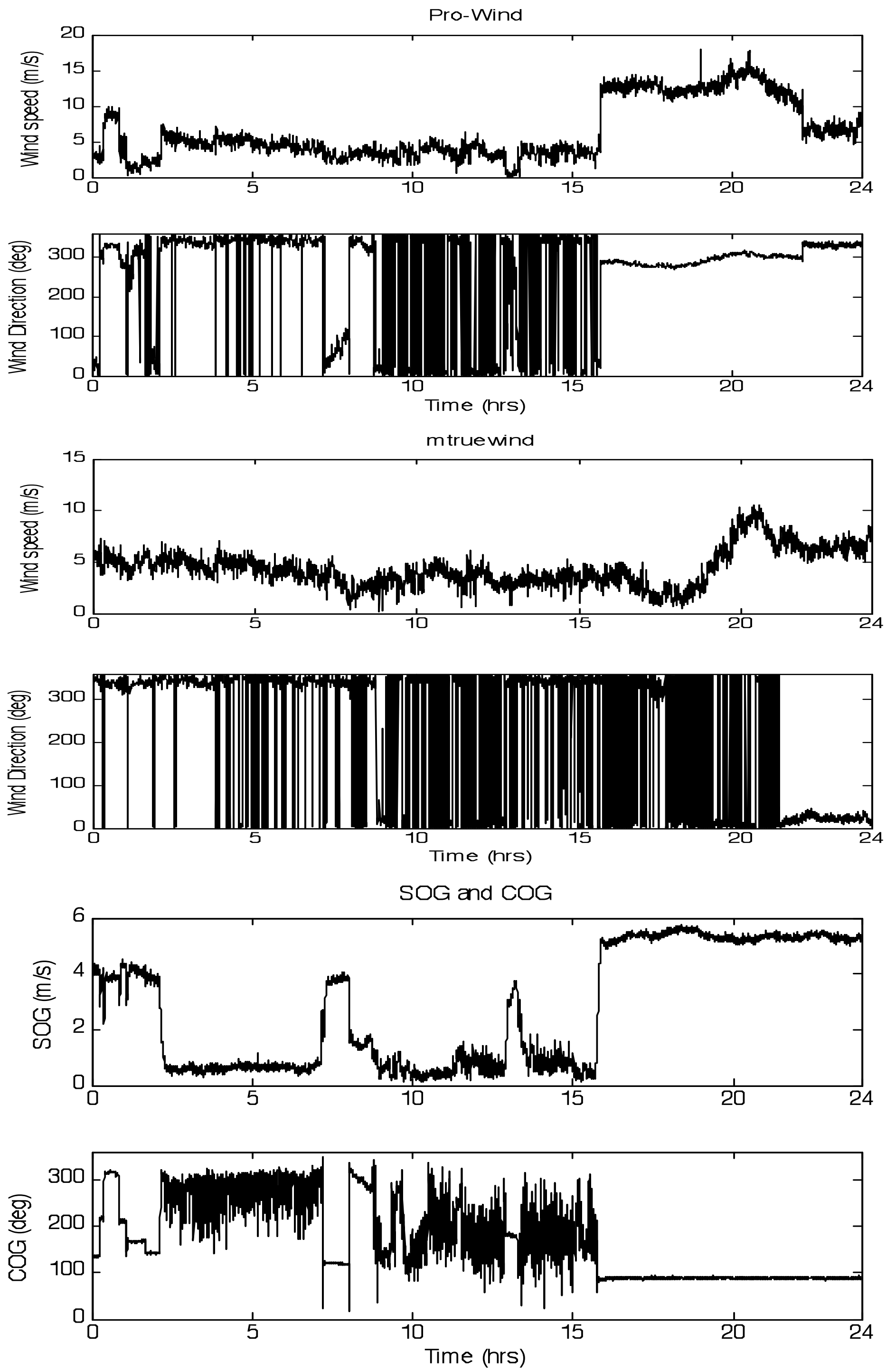


Figure 6.3: Comparison of *prowind* and *mtruewind* from day-of-year 001, 2011.

6.6 Air pressure, light, total and photosynthetically active radiation

Air pressure was recorded using a Vaisala barometer located in the main lab. Photosynthetically Active Radiation (PAR) was recorded using two PAR SKE510 sensors and total incident radiation (TIR) was recorded using two Kipp and Zonen TIR CMB6 sensors located on the port and starboard sides of the foremast. Data were logged using the TECHSAS system and processed using the procedure from D344, with the exception that *metlight_01* merges latitude and longitude from the *gps_g2* feed instead of the gps_4000.

Calibration details for this cruise were as follows:

```
% D359 calibrations for air pressure and light sensors
% Vaisala pressure transmitter, model PTB100A, s/n S3610008
```

```
% Calib cert: NOC00554P, 14-Apr-2010
% y=-1.71797+1.00140*pres
% Skye sPAR, s/n 28556, 12-Feb-2009; 10.53 microV/W/m2
% Skye pPAR, s/n 28557, 12-Feb-2009; 11.04 microV/W/m2
% Kipp&Zonen sTIR, s/n 962301, 19-Feb-2009; 9.76 microV/W/m2
% Kipp&Zonen pTIR, s/n 994133, 09-Aug-2010; 9.70 microV/W/m2

mcalib(otfile1,'y','pres','y = -1.72 + 1.00140*x','/','/', ...
 'ppar','y = 0 + (10/11.04)*x','/','W/m2','spar','y = 0 +
(10/10.53)*x','/','W/m2', ...
 'ptir','y = 0 + (10/9.70)*x','/','W/m2','stir','y = 0 +
(10/9.76)*x','/','W/m2',' ')
```

6.6.1 Results

The air pressure displays the twice-daily cycles in amplitude with 12 hr and 24 hr periods, caused by the atmospheric tide. The strength of these tides displays a longitudinal gradient with an which amplitude of a few millibars in the tropics reducing to almost zero in polar regions. The air pressure observations show a range of between 1008 mb occurring on the 17th December 2010 and almost 1026 occurring on 11th January 2011 (Figure 6.4). The diurnal amplitude was between one and two mb, with a peak at midnight and midday and minima at 06:00 and 18:00 (Figure 6.5).

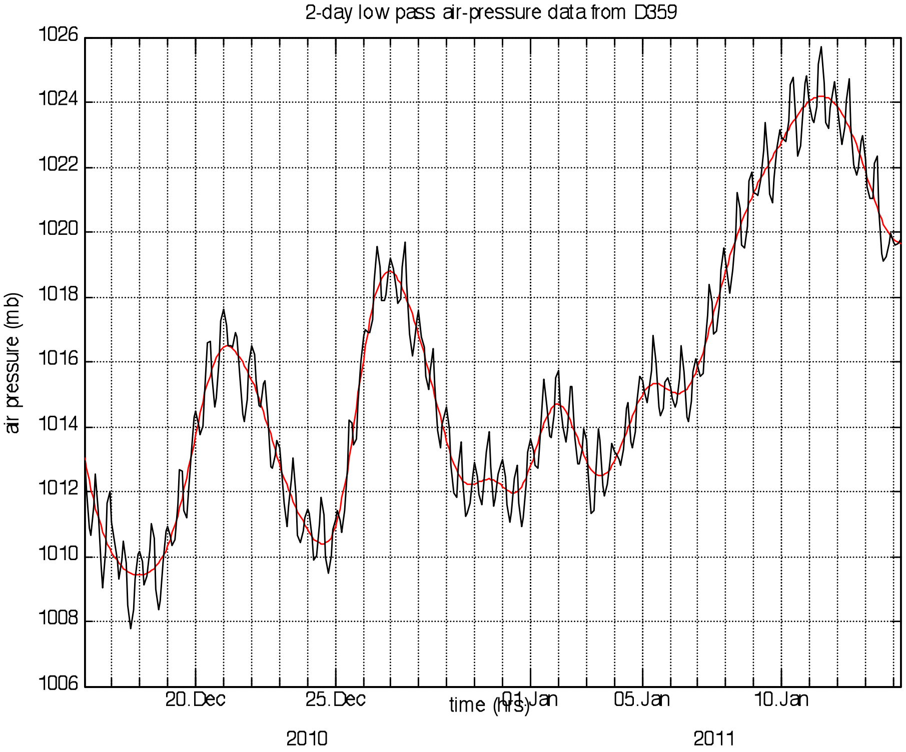


Figure 6.4: Time series of hourly averaged air pressure data (black) and two-day low pass filter (red).

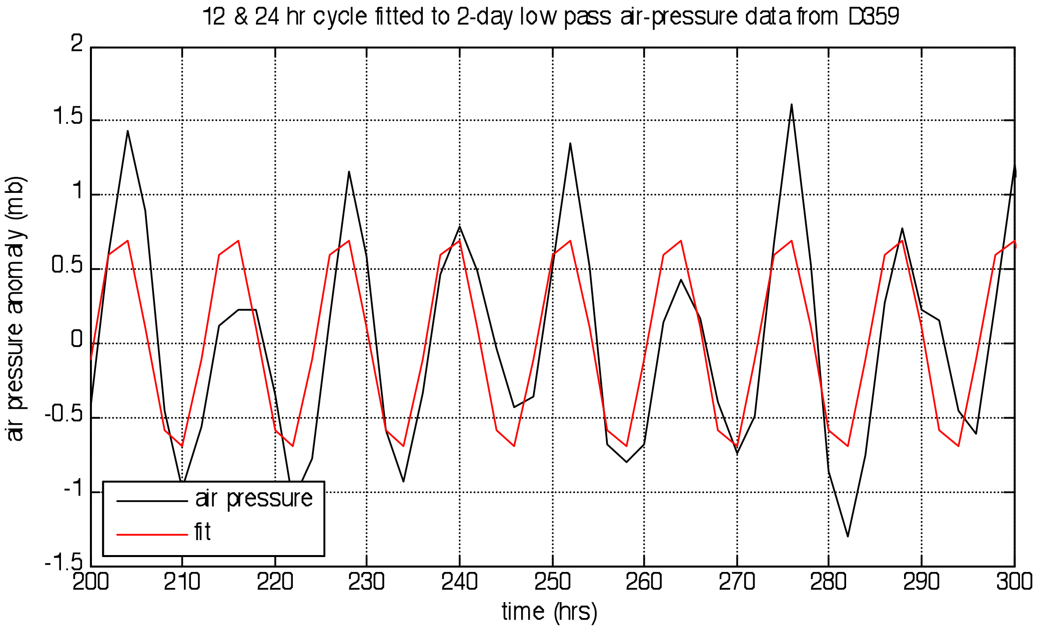


Figure 6.5: Two day high-pass filtered air pressure anomaly (black) and the diurnal plus semidiurnal fits (red). Time in hours from 25th December 2010 to 28th December 2010.

`airpressure_tide.m` was used to fit 12 hr and 24 hr cycles to the raw data. The diurnal cycle has an amplitude of 0.84 mb and a phase of -55.9°, the semi-diurnal cycle has an amplitude of 0.19 mb and a phase of -180.3° (Figure 6.5).

Total incident radiation (TIR) generally peaked in the middle of the day at between 500 and 1000W/m^2. There was a general decrease in TIR as the ship headed north. This trend was not visible in the Photosynthetically Active Radiation (PAR) [wavelengths 400-700nm] results that peaked at approximately 400 W/m^2 throughout the cruise. The results from the light sensors over the cruise show that the port and starboard sensors concur most of the time. However there is a period on the morning of day-of-year 004 in which there was a difference of approximately 200 W/m^2 in PAR and 450 W/m^2 in TIR. The sensors were visually checked from the bridge and it was found that the position of the ship was such that the mast was shadowing the port sensors.
It was also noted, when the ship was heading east to west, the port sensors received more light, however when the ship was heading west to east the starboard sensors received more light. This is because the suns position is low in the sky this time of year and thus one side will receive less light than the other.

6.7 Humidity and air temperature

Humidity and air temperature were recorded using a Vaisala HMP45A humidity and temperature probe located on the foremast. The instrument is calibrated by the manufacture (date of last calibration: 6th April 2010) and thus no further calibration is required. Data were logged using the TECHSAS system and processed using the following scripts:
`mmetsurf_01` – loads data, changes absent data values to NaNs. Merges position data from the *gps_g2* file using time as an independent variable.
`mmetsurf_02` – appends the data
`mmetlight_03` – plots time versus of air temp and humidity data.

6.8 Wave Recorder

The wave height was measured using a Shipbourne Wave Recorder Mk2 version 4.1. As this data stream is not part of the TECHSAS system it was necessary to write specific code in order to copy from the system for further analysis.

The wave recorder produced a number of files per day, these consisted of:
.raw – raw wave height measurements (six per day, consisting of four hours of sampling)
.spc – spectroanlysis of wave height (one every two days)
.par and .inf – summary data
For this cruise we concentrated on the .raw and .spc data files only.
The processing steps are as follows:

1) The files were first copied into the directory data/sbwr.
2) an awk program was run called `sbwr.awk` (for .raw files) and `sbwr_spec.awk` (for .spc files). This program converted the files straight from the wave recorder into a format that could be converted in to mstar (.csv).
3) The program `msbwr_01` (for .raw data) and `msbwr_02` (for .spc files) converted the .csv files into the mstar format. Called `sbwr_di359_dnnn`.
   `msbwr_02` also reshaped the data into a matrix to allow contouring of the data.

The file contains the start time of the record, and the time of each sample relative to the start time of the record. The clock this start time was taken from is the computer clock that the wave recorder runs off, not the ship's clock that all other instruments used. Therefore it was necessary to keep a log of the offset between these two clocks. This was saved as a .asc file (time_log) and converted to *mexec* using the `time_log` script. The drift was fitted using a Matlab linear fitting procedure.

4) `sbwr_time` – converted the time output from the wave recorder into seconds after MEXEC time origin. Output file T_[orignal file name]
5) `msbwr_03` – appended time corrected files and applied the time correction for the clock drift.
6) `plot_waveheight` – produced plots of the wave height verses time.

The clock drift was corrected using:
Offset = 4.98^{-6} * PCtime – 43.112
Where PCtime is the time observed from the PC running the wave recorder. This offset was added to the PCtime to get the GPS time.

7) Spec_01 appended the spectroanalysis files to enable contouring using mcontr.

Figure 6.6 shows a plot of the wave height against time. There are two major spikes occurring on 23rd December 2010 and 3rd January 2011 (day-of-year 357 and 003 respectively).

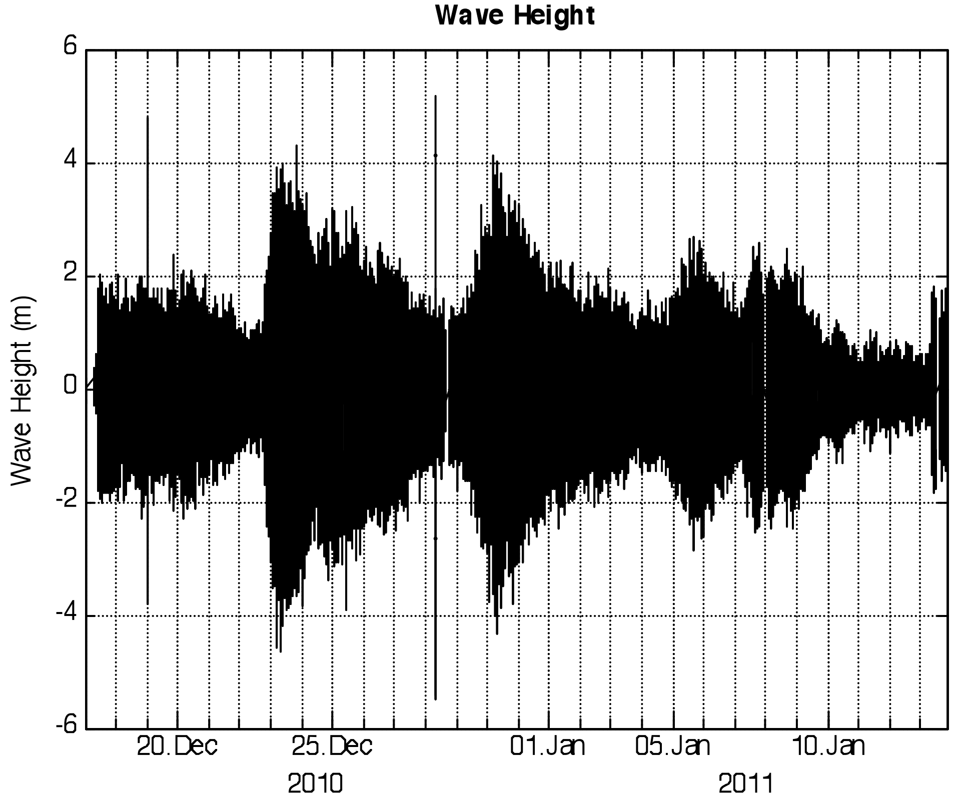


Figure 6.6 Time series of wave height measure on D359.

Figure 6.7 shows the frequency of the wave energy density log10 over time. The wave frequency can be related to period by 1/f where f is the wave frequency. Thus this plot shows an intense band of wave energy concentrated in waves with a period of between 5–15s. Wave energy of all frequencies decreases after 10th January 2011 as the ship was approaching land.

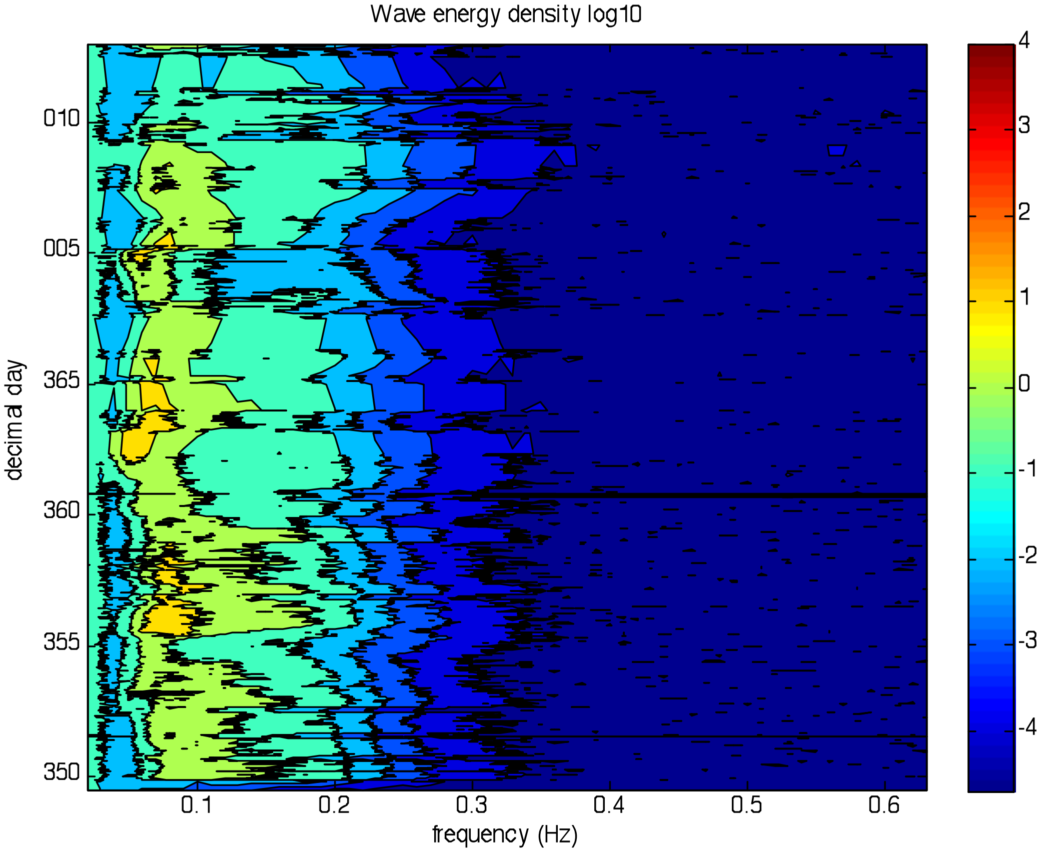


Figure 6.7: Wave energy density (log10) contoured against day-of-year and frequency (Hz).

6.9 Thermosalinograph

Sea water is drawn from an inlet near the bow of the ship at a depth of 6-7 m. A SBE38 temperature probe located in the forward hold on the starboard side measures the temperature of this water. This water is then pumped to the wet lab where a SBE45 MicroTSG, takes temperature and conductivity measurements. The temperature specification for the SBE38 and SBE45 gives an initial accuracy of 1m°C and 2m°C respectively with a typical stability per month of approximately 0.0002m°C. Conductivity has a stability of 0.003S/m and a resolution of 0.0001 S/m.

Throughout the cruise salinity samples were taken from the non-toxic supply located upstream of the SBE45 in the wet lab. Typically these were taken every four hours between the hours of 06:00 – 00:00.

It is expected that due to biological contamination of the SBE45 cell the conductivity is likely to vary throughout the cruise. Calibration against bottle samples is required to correct for this. A total of 95 samples were collected. The bottle salinities were entered into an EXCEL spreadsheet and saved as a *.csv* file. The format used is as follows: bottle number, day of year, hour, minute, second, time in seconds from start of year (2010), salinity. The file was processed using the *mexec* procedure from D344. With the exception that `mtsg_04` merges lat and lon from the *gps_g2* feed instead of the *gps_4000*.

The fit used was:

Cond_cor = $-2.899^{-9}t + 0.08107$

Where t = time.

Figure 6.8 shows the bottle conductivities minus the TSG conductivities plotted as a function of time, and corrected conductivity.

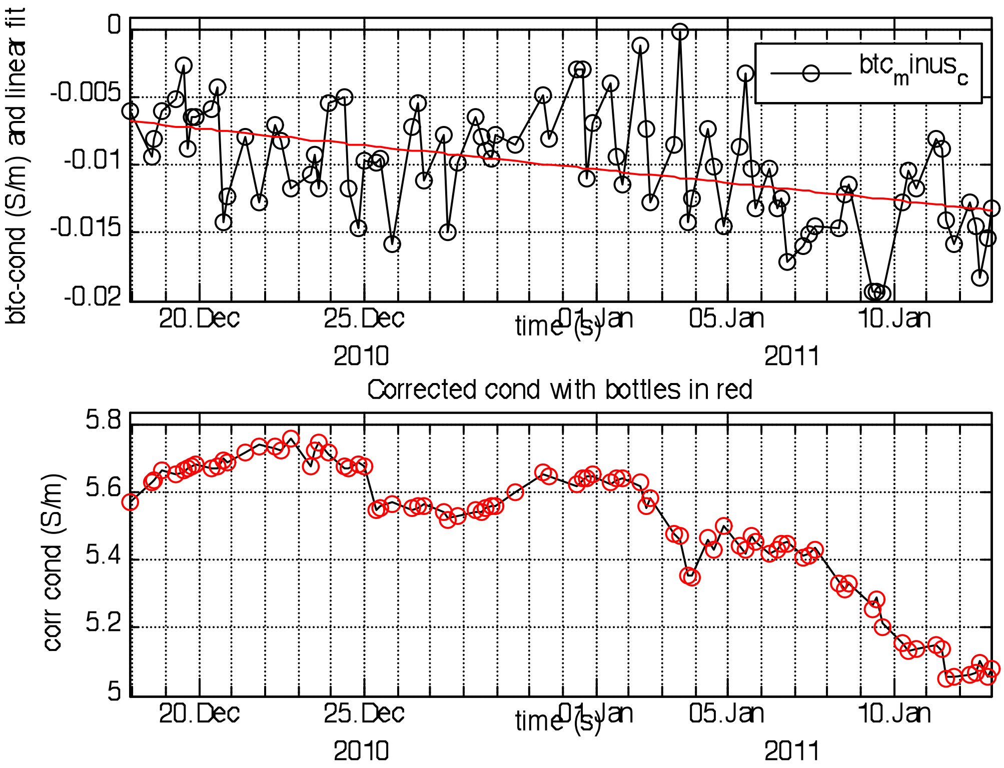


Figure 6.8: Fits used, and corrected conductivities for the TSG data collected on d359.

6.9.1 Results

Near surface salinity and temperature is plotted against time and as a scatter plot against latitude and longitude (Figures 6.9 and 6.10). The space distribution of surface salinity is consistent with other observations in the World Ocean Atlas. In Figure 6.9 the salinity samples have been plotted on top of the corrected surface salinities and show good agreement. There is a decreasing step of approximately 1.5 ˚C occurring on 25th December 2010 at approximately 00:15. This step can also be seen in the observations from the ADCP temperature probe (not shown).

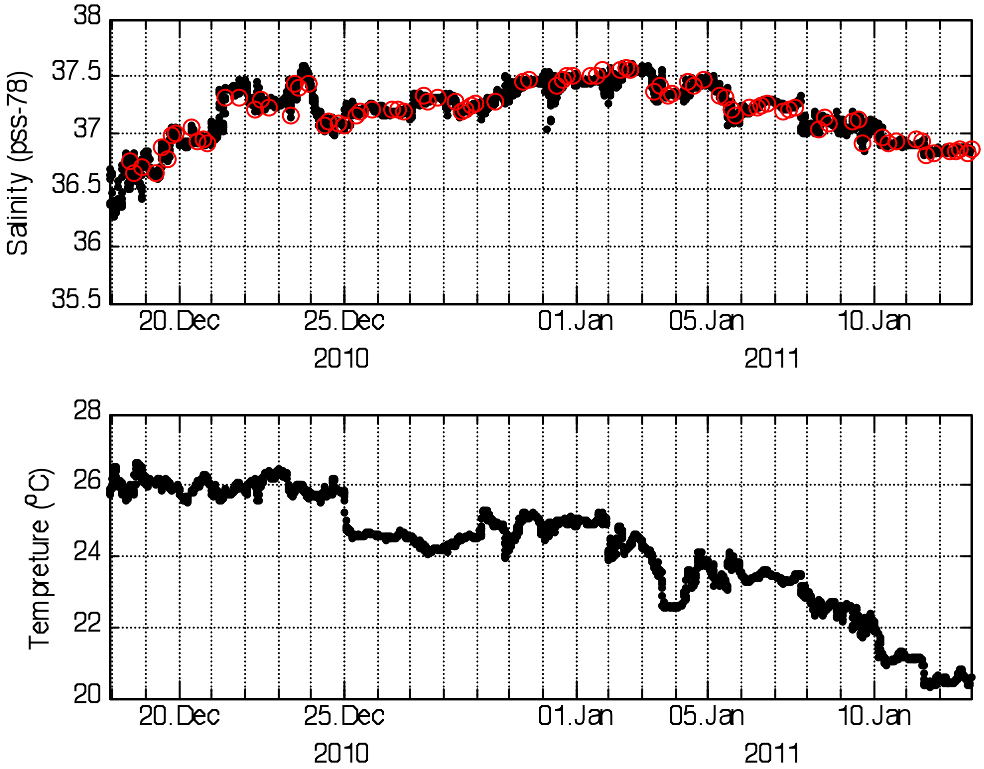


Figure 6.9: Times series of corrected surface salinity and temperature. Red dots show the bottle samples collected.

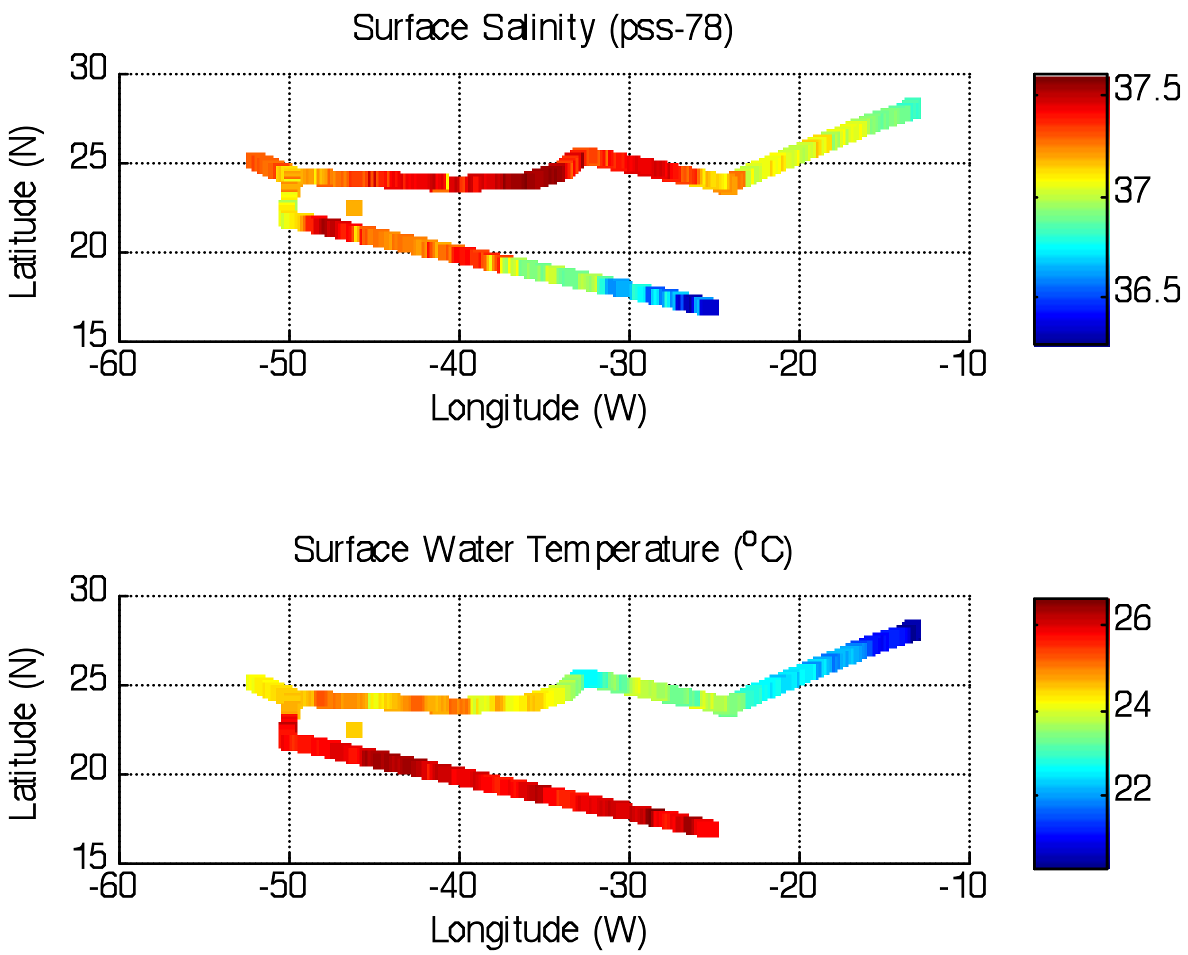


Figure 6.10: Corrected surface water salinity and temperature, collected on D359

It can be seen from Figure 6.10 that the abrupt change in temperature on 25th December occurs when the ship is moving northward at approximately 22.8 N. These results suggest that the ship was moving over a front.

There is a second temperature step of almost 2°C on the 3rd of January 2011. The step is not as abrupt as the previous step, but this could be due to the ship speed at the time. The surface temperature decreases rapidly over the last week of the cruise.

6.9.2 References

Smith S.R., M.A. Bourassa and R.J. Sharp (1999) Establishing more truth in true winds. Journal of Atmospheric and Oceanic Technology 16: 939-952.

7. OS75 ADCP Data Logging and Processing

Steven Alderson

7.1 VMADCP OS75

The OS75 is a vessel mounted Ocean Surveyor Acoustic Doppler Current Profiler with a 75kHz transducer. It is mounted on the ship's hull in a concave configuration 5.3m below the waterline. The four beams are directed at 30° to the vertical with two nominally aligned along the fore-aft axis of the ship.

The instrument is controlled from a PC in the Main Laboratory with the VmDas package. After starting the program, it is initialised by selecting the File:Collect Data sub-menu. This loads the default VmDas configuration file. A specific configuration file can then be created or loaded using the Options:Load or Options:Save As sub-menu. The loaded configuration is always saved to the default each time a setting is changed. The instrument can be configured either by setting a subset of available parameters in the Options:Edit Data Options:ADCP Setup sub-menu, or by specifying a text file containing the parameter set to be downloaded. The latter is preferred since it enables more fine control on the setup of the ADCP.

Once the ADCP has been started (Control:Go sub-menu) data from the transducers is signal processed in the electronics chassis and then passed back to the PC where further processing takes place in software.

Raw and processed data are written to disk by VmDas in files whose name and size is controlled from the Options:Edit Data:Recording sub-menu. On D359 they were written to the directory "C:\ADCP\ADCP Files\OS75_D359" and had filenames with prefix "D359_OS75" of the form "D359_OS75*nnn_mmmmmm.xxx*". Here *nnn* is a three digit sequence number which is specified in the Format sub-menu, but which is also incremented every time the ADCP is started (Start:Go sub-menu). The six digit number *mmmmmm* is a number that automatically increments as a new file opens when the file size limit is reached in any individual file. The filename extension *xxx* labels the contents of each file or group of files. Those of concern here are:

ENX: ADCP single ping data that is in earth co-ordinates, mapped to depth bins and been merged with navigation (in this case from the GPS4000 receiver);

STA: ADCP (short term) averaged data (on D359 using a 2 minute window); the time interval is specified in the Options:Edit Data Options:Averaging sub-menu;

LTA: ADCP (long term) averaged data (on D359 using a 10 minute window), see the Options:Edit Data Options:Averaging sub-menu;

N1R: raw NMEA messages streamed to file with ADCP messages interleaved (allowing GPS and ADCP data to be directly compared independently from VmDas processing);

N2R: other NMEA messages fed into the PC (even if not used) end up in this file and so this provides a mechanism to add separate heading information to the data stream in time order (on D359 $PASHR,ATT messages were supplied from the ADU5 Ashtech receiver).

The ADCP was operated continuously throughout the cruise in narrow band mode, and apart from short periods at the beginning and end of the period, water tracking was used. At approximately daily intervals the ADCP was briefly stopped in order to force the software to open a new set of output files with a new sequence number. This dataset was then transferred by USB memory stick to the RAPID workstation (eurus) and copied into a raw data directory under /local/users/pstar/di359/data/vmadcp/di359_os75. These raw data directories were named rawdata<*nnn*>, where <*nnn*> is the ADCP sequence number.

7.2 Processing

The CODAS (Common Oceanographic Data Access System) software suite developed by the University of Hawaii was used to process the OS75 data. It consists of a mixture of programs in python and matlab. Processing is broken down into a number of steps.

i) Construct the working directory (from directory di359_os75)

```
adcptree.py di359<nnn>nbenx --datatype enx
```

This python script creates the correct directory structure for CODAS processing, copying standard files and command files into their correct locations with names dependent on the current file sequence number.

ii) First pass processing (from directory di359<nnn>nbenx)

```
quick_adcp.py --cntfile q_py.cnt
```

This is the top level python script for fully processing ADCP data. It is either controlled by command line options or reads these options from a file. On D359 these options were read from file. Master copies were maintained in the main OS75 directory (containing rawdata and 'nbenx directories) and then copied into the processing directory for each file sequence number when required. For generality, these files had the string YYYY where a yearbase is required (since D359 covers the time period from December 2010 to January 2011) and XXX where the file sequence number is used. An editing instruction of the form:

```
sed -e 's/YYYY/2011/' -e 's/XXX/818/' ../q_py.cnt > q_py.cnt
```

then copies the file into the correct form and location. File q_py.cnt corresponds to the processing path to calculate absolute ADCP water velocities (i.e. relative to ground), but without heading correction or ADCP calibration. On D359 it looks:

```
# q_py.cnt is
## comments follow hash marks; this is a comment line
--yearbase YYYY
--dbname di359XXXnnx
--datadir /local/users/pstar/cruise/data/vmadcp/di359_os75/rawdataXXX
--datafile_glob *.ENX
--instname os75
--instclass os
--datatype enx
--auto
--rotate_angle 0.0
--pingtype nb
--ducer_depth 5
# end of q_py.cnt
```

Here '#' introduces a comment.

iii) Gyro correction (from directory di359<nnn>nbenx)

On D359 a new message was switched on from the Ashtech receiver. This included $PASHR,ATT messages which include Ashtech headings, but also have diagnostic values which CODAS can use in its processing. To this end, new scripts were written to add heading correction using this source data.

a) Extract gyro data from ENX file

Matlab script ensgyro2rbin was used to read gyro data from the ENX file and create a file for input into a later stage. In practice this command was encased in an m-file (get_enx.m) which sorts out path names, etc. It is run from the top level processing directory for each file sequence (i.e. di359<nnn>nbenx).

b) Extract secondary heading data (Ashtech) from N2R file

Python script serasc2bin.py was used to read Ashtech data from the N2R file and create a file for input into a later stage.

```
serasc2bin.py --redo --yearbase 2010 --type vmdas \
 --count 'last' --message adu <n2rfilename>
```

Here <n2rfilename> is the name of the first N2R file with the correct sequence number (all such files will be read by this procedure i.e. ordered by the 6 digit file number). For simplicity, this was run using Cshell script get_n2r from within the processing directory.

c) Combine, edit and average Ashtech-gyro difference

Matlab script get_headcorr.m reads in the two sets of binary files created in steps a) and b), merges them and averages them to five minute data. This script has been adapted from a sample provided in the CODAS software (file: uh_adcp/programs/adcp_doc/vmdas_doc/heading_correction_example.txt). Again it is run from the top level processing directory for a given sequence number.

d) Add resulting implied rotation to the database

Change directory from the top level processing directory to “cal/rotate”. Copy rotate.tmp to a new file rotate_ash.tmp. Then edit the line:

```
/* time_angle_file: (NOT USED) */
```
to become
```
time_angle_file: head_corr.ang
```
Type the command “rotate head_corr.ang” at the UNIX prompt.

e) Apply the rotation to the velocity data

Return to the top level directory and type:
```
sed –e ‘s/YYYY/2010/’ ../q_pyash.cnt > q_pyash.cnt
quick_adcp.py –cntfile q_pyash.cnt
```
This configuration file contains:

```
# q_pyash.cnt
--yearbase 2011
--steps2rerun navsteps:calib
--instname os75
--auto
```

iv) Editing (from directory di359<nnn>nbenx)

CODAS provides a GUI editor for working with data in its format. To initiate it, start Matlab from the top level processing directory and type:
```
m_setup
adcppath; radcppath;
cd edit
gautoedit
```
Here, m_setup initialises the *mexec* software but also adds the paths to the adcppath and radcppath m-files. These in turn add paths for gautoedit and its dependencies. Gautoedit puts up a window (in a tasteful shade of blue) for data selection and editing. The window divides into four regions vertically: At the top, three boxes specify the start and end decimal days and the step in days to display (e.g. 360, 362 and 0.8 means the data will be presented in sections 360.0-360.8, 360.8-361.6 and 361.6-362.2); Below this, contained within a grey area are options for plotting and editing; by default the only option enabled is the checkbox corresponding to: ”show lat, lon and cruisetrack; The third section contains parameters to determine automatic editing: these were not changed from their default values on D359; The final section at the bottom contains the control buttons.

The sequence of steps adopted on D359 were then: 1. Press “Show now” button- this creates two separate windows, one containing four sub-plots of absolute velocity components (UABS,VABS), percent good and jitter (the latter including ship speed), and a second window with three sub-plots containing ship position in longitude and latitude against time, and vectors of velocity along track. Jitter is a CODAS measure of quality, see documentation for more details; 2. Find the start of data to the nearest 0.1 days and set the start box value to this with step box to 0.1- then press "Show now" again; 3. Examine plots for areas to edit. On D359 the policy was to "edit light". Only columns where all of UABS, VABS and percent good were anomalous were deleted. Single cells were only deleted when UABS or VABS were anomalous, particularly when percent good was weak. Data are displayed and also deleted in blocks of five minutes in time (the size of each cell in the plots). To delete a column the "del bad times" button was used. This presents the user with a pop up choice of variable to edit (in fact all variables are deleted, but this one is used for data selection). After this a new window appears with the variable of choice replotted and a dialog window (called "Choose time selection type") with a two button choice: "select time range" or "click on bad profiles (hit <CR> to end)". The latter choice was used on D359. Using this, a cursor appears when moving the mouse over the single variable plot: single click on columns to delete them, when done just press the return key. To delete cells, select the "rzap bins" button. Choose the variable to use to do the editing from the popup that appears. Then when this variable is plotted in a new window, single cells or rectangles of cells can be selected for deletion. It is best at this stage to make the window as large as possible so that individual cells can be identified. To make the selection, identify the top left cell within the rectangle required, then move the mouse to the cell above and to the left of this one, click and drag into the cell which is at the bottom right of the rectangle. The key here is that the active point of each cell is the top left corner: the editor deletes any cell whose top left corner is contained within the drag selection when the mouse button is released. If any edits have been made the "list to disk" button should be pressed. If not then the edits will be lost when moving on to the next section of data. These edits are not applied directly to the data, but written into files which have to be applied separately in a later step. Move on to the next chunk of data by pressing the "Show next" button. Note that the GUI may crash if there is no data in the range requested. This does not matter as long as the "list to disk" button has been used.

Once the editing is complete, it has to be submitted to the database. Use:

```
sed –e 's/YYYY/2010/' ../q_pyedit.cnt > q_pyedit.cnt
quick_adcp.py –cntfile q_pyedit.cnt
```

with

```
# q_pyedit
--yearbase YYYY
--use_refsm
--steps2rerun apply_edit:navsteps:calib:matfiles
--instname os75
--auto
```

v) Apply calibration (from directory di359<nnn>nbenx)

```
sed –e 's/YYYY/2010/' ../q_pyrot.cnt > q_pyrot.cnt
quick_adcp.py –cntfile q_pyrot.cnt
```

with q_pyrot.cnt:

```
# q_pyrot.cnt
--yearbase YYYY
--rotate_angle 0.0
--rotate_amp 1.0
--steps2rerun rotate:navsteps:calib:matfiles
--instname os75
--auto
```

Here rotate_angle and rotate_amp are the parameters representing the calibration values. Each time quick_adcp.py is run with the "calib" option, any sections of bottom track are used to estimate misalignment angle and amplitude correction required to make the instrument's estimate of speed over the ground consistent with that calculated from GPS positions. These are written into file cal/botmtrk/btcaluv.out. Similarly, for water track data, the software estimates angular and amplitude errors when the ship turns corners (on the assumption that the measured water velocity should not change from one side of the corner to the other). These are written to file cal/watertrk/adcpcal.out.

The calibration values are applied using the "rotate" option. It should be noted that these calibrations are cumulative. The net calibration is the sum of all values applied. It is best to either delete the entire processing directory and start again with new calibrations, or leave each calibration applied in the q_pyrot.cnt file but comment them out as new ones are added. Note that the CODAS software works with a day of year variable whose origin is zero rather than one as in *mexec* (i.e.1st January at 0 seconds is 0 julian day).

7.3 Problems

Once the processing path was in place it was noted that step 3 did not produce sensible answers for the Ashtech-Gyro difference. The correction was large and noisy. On inspection it was found that the Ashtech receiver was sending rubbish. After investigation this was found to be because the Ashtech antenna were incorrectly connected to the receiver (see Shipboard Computing section for more details). Unfortunately this spanned the period from the beginning of the cruise (including the first calibration exercise) until 19:44 GMT on 23/12/2010 when the correct calibration data were installed.

Further problems with navigation data also affected the quality of the early ADCP data. The GPS4000 data were found to contain periods of order an hour when the receiver was repeatedly sending the same message. The CODAS software was unable to process binary files containing such navigation data. An attempt was made to replace the navigation data in the binary file with equivalent data from the *GPS_g2*. However the resulting datasets were very noisy and not considered useable.

There was also a problem doing step 3 with file sequence number 017 which spanned the end of year boundary. This input file was consequently split into two halves using a python script rawutil.py. The two halves were renamed with sequence numbers 817 and 818. Note that file sequence 999 was used on D359 for experimentation with the data.
Other small edits to scripts were required:
Replace "-nojvm" with "-nodesktop" in
sw/uh_adcp/programs/pycurrents/system/call_matlab.py
Correct input to message option in
sw/uh_adcp/programs/pycurrents/data/nmea/serasc2bin.py
Correction in sw/uh_adcp/programs/matlab/rawadcp/quality/mk_avgdh.m for use with CODAS Ashtech-gyro correction
Corrected sw/uh_adcp/programs/matlab/autoedit/agetmat.m to produce a row matrix when using get_corrheading function
Specify explicit default in sw/m_map/m_elev.m

7.4 Further Scripts

do_os75

This is a cshell script to perform each step of the CODAS processing on a supplied file sequence number. It is divided into the 5 steps above. The processing required for a given file sequence number can be stored in the script and repeated automatically. But note that the editing step is still interactive.

mcod_01.m

This is an m-file which loads the mat-files created in the CODAS processing and saves the results into mstar files. At this stage variables such as time and position are one dimensional, whilst velocity and percent good are two dimensional.

mcod_02.m
This routine expands the one dimensional variables into two dimensions by repetition. It then calculates absolute water speed and ship speed over ground from components.
Because of problems with navigation data (see previous section), the next few scripts allow for experimentation on the data set without interfering with the standard processing route.

do_g2
this cshell script constructs a new rawdata directory from an existing one; the new one has sequence number + 900 (e.g. rawdata912 is a copy of rawdata012); a python script then copies all ENX files into the new rawdata directory, but with the navigation data (originally from GPS4000) replaced with that from the G2 receiver.

get_g2
this nasty cshell script extracts the time range of data required from the *GPS_G2* data by looking for the first and last messages in the N1R file; it then uses new *mexec* program mloadt to extract the correct section from the navigation data and then write it into an ascii file.

mloadt
new *mexec* program to load data into matlab based on a range of times

rawnav.py
this python script processes a set of ENX files and replaces the navigation data with new positions from the *GPS_G2* ascii file created by get_g2.

7.5 Results

Table 7.1 summarises data logged by the OS75 during D359.
Bottom tracking was employed during sequence number 005 and 029 specifically to calculate calibration values.

File sequence number 031 corresponds to a part of the ship's track which ran along the same course as one of the RAPID gliders, for the purpose of later inter-comparison.

On 3rd-4th January a bathymetric survey was undertaken which involved following a grid of lines at relatively low speed over a small area of topography. This provides an ideal part of the data to examine ADCP data in more detail, since it contains turns that clearly illustrate the quality (or otherwise) of both the Ashtech correction to the gyro and the ADCP calibration. These introduce cross track velocity errors that relate to the ship speed and direction, and are particularly evident when the ship goes round corners or adopts closely spaced parallel tracks. The data in question were calibrated with parameters derived from the first bottom track section when the Ashtech correction was not available. Thus errors in these parameters are likely. Figure 7.1 shows the ship's track over the region of interest. In order to check the Ashtech-gyro correction the angular difference between the two headings has been calculated independently of the CODAS software (see the section on daily processing). These two methods are compared in Figure 7.2. There seems little evidence here that processing mean Ashtech-gyro differences leads to degradation of the final answers. Figure 7.3 shows near surface velocity vectors plotted around the survey track (an average between 30 and 80m – or three bins). There is no suggestion that vectors change direction around the corners of the track. However alternating north-south and south-north tracks show increasing/decreasing velocity magnitudes perpendicular to the ship's direction. Extracting some average velocities from the centre part of each track and then further averaging the north-south line averages together and the south-north line averages together gives velocities of (11.15, -2.19) cm/s north-south and (20.22, -1.93). The legs were run at 5 knots or 2.6 m/s. This would correspond to a heading error with approximate amplitude of 1°. It should be noted that this agrees with the water track calibration values derived from this part of the ADCP data given in Table 7.1 (file number 020, angular error -1.29).

The later calibration exercise (sequence number 029), produced bottom track calibration values of amplitude factor 1.004 and angular error -2.85°, which is nicely in agreement with the above arguments. Consequently a further rotation and amplitude correction of 1.001 and angular adjustment of -1.05° was applied to all files from 015 to 029. From file sequence number 030 onwards a single adjustment of 1.004 in amplitude and -2.85 in angle was made.

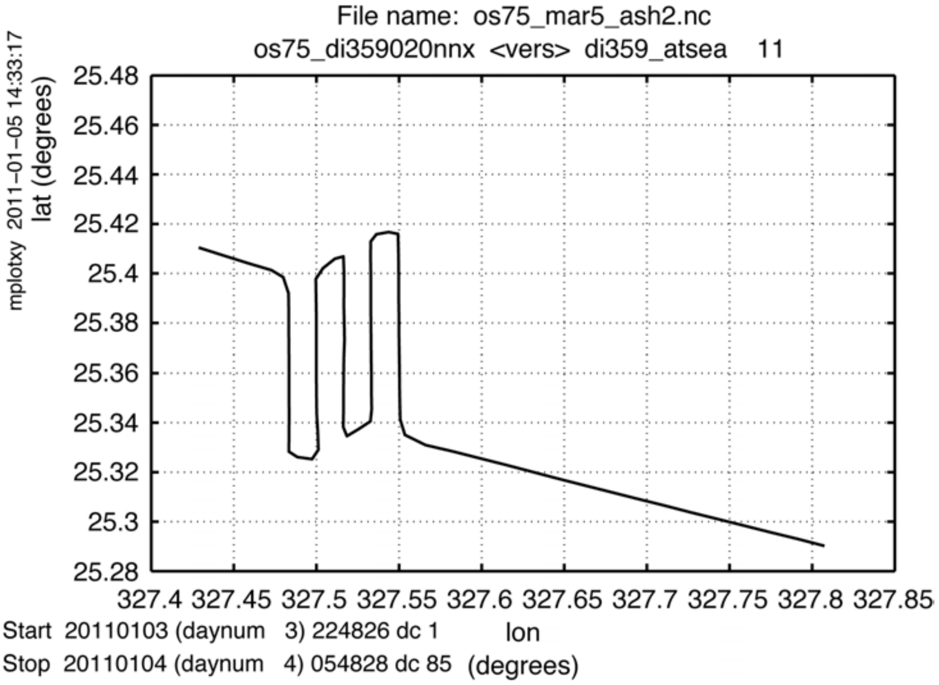


Figure 7.1: A plot of ship's position (latitude against longitude) during the bathymetric survey on the 3rd-4th June.

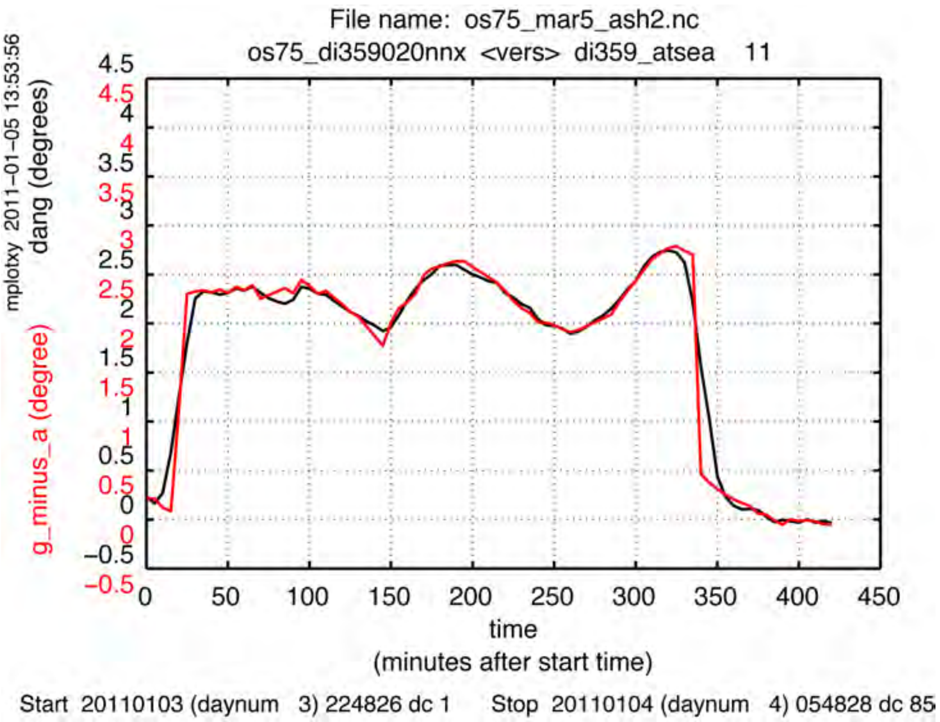


Figure 7.2: A comparison of Ashtech-gyro correction over the bathymetric survey period calculated in two ways: the first produced by the CODAS software using the individual gyro and Ashtech messages (black line); the second by creating two minute mean differences from separate files of gyro and Ashtech data recorded by the Techsas system (red line).

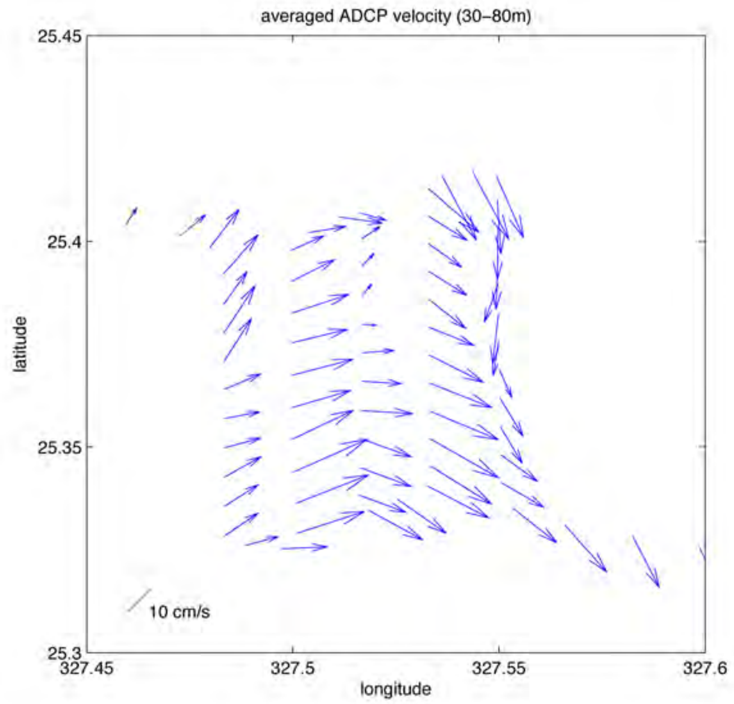


Figure 7.3: Plot of absolute velocity vectors averaged over a layer from 30-80m (three depth bins) for the bathymetric survey period with data calibrated using the first amplitude and angle corrections (from file 005). There are clear velocity differences between alternating lines indicating a need for further calibration.

Table 7.1: Summary of ADCP data sets collected during D359

File sequence	Start time (PC time)	End time (PC time)	Applied Calibration	Resultant Calibration	Comments
D359_OS75005	2010/12/17 18:41:35	2010/12/17 21:21:50	1.0, 0.0°	BT: 1.0025, -1.8°, 23 pts	Bad Ashtech
D359_OS75006	2010/12/17 21:24:43	2010/12/20 10:12:22			Bad Ashtech Missing fixes
D359_OS75008	2010/12/20 10:13:12	2010/12/21 12:02:10			Bad Ashtech Repeat times in gps
D359_OS75009	2010/12/21 12:03:03	2010/12/23 13:06:24			Bad Ashtech Repeat times in gps
D359_OS75010	2010/12/23 13:07:43	2010/12/24 13:09:44			Bad Ashtech Repeat times in gps
D359_OS75011	2010/12/24 13:10:31	2010/12/25 13:07:27	1.004, -2.85	WT: 1.00, 1.04°, 3 pts	
D359_OS75012	2010/12/25 13:08:14	2010/12/26 13:06:12	1.004, -2.85	WT: 1.01, -0.3, 8 pts	
D359_OS75013	2010/12/26 13:07:15	2010/12/27 10:08:18			Repeat times in gps
D359_OS75014	2010/12/27 10:08:39	2010/12/28 13:34:28			Repeat times in gps
D359_OS75015	2010/12/28 13:35:31	2010/12/30 11:05:24	1.004, -2.85	WT: 0.99, 0.85°, 1pt	
D359_OS75016	2010/12/30 11:06:15	2010/12/31 13:51:32	1.004, -2.85	WT: 1.00, -0.37°, 5 pts	
D359_OS75817	2010/12/31 13:52:49	2010/12/31 23:59:04	1.004, -2.85	WT: 1.00, -0.66°, 4 pts	
D359_OS75818	2011/01/01 00:01:11	2011/01/01 13:25:15	1.004, -2.85	WT: 1.01, -0.18°, 3 pts	
D359_OS75018	2011/01/01 13:26:12	2011/01/02 13:19:56	1.004, -2.85	WT: 1.00, 0.37°, 1 pt	
D359_OS75019	2011/01/02 13:20:53	2011/01/03 14:42:18	1.004, -2.85	No calib possible	Straight course

D359_OS75020	2011/01/03 14:43:28	2011/01/04 13:08:54	1.004, -2.85	WT: 1.00, -0.25°, 6 pts	
D359_OS75021	2011/01/04 13:09:49	2011/01/05 13:04:17	1.004, -2.85	No calib possible	Straight course
D359_OS75022	2011/01/05 13:04:59	2011/01/06 12:00:12	1.004, -2.85	No calib possible	Straight course
D359_OS75023	2011/01/06 12:01:01	2011/01/07 12:22:09	1.004, -2.85	WT: 1.01, -1.26°, 1pt	
D359_OS75024	2011/01/07 12:23:12	2011/01/08 12:09:07	1.004, -2.85	WT: 1.01, -0.06°, 6 pts	
D359_OS75025	2011/01/08 12:10:10	2011/01/09 12:14:42	1.004, -2.85	WT: 0.99, -0.20°, 1 pt	
D359_OS75026	2011/01/09 12:15:37	2011/01/10 13:55:52	1.004, -2.85	WT: 1.00, -0.21°, 1 pt	
D359_OS75027	2011/01/10 13:56:37	2011/01/11 11:22:53	1.004, -2.85	WT: 0.99, -0.18°, 3 pts	
D359_OS75028	2011/01/11 11:23:33	2011/01/11 19:11:15	1.004, -2.85	WT: 0.99, -0.5°, 3 pts	
D359_OS75029	2011/01/11 19:16:06	2011/01/12 07:33:46	1.0, 0.0°	BT: 1.004, -2.85°, 67 pts	BT
D359_OS75030	2011/01/12 07:34:50	2011/01/12 19:56:04	1.004, -2.85	WT: 1.01, -0.4°, 2pts	
D359_OS75031	2011/01/12 19:57:16	2011/01/13 10:08:56	1.004, -2.85	WT: 1.00, 0.06°, 12 pts	
D359_OS75032	2011/01/13 10:09:57	2011/01/14 09:21:35	1.004, -2.85	WT: 1.00, -0.1°, 5 pts	

8. Lowered CTD Measurements

8.1 CTD operations

Christopher Barnard

A total of 15 CTD casts were completed during the cruise. One Stainless CTD system was used. CTD cast numbers were of the form XXX and filenames were ctd_di359_xxx where xxx was the cast number. A Test station with 24 bottles on the frame was conducted. All following casts were deployed with only 12 bottles (1,3,5,7,9,11,13,15,17,19,21,23).

8.2 24-way Stainless Steel CTD Frame

The stainless steel frame configuration was as follows:

- Sea-Bird 9/11 *plus* CTD system with frame mounted secondary sensors
- Sea-Bird SBE-32 24-way rosette pylon on NMF 24-way frame
- 12 by 10L custom OTE external spring water samplers
- Tritech PA200 200kHz altimeter
- Sonardyne Deep HF Marker Beacon

The pressure sensor was located 20cm below the bottom of the water samplers, and 131cm below the top of the water samplers. The 20l niskins are 111cm in height between end-cap seals.

8.3 CTD Sensor Configuration

The Sea-Bird CTD configuration for the stainless steel frame was as follows:

- SBE 9 *plus* Underwater unit s/n 09P-46253-0869
- Frequency 0—SBE 3P Temperature Sensor s/n 03P-2674 (primary – 9+ mounted)
- Frequency 1—SBE 4C Conductivity Sensor s/n 04C-2571 (Casts 1-8) then 04C-3768 (Casts-9-15) (primary – 9+ mounted)
- Frequency 2—Digiquartz Temperature Compensated Pressure Sensor s/n 100898
- Frequency 3—SBE 3P Temperature Sensor s/n 03P-4105 (Casts 1-9) then 03P-4872 (Casts-10 - 15) (secondary – 9+ mounted)
- Frequency 4—SBE 4C Conductivity Sensor s/n 04C-3258(secondary – 9+ mounted)
- SBE 5T Submersible Pump s/n 05T-3002 (primary)
- SBE 5T Submersible Pump s/n 05T-2279 (secondary) (Casts 1-8) then 05T-3088 (Casts 9-15)

T-2279 (CASTS 1-9) then 05T-3088 (Casts 10-)(secondary)

- SBE 32 Carousel 24 Position Pylon s/n 32-37898-0518
- SBE 11 *plus* Deck Unit s/n 11P-24680-0587 Main Unit with BestPower UPS s/n ET62010000110004
- SBE 11 *plus* Deck Unit s/n 11P-19817-0495 Spare Unit
- V3 --- Tritech PA-200 Altimeter s/n 6196.118171

To provide a means of location in the event of total loss, the frame was fitted with a 12,000m rated Sonardyne Deep HF Marker Beacon s/n 245116-001 / ID=19 (A13-1).

8.4 Sensor changes

During the first cast 001, there was a large offset between primary and secondary conductivity sensors. The secondary conductivity sensor s/n 04C-2450 was shown to be at fault using a bucket of non toxic sea water of known conductivity being pumped through both cells. No data were saved from this deployment as there were faults with the winch sheaves. Cast 001 was recorded with the new conductivity cell in place 04C-3258.

Further discrepancies after cast 8 with conductivity and temperature led to us changing the primary conductivity from 04C-2571 to 04C-3768. At this point the secondary pump was also changed from 2279 – to 3088. During the investigation there was an offset between the two temperature sensors and the secondary temperature was changed from 03P-4105 to 03P-4872. This occurred before Cast 10.

8.5 Deployment Comments

The Stainless Steel CTD system was deployed using the 11.43mm double armoured conducting galvanised steel CTD wire. This CTD suite was run in real time using an 11 plus deck unit. On the first cast the CTD was aborted due to a problem with the winch sheaves, the weight of the package and the conductivity sensor issues. 100kg of extra lead weight was added to the frame from the spare in order to make up for the lack of instrumentation and less bottles.

8.6 Further Documentation

A sensor information sheet ‘D359 Sensor Information.doc’ and calibration & instrument history sheets were included in the main cruise archive in electronic format (Adobe Acrobat & Microsoft Word). Originals copies of all log sheets were supplied to the PSO in addition to the scanned electronic copies that NMF will retain and also supply to BODC.

9. CTD Data processing

Louis Clement

9.1 Pre-processing using SBE Data software.

Once the CTD data have been produced with Seasave (Version 7.20g) they are converted with the SBE Data Processing software (Version 7.20g). During the conversion four new files are created (Table 9.1).

Table 9.1: Input and output files of the SBE pre-processing (*nnn* represents the cast number)

Input	Output	SBE Data function	Infile folder (Eurus)	Outfile folder (Eurus)
ctd_di359_nnn.hex	*ctd_di359_nnn.cnv* *ctd_di359_nnn.ros*	Data conversion	RAWDATA	ASCII FILES ASCII FILES
ctd_di359_nnn.cnv	*ctd_di359_nnn_ctm.cnv*	Cell thermal mass	ASCII FILES	ASCII FILES
ctd_di359_nnn.ros	*ctd_di359_nnn.btl*	Bottle summary	ASCII FILES	ASCII FILES
ctd_di359_nnn.bl			BOTTLE FILES	
ctd_di359_nnn.hdr			RAWDATA	
CTD_DI359_nnn. XMLCON			RAWDATA	

Three functions of the SBE Data software are used, the first function (Data conversion) transforms the raw data (.hex) into ASCII for the full cast (.cnv) and the bottle firing information (.ros). The firing bottles are recognised with the utilisation of the option '*scans marked with bottle confirm bit'* instead of using the bottle log file (.bl). During the full cast, the CTD starts from the surface, goes to 10m depth for one minute to check the instrument functionality, comes back to surface and then starts the full depth profile.

The second function (Cell thermal mass) corrects the cell thermal effect on the conductivity. This effect generates delays in measured temperatures against conductivities and therefore produces salinity spikes. The function was used with the default parameters: a thermal anomaly amplitude of 0.03 and a thermal anomaly time constant of 7. Due to significant downcast/upcast salinity differences this function has also been tested to find optimal parameters as presented in the next section. Once the output files are created, both input and output files are transferred from the CTD PC to Eurus in the folder specified in Table 9.1. The last function (Bottle summary) copies the bottle position, scan and firing time from (.ros) to (.btl).

9.2 Processing with MSTAR functions.

A collection of Mstar functions transforms CTD data into specific formats (NetCDF) and merges the inputs from their multiple origins (CTD, bottles, winch and GPS). These scripts are gathered under three global functions:

- *ctd_all_part1* applies a sampling rate conversion and extract cast information about the start, bottom and end of the cast (described in section 9.2.1).
- *ctd_all_part2* extracts the CTD and winch information corresponding to the bottle firing times (section 9.2.2).
- *ctd_all_part3* is importing salinity measurements from the fired bottles (section 9.2.3).

The different functions are run in Matlab after having been loaded, with the *m_setup* command, the Mexec environment. The cruise information and path folders on Eurus are stored in the Mexec environment. Each individual script contained in the three global functions and in the CTD data calibration is described in the following sections.

9.2.1 Sampling rate conversion and cast information.

msam _01: Create an empty file *sam_di359_nnn.nc*, which will receive the bottles information, based on the variables defined in *sam_di359_varlist.csv* (/templates).

mctd_01: Read the CTD data from *ctd_di359_nnn_ctm.cnv* and copy them into the new file *ctd_di359_nnn_raw.nc*.

mctd_02: Copy *ctd_di359_nnn_raw.nc* into *ctd_di359_nnn_24hz.nc* and rename the SBE variables with their corresponding values defined in *ctd_di359_renamelist.csv* (/templates). The raw file becomes write protected.

mctd_03: Convert data sampled at 24Hz from *ctd_di359_nnn_24hz.nc* to data sampled at 1Hz in *ctd_di359_nnn_1hz.nc*. Calculate the salinity and potential temperature of the 1Hz data and copy them into *ctd_di359_nnn_psal.nc*.

mdcs_01: Create a blank file *dcs_di359_nnn.nc* which will contain the information about the cast (start, bottom and end). The fields of the new file are defined in *dcs_di359_varlist.csv* (/templates).

mdcs_02: Find the features of the bottom of the cast in *ctd_di359_nnn_psal.nc* and paste them into *dcs_di359_nnn.nc*.

mdcs_03: The characteristics of the start and end of the cast, which are manually defined without the surface data, are copied from *ctd_di359_nnn_psal.nc* into *dcs_di359_nnn.nc*. This function is not included in *ctd_all_part1* because of the manual selection of cast numbers, so it needs to be run independently.

The last two functions **mdcs_04** and **05** are also separated from *ctd_all_part1*, they are thus run separately once the GPS data are available.

mdcs_04: Load the latitude and longitude of the CTD start, bottom and end by looking for their corresponding time, defined in *dcs_di359_nnn.nc,* into *posg2_di359_01.nc* (/nav/gps_g2). The positions are copied into *dcs_di359_nnn_pos.nc*.

mdcs_05: Copy the latitude and longitude in the header of all the NetCDF files of the corresponding cast.

9.2.2 CTD and winch information at bottle firing times.

mctd_04: Create the downcast profile on a 2 db grid in *ctd_di359_nnn_2db.nc* from *ctd_di359_nnn_psal.nc* by extracting the downcast information in *dcs_di359_nnn.nc*. The potential temperature is recalculated according to the new grid.

mfir_01: Extract the position and scan number of each fired bottle in *ctd_di359_nnn.bl* and copy them into the new file *fir_di359_nnn bl.nc*.

mfir_02: Find in *ctd_di359_nnn_1hz.nc* the CTD time corresponding to the bottle firing times stored in *fir_di359_nnn_bl.nc*. Save the time, position and scan number into *fir_di359_nnn_time.nc*.

mfir_03: Copy into *fir_di359_nnn_ctd.nc* the CTD data from *ctd_di359_nnn_psal.nc* which corresponds to the bottle firing times (adjusted to the origin) of *fir_di359_nnn_time.nc*.

mfir_04: Copy data from *fir_di359_nnn_ctd.nc* into *sam_di359_nnn.nc*.

mwin_01: Create a file containing the winch information *win_di359_nnn.nc* (/winch).

mwin_03: Extract the wireout measurement from *win_di359_nnn.nc* by looking at the bottle firing time from *fir_di359_nnn_time.nc* and save it into *fir_di359_nnn_winch.nc*.

mwin_04: Copy the wireout measurement from *fir_di359_nnn_winch.nc* into *sam_di359_nnn.nc*.

9.2.3 Bottles salinity measurements.

The file with the bottle salinities recorded by the salinometer (*sal_di359_nnn.csv*) needs first to be copied into /BOTTLE_SALTS.

msal_01: The bottle salinities are copied from *sal_di359_nnn.csv* into *sal_di359_nnn.nc.*

msal_02: Copy the salinity from *sal_di359_nnn.nc* into *sam_di359_nnn.nc*, which now contains the bottle salinities and the corresponding CTD salinities.

msam_02: Calculate the residuals of the calibration into *sam_di359_nnn_resid.nc* using *sam_di359_nnn.nc.*

9.2.4 CTD calibration.

For the upcast calibration, the script *ctd_cal_di359.m* is executed which used data from the input files *sam_di359_nnn.nc* merged into *sam_di359_all.nc*. For the downcast calibration the script used is *mcalib_dcond2.m* which is executed after the scrip *mcalib_dcond.m*.

mcalib_dcond: Create a file (*ctd_di359_nnn_down_cal.nc*) which contains the CTD downcast data using *ctd_di359_nnn_2db.nc* of the water parcel corresponding to the water parcel of the firing bottle (from *sam_di359_nnn.nc*). The parcel is recognised by its potential temperature.

9.3 CTD data

Fifteen CTD casts were performed during the D359 cruise (Table 9.2); the first cast was a simple test without any mooring instruments attached to it. During the other casts, several MicroCATs were attached to the frame to provide reference data for the MicroCAT calibration. Acoustic releases were also tested on several casts.

Table 9.2: CTD deployment positions and depths.

CTD	Date	Time (GMT)	Latitude (°N)	Longitude (°E)	Depth (m)	Bottom pressure (db)	No. of bottles closed
1	18/12/10	16:43:24	17.451	-28.061	3487.2	3537.4	24/24
2	19/12/10	12:40:16	18.039	-30.973	3503.7	3554.4	12/12
3	20/12/10	12:44:31	18.731	-34.524	5192.3	5288.3	11/12
4	21/12/10	12:34:48	19.421	-38.045	5619.4	5729.1	12/12
5	24/12/10	19.32.34	22.654	-49.962	4513.7	4591.1	11/12
6	27/12/10	19:47:09	25.111	-52.025	5470.1	5577.1	12/12
7	28/12/10	20:36:48	24.158	-49.697	5164.3	5261.3	12/12
8	30/12/10	13:12:18	23.935	-42.787	3507.7	3559.9	12/12
9	30/12/10	18:56:36	23.923	-42.537	4384.7	4459	12/12
10	31/12/10	20:41:17	23.824	-41.074	5014.6	5106.9	11/12
11	03/01/11	19:22:37	25.421	-32.671	5612.6	5724.4	12/12
12	06/01/11	22:39:12	23.822	-24.102	5012.4	5104.6	12/12
13	08/01/11	16:46:12	24.951	-21.294	4488.1	4565.5	11/12
14	11/01/11	18:21:41	27.867	-13.556	1098.1	1108.4	11/12
15	14/01/11	06:25:55	28.455	-15.667	3505.7	3559	12/12

In the deep water, the first and second sensors were not measuring matching salinities. The difference between them was in the range of 0-0.004 psu. The casts 9 and 10 were used to try to correct this discrepancy but did not bring significant improvement. The primary conductivity sensor (SN: 2571) was replaced with a spare (SN: 3768) from cast 9 onwards and the secondary temperature sensor (SN: 4105) was replaced a spare (SN: 4872) from cast 10 onwards.

The difference in downward minus upward salinity was observed to be significant for the two sensors in the θ/S diagram. This difference increased from 0 psu at the bottom to 0.002 – 0.003 psu at around 6°C and becomes randomly distributed around 0 psu in the shallower water. A function *gridded_potemp.m* was created to estimate the salinity difference in the θ/S plan by interpolating the salinity on a gridded potential temperature. To improve the coherence of the downcast and upcast salinities the *AlignCT* and *Cell Thermal Mass* corrections were tested.

AlignCT role is to remove the offset between the conductivity and temperature measurements due to the different sensors location on the intake pipe. From the sensor positions, the conductivity was expected to be slightly delayed relative to temperature. However, no improvement in the salinity spikes has been found for a set of different lag values, therefore no time correction was applied on the conductivity.

The *Cell Thermal Mass* correction removes the error of the measured temperature affected by the temperature difference between the water parcel in the sensor and the seawater at this level. The error is caused by the delay of the instrument to adjust to its surrounding temperature. A *Cell Thermal Mass* correction was first applied by the SBE Data Analysis Program with the standard coefficients. An optimisation was run in *gridded_diff.m* to try to estimate a new set of parameters that would reduce the salinity difference as described in Morison *et al.* (1994). The parameters were found to be at the bottom of the tested range meaning that no improvement in the salinity difference could be made. To ensure a coherent salinity for each water parcel of the two profiles with the bottle measurements, the CTD calibration was not only executed on the upcast but also on the downcast conductivity.

9.4 CTD calibration

The process of calibration adjusts CTD data to the firing bottle conductivities measured with the salinometer. The calibration of the conductivity is applied to the upward and downward profiles of the CTD by defining a factor, which represents the difference of conductivity between the bottles and the CTD. This factor, referred to as the slope correction, is defined by K=Bottle_cond/CTD_cond. Calibrated data can finally be produced by multiplying K to the raw data and reprocessing the raw data. To ensure the accuracy of the measured bottle conductivities, the drifts of the standard salinometer samples were corrected to their theoretical values before the calibration.

9.4.1 Salinometer standardisation

The sample bottle conductivity was measured with an Autosal Salinometer (s/n 68958) in the constant temperature (CT) room (at constant temperature of 24°C). A first standard sea water bottle standardised the salinometer offset (3.6^{-5}) which was then left unchanged throughout the cruise. The CTD bottles were stored in the CT room for 24 hours before measurements. Each cast was preceded and followed by the measurement of an IAPSO standard seawater sample with a K_15 of 0.99997, equivalent to a standard salinity of 34.9988 psu.

The difference between the standard measured salinity and its theoretical value is plotted in Figure 9.1. The drift to higher measured salinities increases with the station number. The sampling of higher salinity surface water preceding the end of the cast standard may explain the higher values for the end of the cast standards (red) compared to the beginning standards (blue). The average drift of the salinometer (black) of each station was then subtracted from each bottle conductivity water sample. This correction reduces the scatter of the mean values (red cross) of the conductivity difference (bottle minus CTD) in Figure 9.2a.

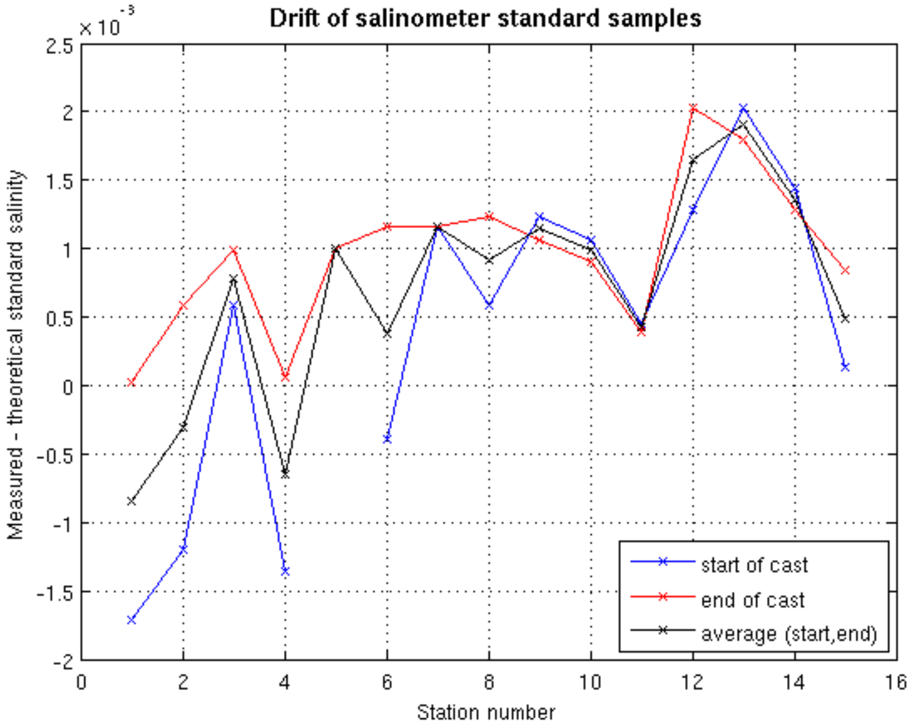


Figure 9.1: Difference between the standard bottle salinities measured by the salinometer and their theoretical values.

9.4.2 Calibration of upward profiles

To calibrate the CTD upcast, conductivity differences (bottles - CTD) above and below 0.002mS/cm and above and below three standard deviations from the mean were not considered. These limits remove obvious outliers, representing 39% of the total data, but also to remove a bias of conductivity measurement observed in the zone of strong salinity gradient in the top 1000m. The slope correction has been defined for two different blocks; the first cast, which was a test, was treated separately than all the other casts. The slope correction applied for the cast 2 to 15 is 0.999991.

A linear correction was also applied to remove the dependence of conductivity on the pressure. The linear coefficients are: a = -5.0065^{-7} and b = 0.0008165.

The application of this correction reduces the conductivity difference in Figure 9.2d by increasing the CTD conductivity shallower than 1631m and reducing it for the depths deeper than 1631m. The means and standard deviations of conductivity residuals after calibration are presented in Table 9.3; they are of the order of 10^{-4}.

9.4.3 Calibration of downward profiles

The calibration applied to the downcast is displayed in Figure 9.3. Each station was treated individually in this case by producing individual slope corrections (Table 9.3). The effect of the calibration is therefore relatively significant for the downcast, whereas for the upcast the linear correction was more significant than the slope correction due to the closeness of K to 1. In this case the means of the difference (Table 9.4) are also of the order of 10^{-4}, however the standard deviations are larger of the order 10^{-3}.

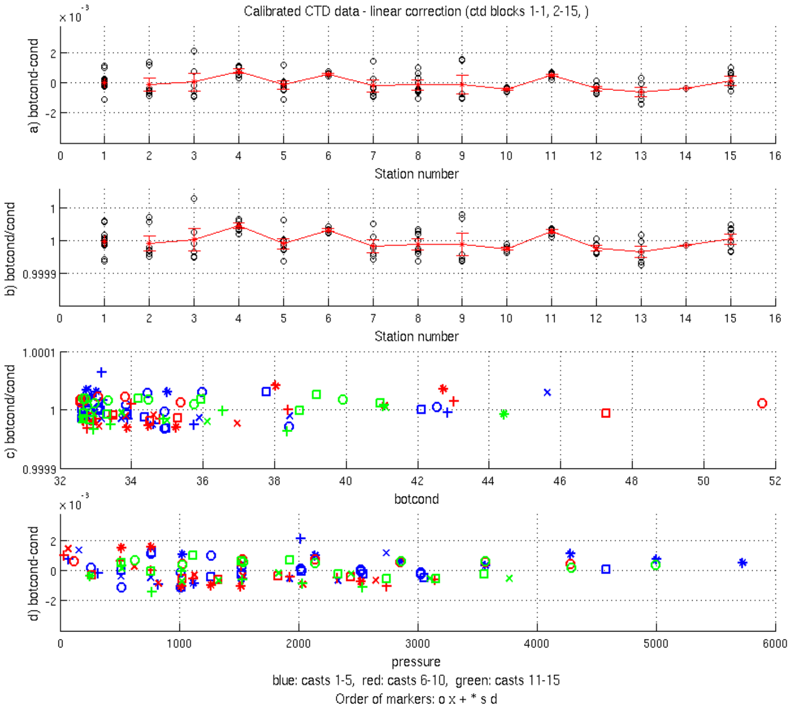


Figure 9.2: UPCAST Calibrated CTD conductivity (C_ctd) compared with bottle conductivity (C_bot). Difference (a) and ratio (b) of C_bot with C_ctd against station numbers. Conductivity ratio against C_bot (c) and conductivity difference against pressure (d).

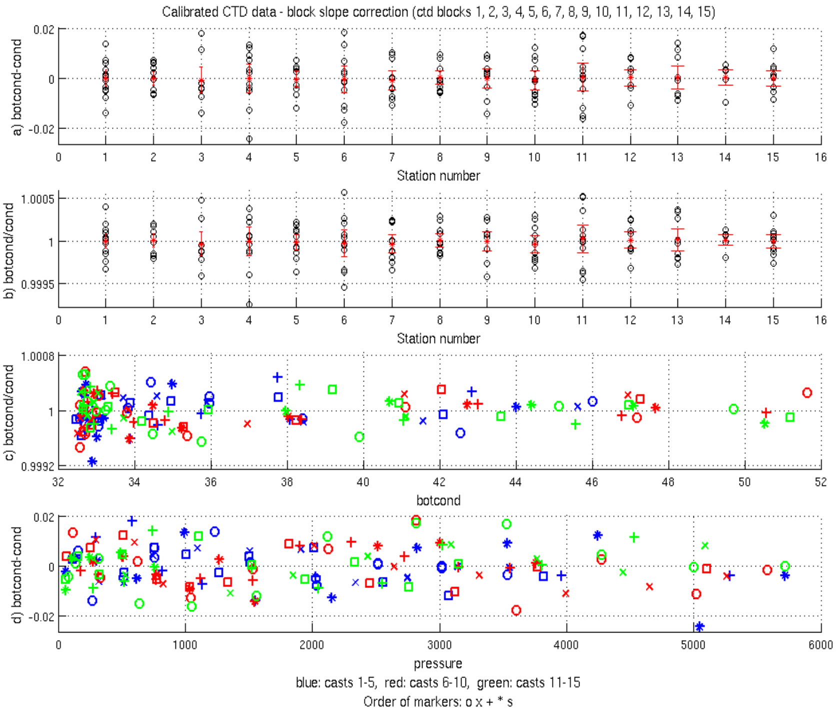


Figure 9.3: DOWNCAST Calibrated CTD conductivity (C_ctd) compared with bottle conductivity (C_bot). Difference (a) and ratio (b) of C_bot with C_ctd against station numbers. Conductivity ratio against C_bot (c) and conductivity difference against pressure (d).

Table 9.3: Slope corrections applied to the CTD downcast to bring them into agreement with the bottle conductivities.

CAST	Slope Correction
1	1.00003
2	0.99999
3	1.00003
4	1.00016
5	1.00000
6	0.99997
7	1.00003
8	0.99998
9	0.99983
10	0.99996
11	1.00001
12	0.99989
13	0.99998
14	1.00002
15	0.99993

Table 9.4: Mean and standard deviation of conductivity difference(bottles - CTD) for each cast (upward and downward).

Depth	**UPCAST**		**DOWNCAST**
	mean (C_bot - C_ctd)	std (C_bot - C_ctd)	std (C_bot - C_ctd)
Full water column	-3.31E-05	5.54E-04	7.84E-03
2000 to 5700 m	-1.18E-04	8.60E-04	8.21E-03

9.5 References

Morison, J., R. Andersen, N. Larson, E. D'Asaro, and T. Boyd, 1994: The correction for thermal-lag effects in Sea-Bird CTD data. *J. Atmos. Oceanic Technol.*, **11,** 1151–1164.

10. Mooring Operations

Steve Whittle

10.1 Deck equipment setup

The double barrel winch system was used throughout this cruise. The hydraulic power pack and electric motor on the double barrel winch had been for a full service before being sent out and there have been no problems during the cruise.

The large orange reeling winch needs to be looked at. There is a potential hazard when deploying, recovering or winding on wire due to the gaps in the cheek plates at either end of the drum. It would be good to have removable plates for these sections, though there were no problems on this cruise due to the awareness of the person driving the scroll carriage. This reeling winch was used for the two longest and heaviest moorings that were MAR1 and EB1. At the end of the cruise the hydraulic hose was changed for the pending RV *Knorr* cruise.

There were no problems with the blue reeling winch and this was used on all recoveries and the majority of deployments.

The diverter sheave was repaired during the cruise as one of the cross members had started to corrode. A backing plate was manufactured and this will be OK for the pending RV *Knorr* but will need to be addressed on return to NOC.

The outboard sheave will need servicing on return to NOC after the pending RV *Knorr* cruise as one of the seals has split.

10.2 Diary of Events

Times are ships time.

Monday 13th December: Arrive at hotel at 0800, day of rest after long travel.

Tuesday 14th: Ship at pilot station at 0900, ships agent did not pick us up from hotel until after the ship had docked. On arrival to the ship at 1100 there were no containers or crane to start the mob. First container, mobile crane and forklift did not arrive until 1300 and then the crane was too small to lift the workshop containers and hire containers onto the ship. We decided to carry on using what at hand; 6 containers were unloaded in the afternoon. Then the correct crane turned up at 1700 but by then we had to arrange the deck for space and told the crane to return the next day.

Wednesday 15th: Continued with mob, loaded workshop container and three hire containers onto the ship, and unload the remaining container and workshop container. Ran DB Winch system but it had no cooling water because this is connected to the non-toxic system. Meeting with Captain and PSO about sailing early but this was put on hold due to late arrival of air freight and Moroccan observer.

Thursday 16th: Checked out of hotel and joined ship as Friday was looking to be departure day. Carried on with mob.

Friday 17th: Air freight arrived at 1200 but 5 boxes of MicroCATs were missing and were found to be still in Lisbon. Started looking at instrumentation and get CTD ready for test deployment on Saturday. Sailed at 1800.

Saturday 18th: Argo floats were deployed in the early hours. CTD test dip at 1000 but this was aborted due to ships winch system problems and poorly conductivity sensor. This was changed and also extra weight was added from spare CTD frame, test deployment resumed at 1300 to 3500m this went with no problems. On return to the deck 12 bottles and 4 release units were added to the frame for a release test next day. Batteried up MicroCATs and set up the lab. Got ready for wire winding, and got ropes into baskets for deployment of mooring MAR0.

Sunday 19th: Wound on mooring MAR1 onto large orange reeler. Slight scuff marks on the jacket of wire length 710m this was repaired using Scotch adhesive glue, self amalgamating tape and PVC tape in a couple of places. Also wound on moorings MAR2 and MAR3. While this was going on a CTD for release dips was in progress for the testing of 4 release's to a depth of 3500m; all four releases worked and when all onboard these were removed and another 5 put in their place for another dip the following day to 5200m. A couple of hydraulic leaks on the double barrel were sorted; these being just loose fittings. Instrumentation progressed with Dave and Chris.

Monday 20th: Wound on NOG Sediment trap mooring first thing in the morning while a CTD release and cal dip took place, all 5 release's were fired successfully at a depth of 5200m. All buoyancy was made up for moorings MAR1, MAR1L6, MAR2 and MAR0. We were then in the position of needing to recover moorings to progress with the other mooring stations. A repair job was completed on the diverter sheave because one of the box section cross members had corroded around the bolt holes. A backing plate has been put in place. At the end of the day another 5 releases were added to the CTD for the following day's cal/release dip. Instrumentation as usual progressed with Chris and Dave. Only down point today was that the Dip clearance for Tenerife waters has not yet been granted and what with Christmas breaks in both the UK and Spain this could cause a major problem.

Tuesday 21st :CTD station to 5600m for cal and release testing, the 5 off release units fired ok, everything seemed to be talking ok on the CTD. Built 2 off billings floats for 1st station and built 3 off double release units for MAR1,MAR1L and MAR0. Instrumentation and battery building progressed by Dave and Chris.

Wednesday 22nd: This was our Xmas day dinner so a day off.

Thursday 23rd: Removed wound on NOG sediment trap mooring drum from the winch and set up for a recovery drum. Built up tripod for mooring MAR1L. Progressed with instrumentation for first three moorings.

Friday 24th: Sighted MAR1 mooring at 0900hrs. All that was on the surface was the Trimsyn floats, 24" syntactic and 37" steel sphere. On recovery of the Trimsyn floats it was obvious that there had been long line activity due to the line, hooks and swivels attached. After the syntactic had been recovered and the two 4mm lines had been joined to each other the wire parted after two turns had been wound round the DB winch. This was due to damage at about 2" from the termination. The wire was looped and secured with bulldog grips and recovery continued. There were no other problems other than slight tangle of 5mm wire around 37" sphere. In total 4 MicroCATs were recovered and all operations finished by 1030hrs. Steamed to CTD station for Cal and 4 off release dips.

Saturday 25th : Up at 0600hrs to ping for MAR1 using ship hull transducer and "super ducer". Although some ranges came back it was decided that these were not true ranges so headed to MAR2 and pinged that mooring. Found and ranged mooring and then released. Hooked into by 0830hrs and started to recover. All went well except for slight tangles around buoyancy and MicroCATs. All on board by 1100hrs. Steamed to MAR1L4 lander station to ping and recover. On arrival lander was ranged and released but the rise rate was only 23m/min. On waiting to recover the lander, glass was broken down and a new recovery drum was installed. The lander broke the surface at 1600hrs but only the recovery float was showing. Managed to get grapnels into the line and attached the recovery line. On hauling in the package seemed to wrap around the prop or rudder, veered on the winch and slackened off tension and package broke free. On recovery we saw that the bottom four glass had imploded. All on board by 1630hrs. Went straight into deployment of the lander but have added an extra 15m of polyprop between the billings float and the first set of four glass buoyancy. Surveyed for MAR1 mooring overnight.

Sunday 26th: After a night trying to range MAR1 mooring, some good fixes were made and it was decided to fire on the best position. This proved to be successful and MAR1 was released from the bottom and on the surface at about 0900hrs. After hooking into the glass package we started to haul aboard. There were some slight tangles at the buoyancy packages and the 5mm wire that had been snagged by long line, but the mooring came up without any major problems and the whole mooring was recovered by 1200hrs. After lunch we set to in getting MAR1 prepared for deployment and were ready to deploy by 1400hrs. This went ahead with no problems, and was all streamed by 1745hrs but we had to tow for 90min. Deployed anchor and then ranged MAR1 to the bottom. Steamed overnight to MAR0 mooring position.

Monday 27th: Started to recover MAR0, all went well and this mooring was completed at 1130hrs. After lunch we deployed MAR0 out of baskets. After completion of the deployment we wound MAR0 mooring onto a smaller drum so that it can be sent back to NOC for measuring on the laser counter. Serviced five release units ready for the CTD casts over the following days. On servicing release Sn 908 it was found that corrosion had started at the face of the housing at the transducer end so it was decided not to use this release and send it back to NOC for further investigation. Organised the deck for the deployment of MAR2 and broke down the recovered glass. MicroCATs put on CTD frame for cal dip. Instrumentation progressed by Chris and Dave.

Tuesday 28th: Started deployment of MAR2 at 1000hrs and completed with anchor deployed at 1230hrs. Ranged on MAR2 and did a MAR1 triangulation. Built glass for MAR3 mooring and MAR3L6. I have been adding 15m of polyprop under the 5m chain length at the top of the mooring as this should aid in recovery next year. Serviced two more release units but s/n 925 failed a bench test so sending it back to NOC at the end of the cruise. CTD station for MicroCAT cal dip, also test dips for 4 off release units; all fired. Steamed overnight towards MAR3 station.

Wednesday 29th: Wound on EBH4 and built lander frame. One release was put on the CTD for the following day's dip. Instrumentation progressed by Dave and Chris. Fire and flood drill at 1615hrs.

Thursday 30th: Wound on mooring EB1 onto orange reeling winch. Also made up glass for NOG sediment trap mooring. 2 off CTD cast, one of which had MicroCATs and a release for testing. Instrumentation progressed by Dave and Chris. Continued steaming towards MAR3 mooring station.

Friday 31st: Ranged MAR3L4 at 0600 and sent release code; lander on the surface at 0700 and onboard by 0730. After breakfast started to deploy lander MAR3L6 at and all deployed by 0835. Moved onto MAR3 station but alas no ranges that were worth noting, blind fired release and tried to get a range in the time it would have risen to the surface but again no ranges what-so-ever. It was decided that there was a failure of the release so we went into the deployment of MAR3. This commenced at 1215 with anchors away at 1445. Ranged all the way to the bottom. It was also decided to double up on the release and add 1 extra glass buoyancy to the last package. We were going to recover the NOG sediment trap mooring but this was put on hold because it could have meant the mooring coming up in the darkness so we moved onto a CTD station.

Saturday 1st January 2011: Ranged NOG mooring at 0730hrs and straight in with correct range so released and on the surface at 0815. No problems recovering and did not come in a tangle like last year. All on board just after 0930hrs. After a quick turn round we went straight into a deployment at 1030hrs with anchors away by 1145hrs . Started transit to EB1 mooring site. Built glass for EB1 and EB1L7, and removed release from tripod frame to get ready for service and CTD dip.

Sunday 2nd: Argo floats were deployed in the early hours and in the evening. Serviced 2 off release units for CTD dip. Wound rope into baskets for moorings EBHi, EBH1, EBH2 and EBH3 and assembled billings float for EB1L7. Clocks put forward 1 hour.

Monday 3rd: A morning of maintenance and housekeeping in the workshop container. Built doubler release unit for EB1L7 and wound on EBH5 marking the last length of wire as this was wound on. CTD deployment at 1530hrs with 2 release units on for testing.

Tuesday 4th: Built double release unit for EB1. Also built tripod for EB1L7. Assembled mini mooring masts, floatation and instrument clamps. Clocks forward 1 hour. Instrumentation progressed by Dave and Chris.

Wednesday 5th: Built EBH1L7 tripod and rigged reeling winch with a recovery drum for mooring EB1. Instrumentation progressed by Chris and Dave. Cleaned ships scientific workshop.

Thursday 6th: Ranged and released EB1 mooring at 0645hrs and on the surface at 0745. All on board by 1130hrs. After lunch ranged and released EB1L5. On surface at 1320hr and all in board by 1400hrs then straight into deployment of EB1L7. It was found that 1 of the release units (s/n 927) had corroded at the transducer end cap and had leaked water. I suspect that the material for the end cap is not Duplex. Dismantled recovered glass and built glass for EBHi, EBH1,EBH2,EBH3 and EBH1L7. Serviced 2 release units for CTD dip, one of which (s/n 248) was found to have corroded components on the PCB. 1 release unit put onto CTD with MicroCATs for cal dip.

Friday 7th: Started to deploy EB1 at 0810hrs. No problems during deployment and anchor in the water at 1210hrs after towing for 45min. Triangulated position and then transited to EBHi station. During the afternoon we started to pack/tidy deck for the port call and rigged for recovery of EBHi.

Saturday 8th: Arrived on station at 1030hrs ,ranged and released EBHi at 1130hrs. On the surface and all on board by 1230hrs. Deployed EBHi. CTD cast for MicroCATs after mooring operations.

Sunday 9th: Built tripod and glass spheres for EBM1L. Serviced release units.

Monday 10th: Ranged on EBH1 at 0845 but only random numbers coming back. Attempted a blind release and waited the expected rise time and more but still a no show. Ranged and released lander and all on board by 1115hrs. Deployed lander after lunch quickly followed by EBH1 after a short tow to get correct depth. Steam to EBH2 station and tried to range on arrival. Clocks forward 1 hour.

Tuesday 11th: Ranged and released EBH2 at 0715hrs and on surface at 0745hrs. Due to ship movements the 2nd string of buoyancy and rope got wrapped around the prop and rudder. Hauled in most of the slack rope and tied off on a cleat the rope to the last buoyancy package and release. The bosun's mate came up with the idea of sending a heavy weight (55kg pie weight) to release the buoyancy from under the ship. After deploying the weight the rope from the second buoyancy to the rope that was tied off at the cleat was cut enabling us to free the buoyancy and remaining line. Transited to EBH3 station, on arrival ranged and released mooring. All on board, then got deck ready for, and deployed, EBH3. Transited to EBH4 and EBH5 to range moorings for recovery on Wednesday. CTD station to 1000m for test dip for 3 off release units for doubling up EBH4 and EBH5 moorings. Also on the same site there was a second CTD station to 500m for testing of mini mooring release units. All releases fired on both dips.

Wednesday 12th: Ranged and released EBH4 mooring at 0715hrs and all on board. Then transited to EBH5 mooring. Ranged and released and all onboard by 1100hrs. After lunch deployed EBH4 and EBH5 then rigged up to deploy EBM1L. EBH4 and EBH5 deployments completed by 1645hrs. Transited to mini–mooring stations to range for releasing the following day.

Thursday 13th: Only managed to range on one mini–mooring during the night so it was not looking good. Recovered EBM5 at 0800hrs; this was tangled in long line, netting and trawl floats. A lot had to be cut away before hauling on board. This could be why the others had not talked back to us. Spent the morning trying to locate the others before a decision on whether to deploy new mini-moorings was made. Mini-moorings were cancelled. Deployed PIES and transited to CTD station.

Friday 14th: CTD for cal of 19 microcats at 0430hrs.

Continued packing. RRS Discovery docked at 1400hrs. Continued packing workshop container and cages for demob on Saturday.

Saturday 15th: Demob started at 0800hrs. Three containers arrived from Southampton full of equipment for the next cruise. The shore side crane lifted containers from the ship's slots and these were packed first along with 2 empty containers that were already on dockside. In the afternoon the three loaded containers were unloaded and equipment put on aft deck and boxes in the hanger. They were then reloaded with equipment from the Rapid cruise to go back to NOC. In total there were 12 container loads completed by the Rapid techs and ships crew as nobody had turned up from the next scientific/technical party prior to the ship docking.

10.3 Summary of moorings recovered and deployed

See the tables in appendices G and H for a summary of the mooring operations, along with appendix I which summarises the lost instrumentation.

11. Mooring Instrumentation Data Processing

11.1 MicroCAT Processing

Processing of MicroCAT data follows details in CR51 (D344 cruise report). Processing was done from the normal starting directory rapid/. For D359, the base directory on the UNIX box, named "eurus", was /noc/users/pstar/rpdmoc/.
The path for the calibration casts info.dat file is:
rapid/data/moor/proc_calib/d359/cal_dip/cast##info.dat where ## refers to the cast number, ranging from 1-15.
The path for the moorings info.dat file is: rapid/data/moor/proc/*mooring*/*mooring*info.dat where *mooring* refers to the full mooring name. A subdirectory, named microcat/, was created in each mooring directory for the processed MicroCAT data,
rapid/data/moor/proc/*mooring*/microcat/

11.1.1 Stage 0 – Download

Raw instrument data are downloaded from MicroCATs using SeaBird's SeaTerm (older firmware SMPs), SeaTermV2 (newer firmware SMPS), or Darren's IMP_download_v5 software (for IMPs) following procedure sheets. See details in cruise report 51 for D344, sections 18.2 and 18.6. Details were recorded on paper as setup logsheets. After downloading, the files are transferred to: rapid/data/moor/raw/d359/microcat/ using a filename based on their serial number (e.g. 4461_data.asc).

11.1.2 Stage 1—Conversion to the .raw RDB format

Stage 1 processing converts the data for all the MicroCATs on each mooring from the ASCII or cnv format to RAPID RDB format.
For calibration casts on D359, the MATLAB script was called mc_call_caldip_d359 runs the conversion function microcat2rodb_3.m as a batch file for each instrument on a calibrations cast. It also loads the CTD data for comparison. The script must be edited for each cast number. Names and paths are hard coded into the script at the beginning. It uses the info.dat file to select the instrument that it needs, therefore it is critical that the info.dat files accurately reflect the instruments. Positions and times of deployment may be nominal, and are not used in the code.

For data from recovered moorings on D359, the script used was mc_call_2_003.m. The script opens the stage0 files and converts them to .raw files. It also produces summary plots of the data and creates a stage1_log file, which records a summary of the operations carried out. Output .raw files (e.g., mar1_6_200940_4461.raw) are stored in:
rapid/data/moor/proc/*mooring*/microcat (for recovered instruments) &
rapid/data/moor/proc_calib/d359/cal_dip/microcat/cast1 (for cal dips).

11.1.3 Stage 2—conversion to .use RDB format

Data were converted to .use format using the MATLAB script microcat_raw2use_003.m. It uses the times in the info.dat file to chop off the deployment and recovery period, and produces a stage2 log. The mooring name, cruise, operator, and plot intervals must be updated. The result is a file called mar1_6_200940_4461.use and is stored in: rapid/data/moor/proc/*mooring*/microcat

11.2 Seaguard processing

A Seaguard current meter was deployed for the first time on D344 and recovered on D359. Processing scripts were written during D344 to process the data.

11.2.1 Stage 0—Download

Data were downloaded from the Seaguard using the included Seaguard Studio software. As this is the first time a Seaguard was recovered, more complete details on the download from the procedure sheet are included here.

To download the data, the instrument was opened and the screen was tapped using the included stylus to wake it. The small tape icon at the bottom right indicated that the instrument was still logging. The number of records was checked by looking in the Menu> Recorder Panel (about 20,000 for the 1 year deployment). Logging was stopped by clicking "stop" and the time was noted to determine the clock offset from GMT. To remove the SD memory card, the round card port was unscrewed and card removed. Data files were copied to a laptop computer using an external card reader, transferring the entire directory called RCM_*SSS_YYYYMMDD_HHMM* where *SSS* is the instrument serial number. In this folder were 6 files, three.dsc, two .dat and a .xml file.

In the Seaguard Studio software, these data were imported using the File>Import menu and selecting the appropriate directory. Data were then exported using the Tasks menu at the bottom left, and "Export value type data to Matlab". All files were selected ("Check all") and data were exported. The software created 5 files: Conductivity #237.csv, DCS #218.csv, Pressure #246.csv, System Parameteres.csv and Temperature #204.csv. These files are read in the stage 1 processing.

11.2.2 Stage 1—Conversion from .csv to RDB format

The scripts used for D359 were called seaguard_call.m to read the *.csv files into .raw format.

The result is a data file called ebhi_6_200934_114.raw, which is stored under the mooring name in the directory rapid/moor/proc/.

11.2.3 Stage 2—Conversion to .use format

Data were converted to .use format using the MATLAB script seaguard_raw2use_call.m. Paths and filenames must be updated. The result is a data file with the name ebhi_6_200934_114.use.

11.3 S4 processing

The current meters recovered from the moorings during D359 were S4s, with the exception of a single Seaguard. For S4s recovered during D359, it was discovered that they had been set up incorrectly. All S4s were only set to receive on channel 6, rather than channels 2, 3, 4, 5 and 6. Thus, only velocity data were recovered.

11.3.1 Stage 0—Download

Data were downloaded using software written by Darren Rayner called "S4 Terminal", and converted to an ASCII file. See the download instruction sheets for further information. S4 current meter number 35612577 would be stored as:
rapid/data/moor/raw/d359/s4/35612577_data.asc.

11.3.2 Stage 1—Conversion to .raw

Data were converted into .raw format using the MATLAB script s42rodb_v5_scr.m converting the .asc file to the .raw format with the relevant header. In order to run the script, the mooring name and paths must be updated. The code checks the info.dat file and looks for data files in the appropriate directories. The result is a stage1 log file and the data file, mar1_6_200940_35612577.raw stored under the mooring name in the rapid/moor/proc/ directory.

11.3.3 Stage 2—Conversion to .use

Data were converted into .use format using the MATLAB script s4raw2use_v2_script_version.m which chops the deployment and recovery periods using the times in the info.dat file. Note: this replaces the previous script in batch_s4raw2use_v2.m.

11.4 PIES Instrument download

The data processing for this instrument was derived from the cruise report for D334 (chapter 17) and D344 (chapter 22). Updated instructions and details are included here. Unfortunately, due to a firmware issue with the PIES deployed at EBP1, data received during telemetry were all dated with yearday 1, and it was not possible to reconstruct the time series of pressure data or travel times. It was deployed during D334 on 15th November 2008, but will not be recovered until 2011. As a result of the firmware bug, it will not likely be worthwhile to attempt acoustic telemetry download during the coming cruise (September 2011).

A Benthos DS-7000 deck unit was attached to a laptop running MATLAB. The transducer was suspended over the side of the ship as deep as possible, and the electronics were set up in the saltwater annex. The MATLAB routine PPDTb_v3.m received the signals and PPlotPDT.m plotted them as they were received. PPlotPDT.m occasionally needed to be restarted.

The sea state was calm, and the ship maintained position over the PIES unit using its bow thrusters. The laptop was connected via an Ethernet cable to the ship's network, and so had a MATLAB license served across the network.

Steps:

1) Create a new directory for telemetry and copy the IES MATLAB files into the directory.
2) All paths in PPDTb_v3.m, PPplotPDT.m, renamePDT.m and deletePDT.m were updated for the new directory. All plot and data files were deleted. The code within PPDTb_v3.m which changes channel frequencies and gains was commented out.
3) Running Traxset.m was attempted with the DS-7000 in REMOTE mode, but it was found to crash, and also to set the channels to settings that were not reflected in previous cruise reports. Instead, channels were set manually with the deck unit in RANGING mode to match previous cruise reports as:

Channel	1	2	3	4	5	6	7	8
Gain	6	8	6	6	6	6	6	6
Reception frequency	12.0	12.5	12.0	11.5	11.0	10.5	10.0	15.0
Transmission frequency	12.5	15	15	15	15	15	15	15

4) Put the transducer in the water.
5) Wait to hear the PIES sampling in REMOTE mode (every 10 minutes), recording the time of first ping to calculate the clock drift (making sure to correct for travel-time through the water column). The sampling sounds like a set of 4 pings at 10 minute intervals.
6) Switch to COMMAND mode on the DS-7000 and send CLEAR (76 for all PIES). Wait for the 2-ping response (at 12.0 kHz). If no reply is heard, resend the command. If the reply seems to be garbled by lots of echos, try adjusting the gain down (see the manual for settings based on water depth). It may also be necessary to reduce the power of the Benthos deck unit. The power settings only affect the AC power supply. If batteries are installed, they must be removed in order for a reduction in the power setting to have any effect.
7) Send the TELEM code (depends on the instrument), and wait for the 2-ping reply.
8) After the next scheduled sampling time, the PIES will switch to telemetry mode as detailed in the IES User's manual.
9) Open 2 MATLAB sessions, one to run PPDTb_v3.m to receive the signals and the second to plot them with PPlotPDT.m.

Troubleshooting:

- If there are problems with the com port (com1, for serial), run cf.m.
- If there are MATLAB errors mentioning a lack of silent ping (@) response, check the data cable. The connector we had for the serial to S110 cable was faulty, resulting in the deck unit being unable to talk to the laptop.

12. Apex Argo Float Deployments

Pre-deployment tests were run on four Apex type argo floats to check their different components. Argo floats first need to be connected to a terminal through a communication program. The program used is Hyper-Terminal on a PC running on Windows; ProComm is an alternative communication program. Hyper-Terminal can be found in All Program → Accessories → Communication. To connect the float to the PC, an RS232 converter associated with communication cables, both provided by Teledyne Webb Research with the float, were connected through the COM port via a COM to USB converter. The converter must be powered with 12 VDC.

A new connection is created at the opening of Hyper-Terminal. In properties, the COM port, which corresponds to the COM of the USB, is selected as 'Connect using' with the following configuration:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

The connection is established with the menu Call; the two clamps, which should not touch the hull, are attached to the float. The float should normally exit the hibernate mode and detect the ‘asynchronous wake-up’ before entering the Command mode. A text file of all the commands is saved (Transfer → Capture Text).

The properties of the float are analysed through the procedure of the ‘Argo Test Logsheet’ (also detailed in the ‘APEX Final Test Procedure for Controller APF-9A’). The command L allows to list the float parameters and P shows the pressure table. The real time is compared to the GMT by pressing T. The nine steps are:

- Connect the float to the terminal and check floats id and pressure levels.
- Check real time against GMT.
- Test transmission.
- Test high pressure pump.
- Test battery voltage and internal vacuum.
- Check pneumatic system.
- CTD test.
- Run self test.
- Hibernate.

The (GMT - float) time offset was ranged from -42 to 18 seconds. The transmission test was run by placing a cat's meow passive beeper close and parallel to the antenna while sending a signal (Command IT). Float 5010 produced a faint signal compared to the other three.

The voltage was measured at 15.1 V, slightly lower than the 15.2 V requirement of the logsheet. The internal vacuum was above the required range 78-87 for the last two floats (5008 and 5009). This must be due to the high room temperature above the required range of 20-24°C during these tests; the two floats were also on the deck during the afternoon before the tests.

12.1 Argo floats deployment

The properties of the four launched Argo floats are listed in Table 12.1. During the first deployment, it was noticed that the 'activation mode' could not be obtained with the expected method in the manual, which consists of resetting the float with the magnet, no signal was received by the cat's meow beeper. To activate the float without the magnet, the manual ‘Pressure Activation Deployment’ was launched by connecting the float to a terminal and typing A for the first float (Hull serial 5010). Another method was used for the other three floats with the command E which replicates the ‘Activation Mode’ expected with the magnet. In this case the 6 beeps 8 seconds apart were followed by the inflation of the bladder and then a regular signal was heard on the beeper.

Table 12.1: Argo floats characteristics.

Hull s/n	Activation time (DOY/hh:mm)	Expected dive time	Deployment time	Lat (N)	Lon (W)
5008	002/8:10	002/14:10	002/8:28	23°51.03	38°01.64
5009	002/20:00	003/2:00	002/20:18	23°50.68	36°00.59
5010	352/05:06	352/11:06	352/05:23	17°07.57	36°30.24
5011	352/19:42	353/01:42	352/19:55	17°29.27	28°14.44

13. Cross-Calibrated Multi Platform & QuikSCAT Winds at 26.5°N

The Ekman contribution to the AMOC is presently estimated using QuikSCAT satellite scatterometer estimates of 10m winds, that are converted to stress and then to Ekman transports. A spinning antenna on NASA's QuikSCAT satellite failed at 0700 GMT on Monday 23rd November 2009. We are being advised by Liz Kent of the surface process group at the NOC and by Tong Lee of JPL, NASA about a suitable replacement data set. A likely alternative to the QuikSCAT is the CCMP (Cross-Calibrated Multi-Platform) vector wind product. This product is formed using an objective analysis to merge available satellite observations of ocean surface wind from different sensors (including wind speed from passive microwave radiometers such as SSM/I and vector wind from various scatterometers). ECMWF product is used to help determine direction when there is an ambiguity in wind direction and when scatterometer data are not available. A brief analysis of an overlapping set of CCMP and QuikSCAT data is given below.

CCMP level_3.0 daily files from July 1987 to Dec 2009 were extracted (ftp://podaac-ftp.jpl.nasa.gov/OceanWinds/ccmp/) and a subset of the data written to a Matlab file. The subset data are in the geographical limits of 280 to 345 E (80 to 15W) and 25 to 27W. Twice daily Ekman transports at 26.25°N were computed from QS data and once daily Ekman transports at 26.375°N computed from the CCMP data. Both data sets were then 10-day low-pass filtered and the CCMP data interpolated onto the QuikSCAT time base. Differences between the two timeseries are shown in Figure 13.1. The mean difference is 0.048Sv with a standard deviation of 0.467Sv.

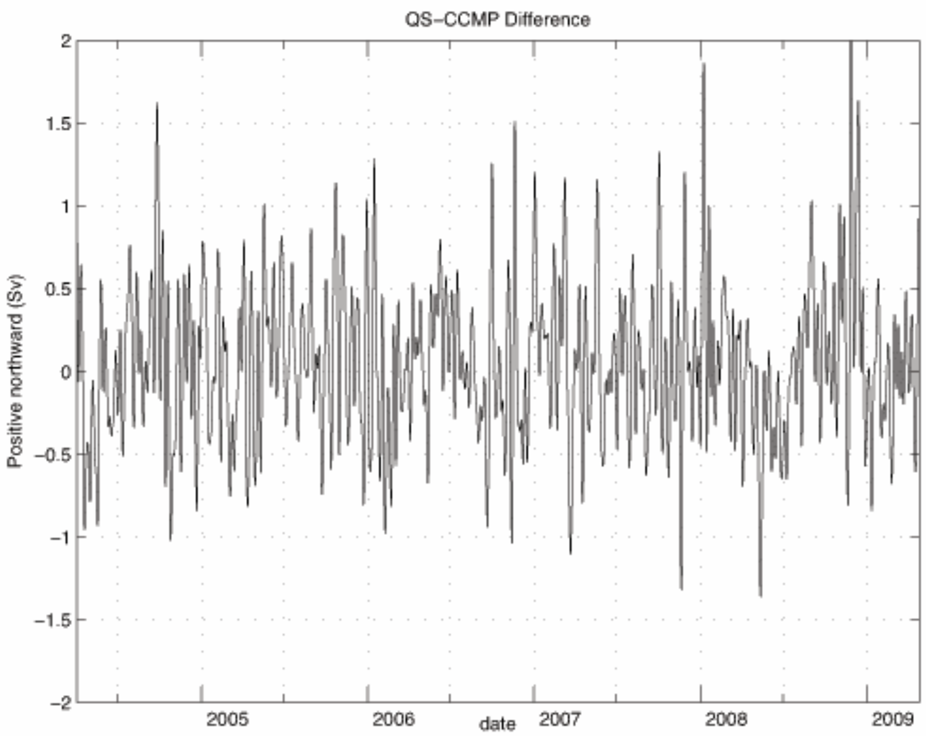


Figure 13.1: Difference between QuickSCAT and CCMP winds

13.1 References

Atlas, R., R. Hoffman, J. Adrizzone, S. M. Leidner, J. C. Jusem, D. K. Smith, and D. Gombos (2011), A Cross-calibrated, Multiplatform ocean surace wind velocity product for meteorlogical and oceanographic applications, *Bull. Amer. Meteo. Soc.*, 157-174.

14. Appendices

Appendix A: Details of Sea-Bird SBE37s lowered on CTD calibration casts

Cast	Type	s/n	Deployment	Pressure sensor	Comments
2	IMP m/c	4066	pre-deployment	?	Was left logging for 24 hours after cast
2	IMP m/c	4068	pre-deployment	?	3500 m pressure rating
2	IMP m/c	4070	pre-deployment	?	3500 m pressure rating
2	IMP m/c	4071	pre-deployment	?	3500 m pressure rating
2	IMP m/c	4072	pre-deployment	?	3500 m pressure rating
2	SMP m/c	3902	pre-deployment	Kistler	
2	IMP m/c	4178	pre-deployment	Kistler	
2	IMP m/c	4722	pre-deployment	Kistler	
2	SMP m/c	6121	pre-deployment	Paine	
2	SMP m/c	6122	pre-deployment	Paine	
2	SMP m/c	6123	pre-deployment	Paine	
2	SMP m/c	6124	pre-deployment	Paine	
2	SMP m/c	6828	pre-deployment	Kistler	
2	SMP m/c	7468	pre-deployment	?	
2	SMP m/c	6331	pre-deployment	Paine	
2	AR				
2	AR				
2	AR				
2	AR				
3	IMP m/c	4180	pre-deployment	Kistler	
3	SMP m/c	6125	pre-deployment	Paine	Logging didn't start
3	IMP m/c	4468	pre-deployment	Kistler	Short-circuited due to a loose washer in the battery compartment
3	SMP m/c	4305	pre-deployment	Kistler	
3	SMP m/c	6126	pre-deployment	Paine	
3	IMP m/c	4470	pre-deployment	Kistler	
3	SMP m/c	6129	pre-deployment	Paine	
3	SMP m/c	6137	pre-deployment	Paine	
3	SMP m/c	6320	pre-deployment	Paine	
3	SMP m/c	6322	pre-deployment	Paine	
3	SMP m/c	6323	pre-deployment	Paine	
3	SMP m/c	6325	pre-deployment	Paine	
3	SMP m/c	6326	pre-deployment	Paine	
3	SMP m/c	6327	pre-deployment	Paine	
3	SMP m/c	6332	pre-deployment	Paine	
3	AR				
3	AR				
3	AR				
3	AR				
3	AR				
4	IMP m/c	4474	pre-deployment	Kistler	
4	IMP m/c	4475	pre-deployment	Kistler	
4	IMP m/c	4708	pre-deployment	Kistler	
4	SMP m/c	4306	pre-deployment	Kistler	
4	SMP m/c	4307	pre-deployment	Kistler	
4	IMP m/c	4466	pre-deployment	Kistler	
4	SMP m/c	6127	pre-deployment	Paine	

4	SMP m/c	6128	pre-deployment	Paine	
4	SMP m/c	6125	pre-deployment	Paine	
4	IMP m/c	4468	pre-deployment	Kistler	
4	IMP m/c	4471	pre-deployment	Kistler	
4	IMP m/c	4472	pre-deployment	Kistler	
4	SMP m/c	6333	pre-deployment	Paine	
4	SMP m/c	7363	pre-deployment	Paine	
4	SMP m/c	3933	pre-deployment	Kistler	
4	AR				
4	AR				
4	AR				
4	AR				
4	AR				
5	SMP m/c	3934	pre-deployment	Kistler	
5	IMP m/c	4709	pre-deployment	Kistler	
5	IMP m/c	4710	pre-deployment	Kistler	
5	IMP m/c	4711	pre-deployment	Kistler	
5	IMP m/c	4715	pre-deployment	Kistler	
5	SMP m/c	6824	pre-deployment	Kistler	
5	SMP m/c	6825	pre-deployment	Kistler	
5	SMP m/c	7681	pre-deployment	Druck?	
5	IMP m/c	4461	post-deployment	Druck	From mar1_drift, greenish growth
5	IMP m/c	4464	post-deployment	Druck	From mar1_drift, greenish growth
5	SMP m/c	5779	post-deployment	Paine	From mar1_drift, greenish growth, clock is 3 minutes off GMT
5	SMP m/c	5780	post-deployment	Paine	From mar1_drift, greenish growth, clock is 7 minutes off GMT
6	SMP m/c	5241	post-deployment	Paine	
6	SMP m/c	5762	post-deployment	Paine	
6	SMP m/c	5763	post-deployment	Paine	
6	SMP m/c	5766	post-deployment	Paine	
6	SMP m/c	5767	post-deployment	Paine	
6	SMP m/c	5768	post-deployment	Paine	
6	SMP m/c	5770	post-deployment	Paine	
6	SMP m/c	5771	post-deployment	Paine	
6	SMP m/c	5773	post-deployment	Paine	
6	SMP m/c	5774	post-deployment	Paine	
6	SMP m/c	5775	post-deployment	Paine	
6	SMP m/c	5778	post-deployment	Paine	
6	SMP m/c	5781	post-deployment	Paine	
6	SMP m/c	5782	post-deployment	Paine	
6	SMP m/c	6830	post-deployment	Paine	P offset > 10 dbar
7	IMP m/c	4718	post-deployment	?	P offset > 15 dbar
7	IMP m/c	3282	post-deployment	Druck	
7	IMP m/c	3284	post-deployment	Druck	
7	SMP m/c	5240	post-deployment	Paine	
7	SMP m/c	5776	post-deployment	Paine	
7	SMP m/c	5783	post-deployment	Paine	
7	SMP m/c	5784	post-deployment	Paine	
7	SMP m/c	5785	post-deployment	Paine	
7	SMP m/c	5786	post-deployment	Paine	
7	SMP m/c	5787	post-deployment	Paine	
7	SMP m/c	5788	post-deployment	Paine	
7	SMP m/c	5789	post-deployment	?	P offset > 10 dbar
7	AR				

7	AR				
7	AR				
7	AR				
8	IMP m/c	4717	pre-deployment	Kistler	
8	IMP m/c	4719	pre-deployment	Kistler	
8	IMP m/c	4720	pre-deployment	Kistler	
8	IMP m/c	4721	pre-deployment	Kistler	
8	SMP m/c	6826	pre-deployment	Kistler	
8	SMP m/c	6827	pre-deployment	Kistler	
8	IMP m/c	4066	pre-deployment	?	
11	IMP m/c	4473	pre-deployment	Kistler	
11	IMP m/c	4184	post-deployment	Druck	
11	IMP m/c	4462	post-deployment	Druck	
12	SMP m/c	5484	post-deployment	Paine	P offset > 10 dbar
12	SMP m/c	5486	post-deployment	Druck	
12	SMP m/c	6335	post-deployment	Paine	
12	SMP m/c	3900	post-deployment	Druck	
12	SMP m/c	3901	post-deployment	Druck	
12	SMP m/c	3903	post-deployment	Druck	
12	SMP m/c	3904	post-deployment	Druck	
12	SMP m/c	3910	post-deployment	Druck	
12	SMP m/c	3911	post-deployment	Druck	
12	SMP m/c	3912	post-deployment	Druck	P offset > 10 dbar
12	SMP m/c	3916	post-deployment	Druck	
12	SMP m/c	3918	post-deployment	Druck	P offset > 10 dbar
13	SMP m/c	3251	post-deployment	Druck	
13	SMP m/c	3486	post-deployment	Druck	
13	SMP m/c	3890	post-deployment	Druck	P offset > 15 dbar
13	SMP m/c	3891	post-deployment	Druck	P offset > 20 dbar
13	SMP m/c	3893	post-deployment	Druck	P offset > 10 dbar
13	SMP m/c	3277	post-deployment	Paine	
13	SMP m/c	3484	post-deployment	Paine	
15	SMP m/c	3248	post-deployment	Druck	
15	SMP m/c	3249	post-deployment	Druck	
15	SMP m/c	3252	post-deployment	Druck	
15	SMP m/c	3253	post-deployment	Druck	
15	SMP m/c	3254	post-deployment	Paine	
15	SMP m/c	3255	post-deployment	Paine	
15	SMP m/c	3256	post-deployment	Paine	P offset > 10 dbar
15	SMP m/c	3257	post-deployment	Druck	
15	SMP m/c	3269	post-deployment	Paine	
15	SMP m/c	3270	post-deployment	Paine	
15	SMP m/c	3271	post-deployment	Paine	
15	SMP m/c	3483	post-deployment	Druck	
15	SMP m/c	5485	post-deployment	Paine	
15	SMP m/c	3220	post-deployment	Druck	
15	SMP m/c	3259	post-deployment	Druck	
15	SMP m/c	3264	post-deployment	Druck	
15	SMP m/c	3265	post-deployment	Paine	
15	SMP m/c	3266	post-deployment	Paine	
15	SMP m/c	3268	post-deployment	Druck	

Appendix B: Instrument Record Lengths

Inst	**s/n**	**Start**	**End**	**Median press dbar**	**Comments**
ebm5_3_200924	03220	2009/10/24	2011/01/13	208.4	
ebh4_7_200929	03252	2009/10/24	2011/01/12	325.6	
	03253	2009/10/24	2011/01/12	398.7	
	03254	2009/10/24	2011/01/12	499.0	
	03255	2009/10/24	2011/01/12	608.0	
	03256	2009/10/24	2011/01/12	699.9	
	03257	2009/10/24	2011/01/12	811.5	
ebh5_5_200927	03248	2009/10/24	2011/01/12	120.0	
	03249	2009/10/24	2011/01/12	194.1	
	03483	2009/10/24	2011/01/12	271.4	
ebh3_6_200930	03259	2009/10/25	2011/01/11	867.4	
	03264	2009/10/25	2011/01/11	978.3	
	03265	2009/10/25	2011/01/11	1097.6	
	03266	2009/10/25	2011/01/11	1208.8	
	03268	2009/10/25	2011/01/11	1425.7	
ebh2_6_200931	03269	2009/10/25	2011/01/11	1568.7	
	03270	2009/10/25	2011/01/11	1795.2	
	03271	2009/10/25	2011/01/11	2039.7	
ebh1l5_5_200834	0396	2008/11/18	2011/01/10	3059.6	
ebhi_6_200934	05485	2009/10/28	2011/01/08	3459.3	
	03277	2009/10/28	2011/01/08	4015.9	
	03484	2009/10/28	2011/01/08	4568.1	
eb1l5_5_200824	0004	2008/10/31	2011/01/07	5203.9	
eb1_8_200935	03251	2009/10/30	2011/01/06	70.7	
	03486	2009/10/30	2011/01/06	122.7	
	03890	2009/10/30	2011/01/06	197.3	
	03891	2009/10/30	2011/01/06	276.6	
	03893	2009/10/30	2011/01/06	435.2	
	03900	2009/10/30	2011/01/06	627.2	
	03901	2009/10/30	2011/01/06	836.8	
	03903	2009/10/30	2011/01/06	1041.9	
	03904	2009/10/30	2011/01/06	1234.1	
	03910	2009/10/30	2011/01/06	1650.6	
	03911	2009/10/30	2011/01/06	2068.0	
	03912	2009/10/30	2011/01/06	2558.0	
	05486	2009/10/30	2011/01/06	3090.0	
	03916	2009/10/30	2011/01/06	3578.6	
	03918	2009/10/30	2011/01/06	4077.2	
	05484	2009/10/30	2011/01/06	4613.5	
	06335	2009/10/30	2011/01/06	5051.3	
mar3l4_4_200825	0414	2008/11/04	2010/12/31	5148.2	
mar1_6_200940	04461	2009/11/07	2010/12/24	74.6	
	04464	2009/11/07	2010/12/24	110.0	
	05779	2009/11/07	2010/12/24	165.4	

	05780	2009/11/07	2010/12/24	192.2	
	05781	2009/11/07	2010/12/24	427.7	
	05782	2009/11/07	2010/12/24	477.0	
	05783	2009/11/07	2010/12/24	535.6	
	05784	2009/11/07	2010/12/24	707.2	
	04718	2009/11/07	2010/12/24	838.2	
	05785	2009/11/07	2010/12/24	1038.3	
	05786	2009/11/07	2010/12/24	1242.9	
	05787	2009/11/07	2010/12/24	1443.9	
	05240	2009/11/07	2010/12/24	2061.9	
	05788	2009/11/07	2010/12/24	2579.9	
	05789	2009/11/07	2010/12/24	3104.7	
	05776	2009/11/07	2010/12/24	3577.2	
	03282	2009/11/07	2010/12/24	4121.9	
	03284	2009/11/07	2010/12/24	4638.8	
mar1l4_4_200830	0035	2008/11/08	2010/12/25	5329.5	
	0012	2008/11/09	2010/12/25	5329.6	
mar2_5_200942	05762	2009/11/08	2010/12/25	1105.4	
	05766	2009/11/08	2010/12/25	1405.7	
	05767	2009/11/08	2010/12/25	1819.8	
	05768	2009/11/08	2010/12/25	2286.9	
	05770	2009/11/08	2010/12/25	2795.6	
	05771	2009/11/08	2010/12/25	3312.1	
	05763	2009/11/08	2010/12/25	3833.6	
	05773	2009/11/08	2010/12/25	4342.7	
	05774	2009/11/08	2010/12/25	4850.8	
	05775	2009/11/08	2010/12/25	5258.8	

Appendix C: Mooring Instrument Sampling Parameters

MAR0_4_201029

SBE53 BPR	BPR unit, s/n:	0003
	INITLOGGING	Y
	Info header:	Mar0_D359_2010
	Tide interval:	30 min
	Tide Measurement Duration:	30 min
	Reference sample frequency	Every 96 samples
	Start	27/12/10 @ 12:00
	Target depth	5600 m
SBE26 BPR	BPR unit, s/n:	0391
	Tide interval:	30 min
	Tide measurements per burst:	9999
	Wave samples per burst:	68
	Number of 0.25s periods to integrate waves:	33
	Frequency of ref measurements (N samples):	9999
	Start:	27/12/10 @ 12:00
	Target depth:	5600 m
InterOcean S4	Current meter, s/n:	35612574
	Header:	MAR0_2010_5600m
	On time:	1 min
	Cycle time:	30 min
	Average count:	120
	Channels at average:	2, 3, 4, 5, 6
	SRB count	48
	Channels at SRB	2,3,4,5 6
	Write mode:	Internal
	Start:	27/12/10 @ 12:30
SBE37 MicroCAT	IMP CTD unit, s/n:	4306 IMP (5100 m) 4307 IMP (5350 m) 4466 IMP (5475 m) 6127 (5225 m) 6128 (5475 m)
	Sample interval:	1800 s
	Start:	27/12/10 @ 13:00

MAR1L5_5_200941

SBE53 BPR	BPR unit, s/n:	0063, 0028
	Header:	MAR1L_D359
	Tide interval:	30 min
	Tide measurements duration	30 min
	Frequency of reference measurement	Every 96 samples
	Start:	25/12/10 @ 12:00
	Target depth:	5222

MAR1_7_201028

Sontek Argonaut	Current meter, s/n:	D320
	Deployment name:	359_m1
	Start:	23/12/10 @ 20:30
	Target depth:	1500 m
InterOcean S4	Current meter, s/n:	35612576
	Header:	MAR1_DEPLOY_359
	On time:	1 min
	Cycle time:	30 min
	Average count:	120
	Channels at average:	2, 3, 4, 5, 6
	SRB count	48
	Channels at SRB	2,3,4,5 6
	Write mode:	Internal
	Start:	27/12/10 @ 12:30
	Target depth:	5100 m

SBE37 MicroCAT	SMP CTD unit, s/n, (target depth):	3902 (100 m)
		6331 (50 m)
		4068 IMP (175 m)
		6121 (250 m)
		6129 (325 m)
		4722 IMP (400 m)
		4071 IMP (600 m)
		6122 (800 m)
		4072 IMP (1000 m)
		6828 (1200 m)
		7468 (1600 m)
		6123 (2000 m)
		4178 (2500 m)
		6124 (3000 m)
		4180 (3500 m)
		6327 (4000 m)
		4305 (4500 m)
		6126 (5000 m)
	Sample interval:	1800 s
	Start:	26/12/10 @ 12:00

MAR2_6_201030

SBE37 MicroCAT	SMP CTD unit, s/n, (target depth):	4070 IMP (1100 m)
		4468 IMP (1400 m)
		3934 (1600 m)
		6137 (1800 m)
		6320 (2250 m)
		6322 (2750 m)
		4470 IMP (3250 m)
		6323 (3750 m)
		6325 (4250 m)
		6326 (4750 m)
		4471 IMP (5170 m)
	Sample interval:	1800 s

	Start:	28/12/10 @ 12:00
InterOcean S4	Current meter, s/n:	35612565
	Header:	Mar2_deploy_d359
	On time:	1 min
	Cycle time:	30 min
	Average count:	120
	Channels at average:	2 (Hx), 3 (Hy), 4 (Con), 5 (T), 6 (z)
	Special record block count:	48
	Channels for SRB:	2, 3, 4, 5, 6
	Write mode:	Internal
	Start:	27/12/10 @ 23:00
	Target depth:	5150 m

MAR3_7_201032

SBE37 MicroCAT	SMP CTD unit, s/n (target depth):	6125 (2500 m) 3933 (3000 m) 6333 (3500 m) 6332 (4000 m) 4472 (4500 m) 7363 (4995 m)
	Sample interval:	1800 s
	Start:	31/12/10 @ 19:30
InterOcean S4	Current meter, s/n:	35612564
	Header:	
	On time:	1 min
	Cycle time:	30 min
	Average count:	120
	Channels at average:	2 (Hx), 3 (Hy), 4 (Con), 5 (T), 6 (z)
	Special record block count:	48
	Channels for SRB:	2, 3, 4, 5, 6
	Write mode:	Internal
	Start:	31/12/10 @ 19:30
	Target depth:	5000 m

EB1L7_7_201102

SBE53 BPR	BPR unit, s/n:	0054, 0061
	Header:	EB1L7_D359
	Tide interval:	30 min
	Tide measurements duration	30 min
	Frequency of reference measurement	Every 96 samples
	Start:	
	Target depth:	5100 m

EB1_9_201113

SBE37 MicroCAT	SMP CTD unit, s/n: (target depth)	5240 (50 m), 5141 (100 m), 5762 (175 m), 5763 (250 m),

		5766 (325 m), 5767 (400 m), 5768 (600 m), 5770 (800 m), 5771 (1000 m), 5773 (1200 m), 5774 (1600 m), 4774 IMP (2000 m), 5776 (2500 m), 5778 (3000 m), 5779 (3500 m), 5780 (4000 m), 5781 (4500 m), 4710 IMP (5000 m)
	Sample interval:	1800 s
	Start:	7/1/11 @ 15:00
	Target depth:	50

Sontek Argonaut	Current meter, s/n:	D301
	Deployment name:	359_m1
	Start:	7/1/11 @ 15:00
	Target depth:	1500 m
RCM 11	Current meter, s/n:	395
	Pings per ensemble:	600
	Temperature range:	2 – 3
	Conductivity range:	32 – 34
	Recording interval:	30
	No of channels:	8
	Mode:	Burst
	DSU serial number:	14722
	Start:	7/1/11 @ 15:00
	Target depth:	4990 m

EBHi_7_201104

SBE37 MicroCAT	SMP CTD unit, s/n: (target depth)	5783 (3500 m), 5784 (4000 m), 5785 (4500 m),
	Sample interval:	1800 s
	Start:	8/1/11 @ 15:30
RCM 11	Current meter, s/n:	399
	Pings per ensemble:	600
	Temperature range:	2 – 3
	Conductivity range:	32 – 34
	Recording interval:	30
	No of channels:	8
	Mode:	Burst
	DSU serial number:	14383
	Start:	8/1/11 @ 15:30
	Target depth:	4400 m

EBH1_7_201106

SBE37 MicroCAT	SMP CTD unit, s/n: (target depth)	5786 (2500 m), 5787 (3000 m),
	Sample interval:	1800 s
	Start:	
RCM 11	Current meter, s/n:	426
	Pings per ensemble:	600
	Temperature range:	2 – 3
	Conductivity range:	31 – 34
	Recording interval:	30
	No of channels:	8
	Mode:	Burst
	DSU serial number:	14696
	Start:	
	Target depth:	2900 m

EBH1L7_7_201105

SBE53 BPR	BPR unit, s/n:	0064, 0060
	Header:	EBH1L7_D359
	Tide interval:	30 min
	Tide measurements duration	30 min
	Frequency of reference measurement	Every 96 samples
	Start:	10/1/11 @ 15:30
	Target depth:	

EBH2_7_201112

SBE37 MicroCAT	SMP CTD unit, s/n: (target depth)	4473 (1600 m), 5775 (1800 m), 4475 (2000 m),
	Sample interval:	1800 s
	Start:	11/1/11 @ 11:00
RCM 11	Current meter, s/n:	443
	Pings per ensemble:	600
	Temperature range:	4 – 5
	Conductivity range:	32 – 35
	Recording interval:	30
	No of channels:	8
	Mode:	Burst
	DSU serial number:	16230
	Start:	
	Target depth:	1900 m

EBH3_7_201107

SBE37 MicroCAT	SMP CTD unit, s/n: (target depth)	4708 (900 m), 4709 (1000 m), 5782 (1100 m), 4711 (1200 m), 4715 (1400 m)
	Sample interval:	1800 s

	Start:	11/1/11 @ 11:00
RCM 11	Current meter, s/n:	444
	Pings per ensemble:	600
	Temperature range:	6 – 7
	Conductivity range:	34 – 37
	Recording interval:	30
	No of channels:	8
	Mode:	Burst
	DSU serial number:	14723
	Start:	
	Target depth:	1300 m

EBH4_8_201108

SBE37 MicroCAT	SMP CTD unit, s/n: (target depth)	4717 (325 m), 4719 (400 m), 4720 (500 m), 4721 (600 m), 6824 (700 m), 6825 (800 m)
	Sample interval:	1800 s
	Start:	12/1/11 @ 15:00

EBH5_6_201109

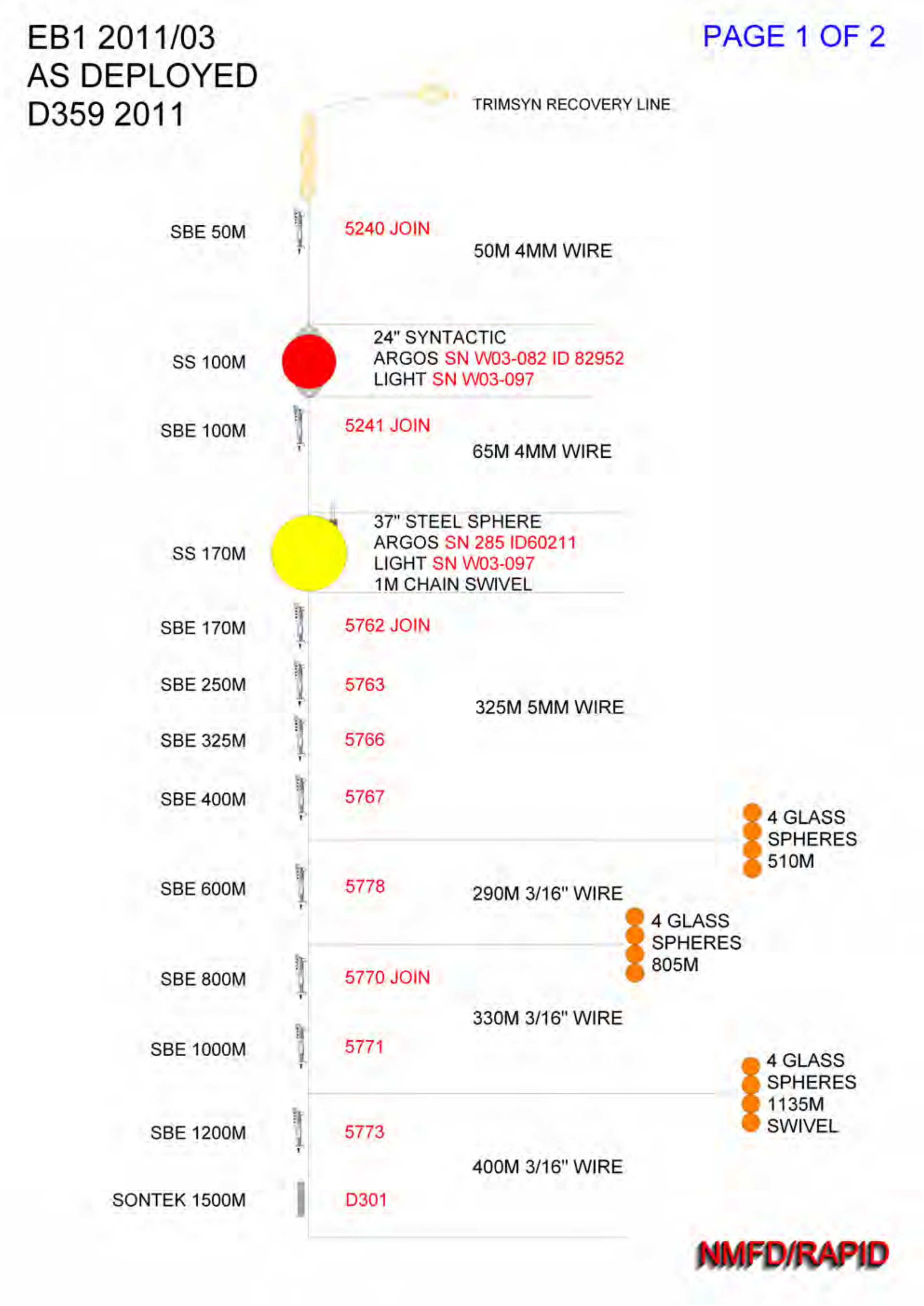
SBE37 MicroCAT	SMP CTD unit, s/n: (target depth)	6826 (100 m), 6827 (175 m), 3282 IMP (250 m),
	Sample interval:	1800 s
	Start:	12/1/11 @ 18:00
InterOcean S4	Current meter, s/n:	35612578
	Header:	
	On time:	1 min
	Cycle time:	30 min
	Average count:	120
	Channels at average:	2 (Hx), 3 (Hy), 4 (Con), 5 (T), 6 (z)
	Special record block count:	48
	Channels for SRB:	2, 3, 4, 5, 6
	Write mode:	Internal
	Start:	12/1/11 @ 18:00
	Target depth:	450 m
RCM 11	Current meter, s/n:	507
	Pings per ensemble:	600
	Temperature range:	11 – 14
	Conductivity range:	39 – 43
	Recording interval:	30
	No of channels:	8
	Mode:	Burst
	DSU serial number:	7869
	Start:	12/1/11 @ 18:00
	Target depth:	750 m

Sontek Argonaut	Current meter, s/n:	D303
	Deployment name:	
	Start:	12/1/11 @ 18:00
	Target depth:	950 m

EBH4L2_2_201110

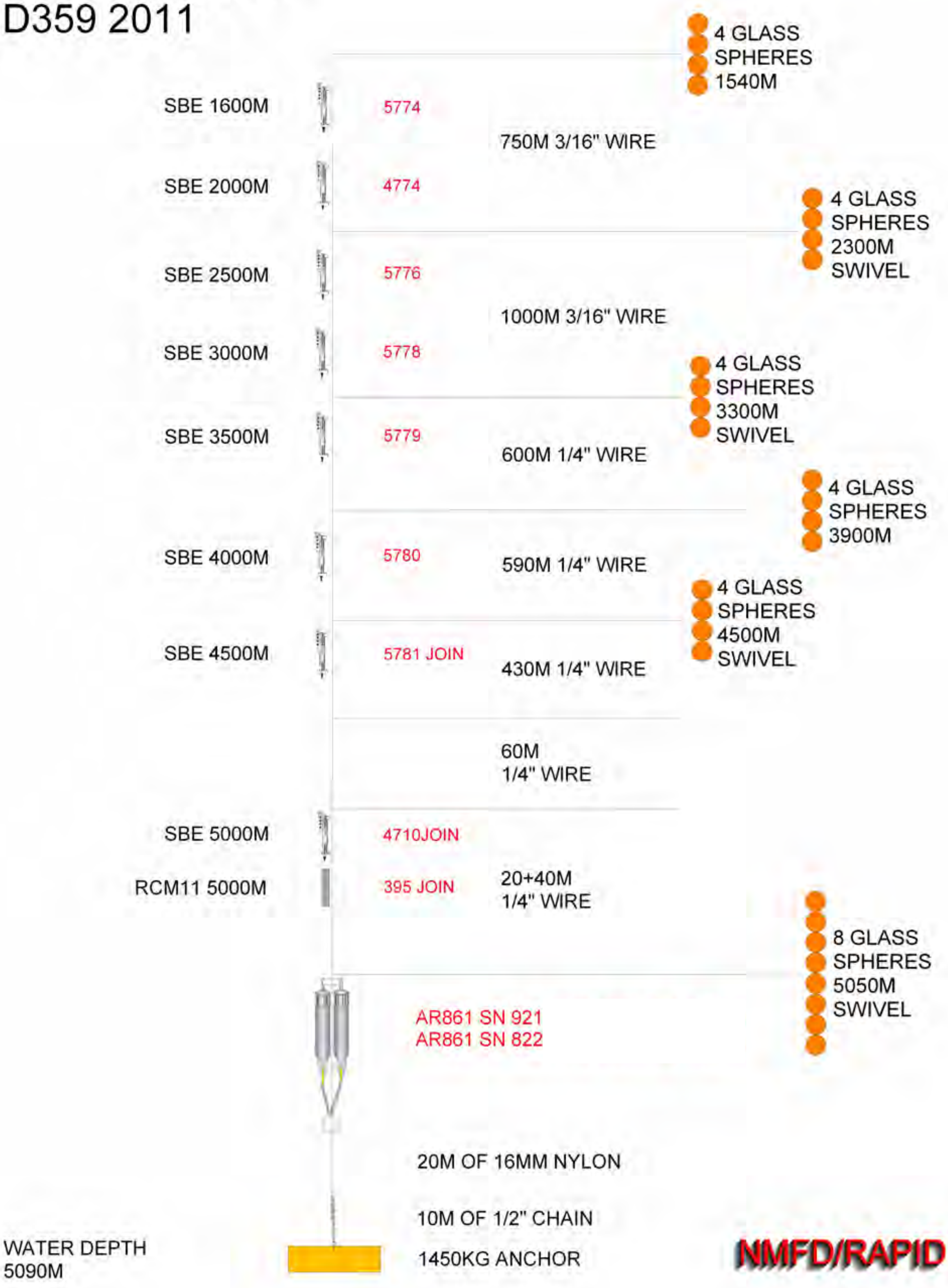
SBE53 BPR	BPR unit, s/n:	0004, 0002
	Header:	EBH4L2_D359
	Tide interval:	30 min
	Tide measurements duration	30 min
	Frequency of reference measurement	Every 96 samples
	Start:	
	Target depth:	1010 m

Appendix D: Deployed Mooring Diagrams

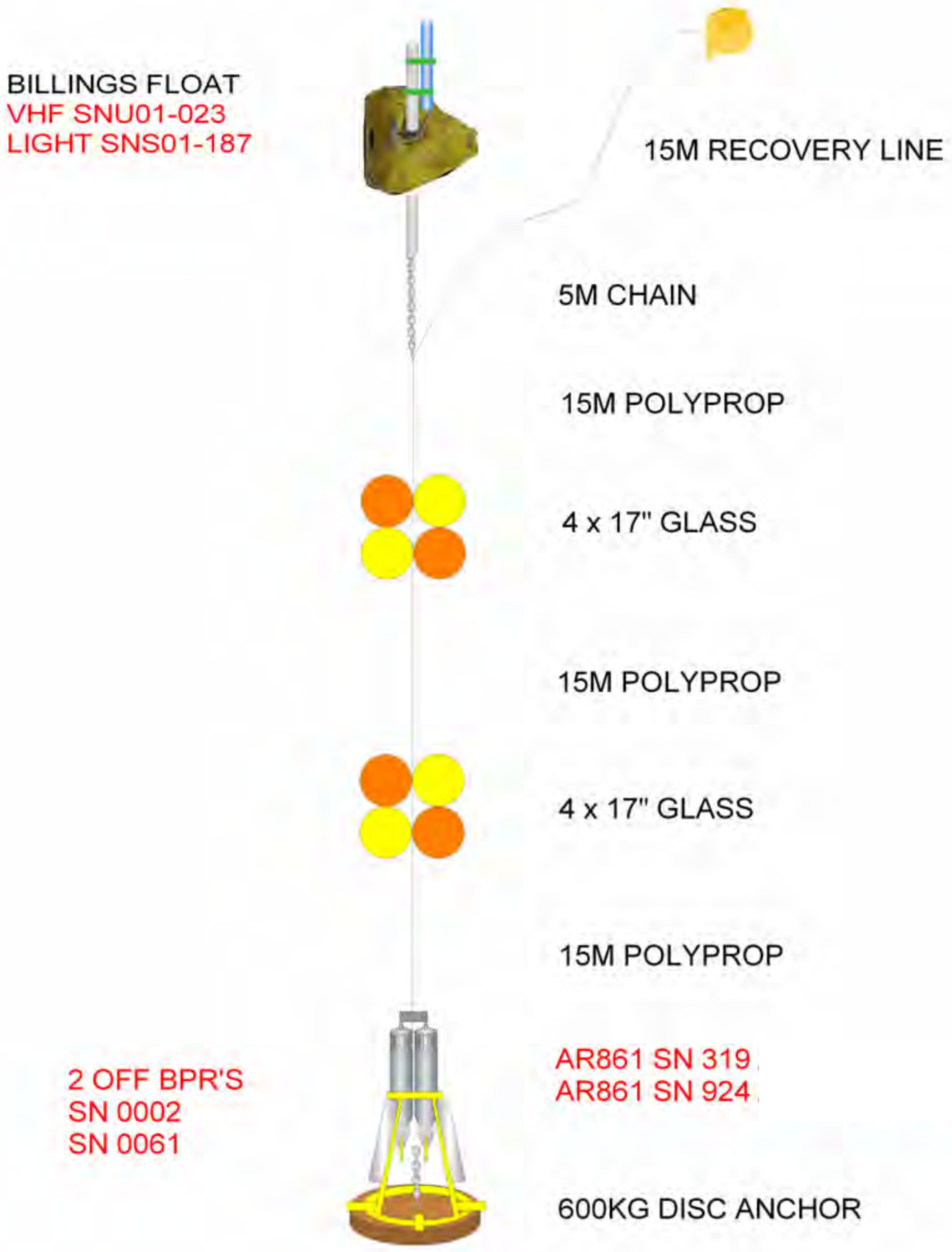


EB1 2011/03
AS DEPLOYED
D359 2011

PAGE 2 OF 2



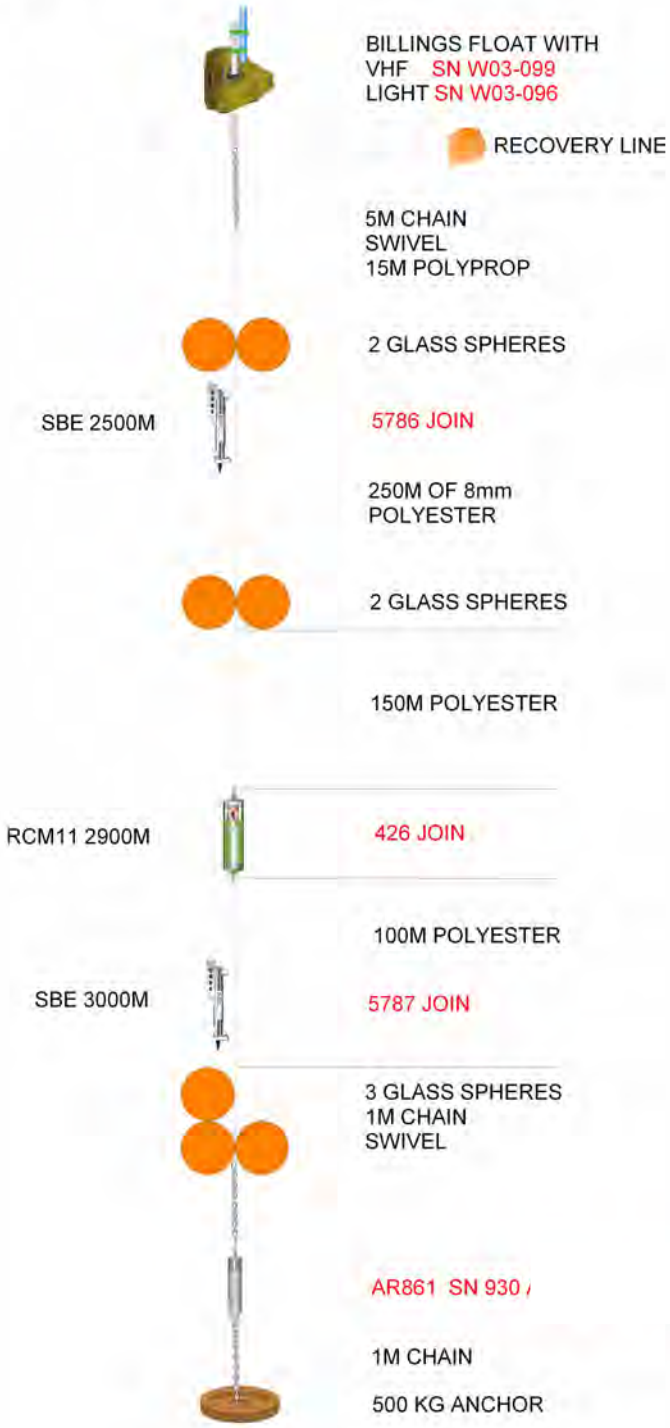
EB1L7 2011/02
AS DEPLOYED
D359 2011



WATER DEPTH
5090M

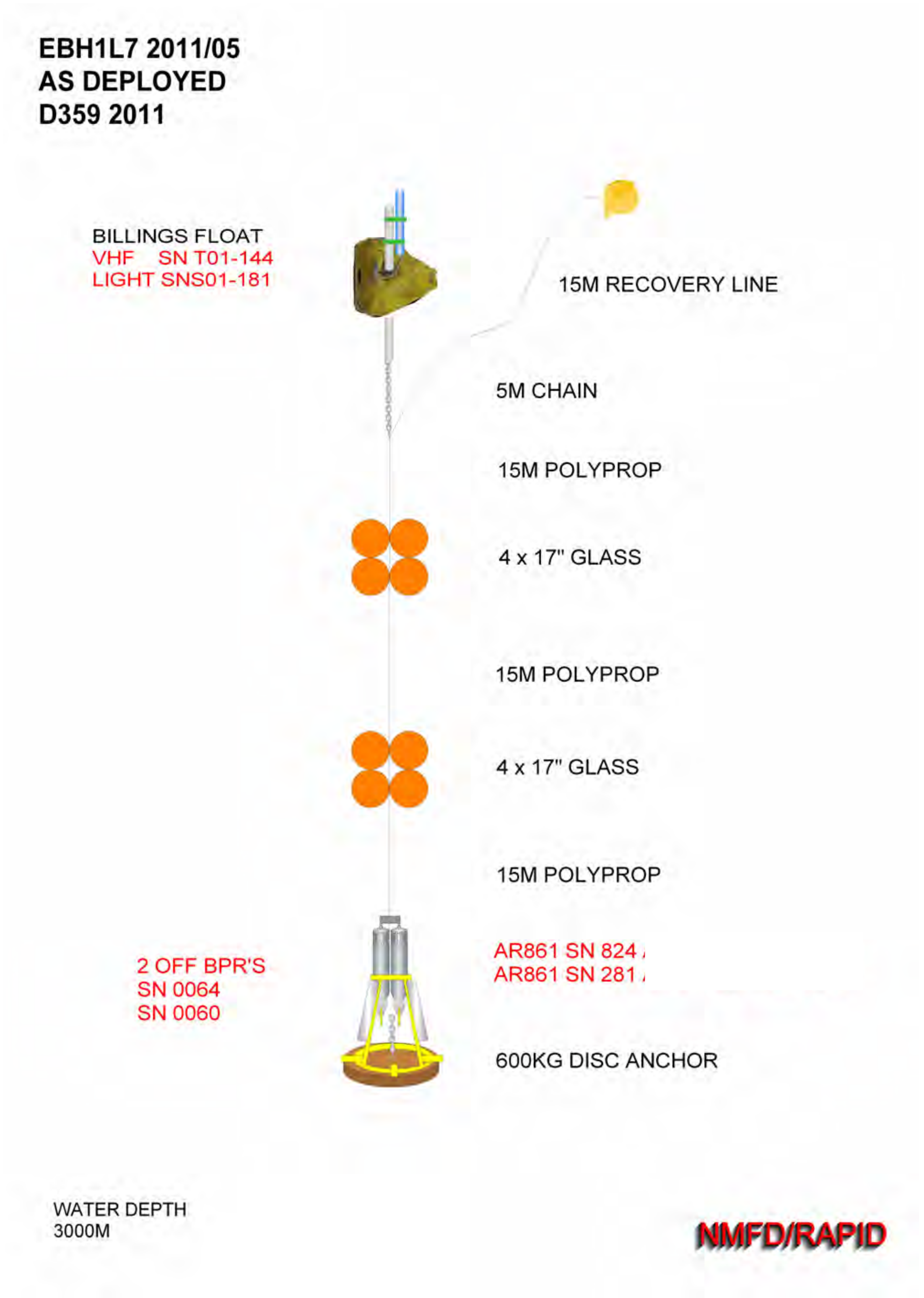
NMFD/RAPID

EBH1 2011/06
AS DEPLOYED
D359 2011

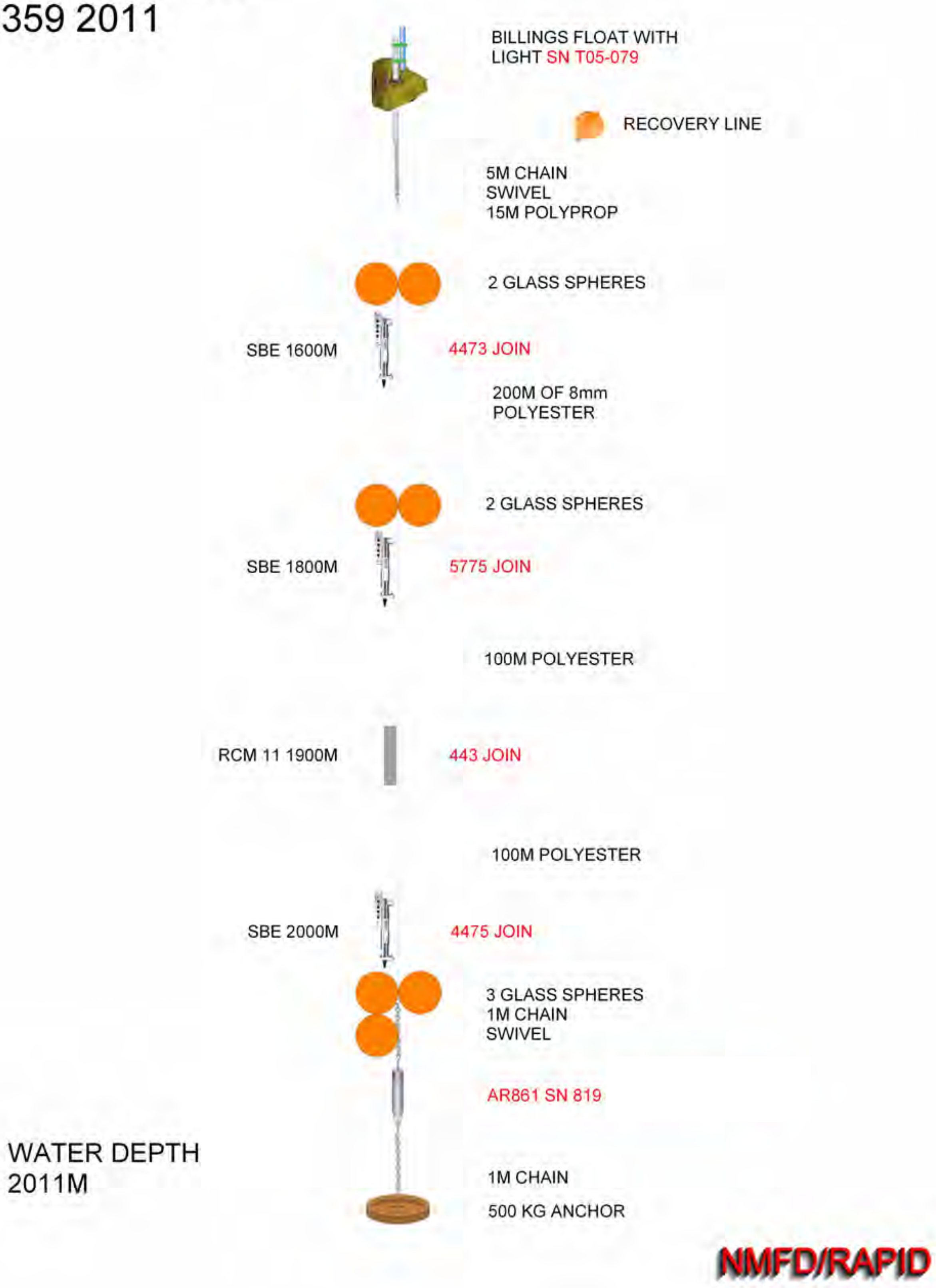


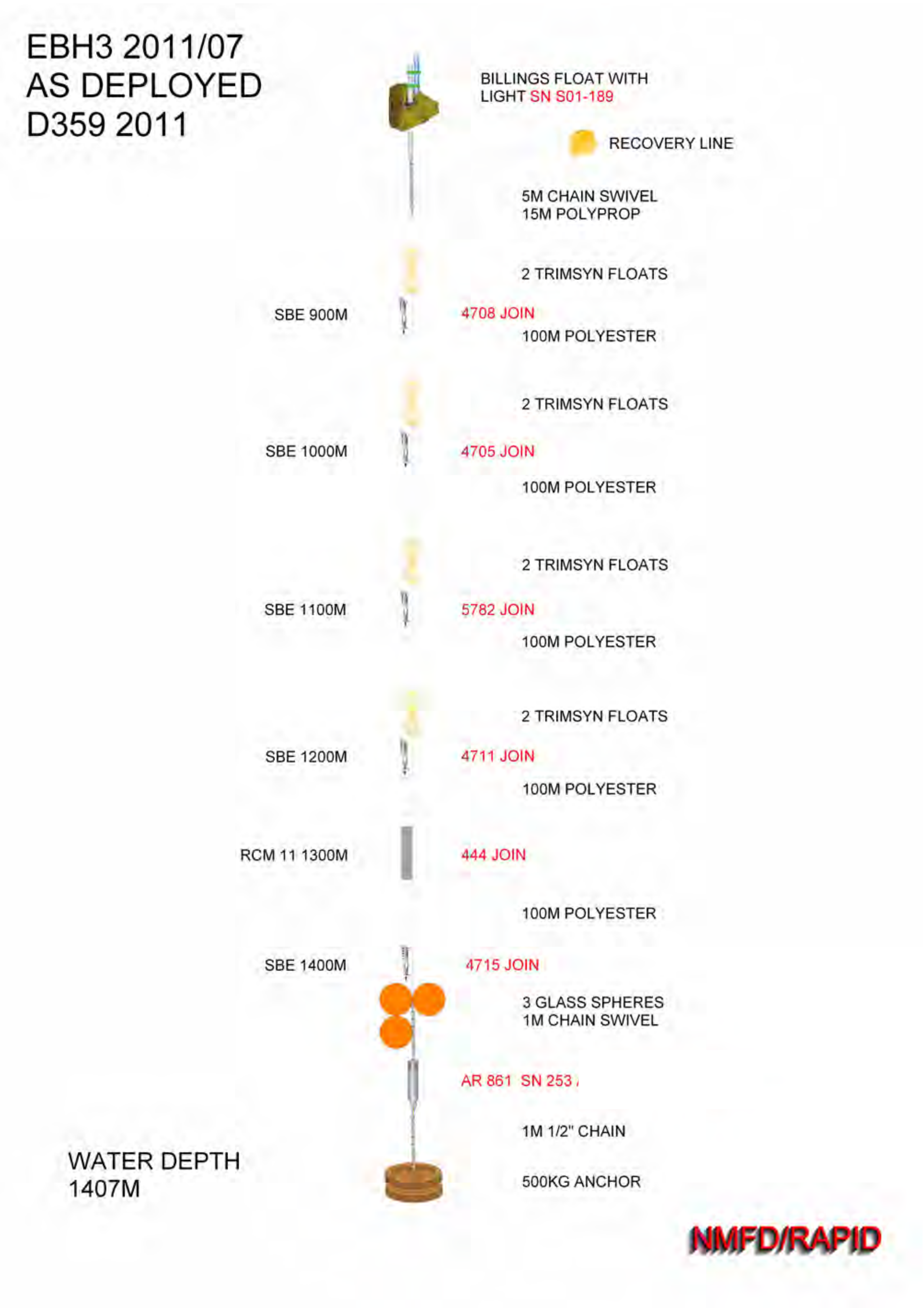
WATER DEPTH
3000M

NMFD/RAPID


EBH1L7 2011/05
AS DEPLOYED
D359 2011
BILLINGS FLOAT
VHF SN T01-144
LIGHT SNS01-181
15M RECOVERY LINE
5M CHAIN
15M POLYPROP
4 x 17" GLASS
15M POLYPROP
4 x 17" GLASS
15M POLYPROP
2 OFF BPR'S
SN 0064
SN 0060
AR861 SN 824
AR861 SN 281
600KG DISC ANCHOR
WATER DEPTH
3000M
NMFD/RAPID

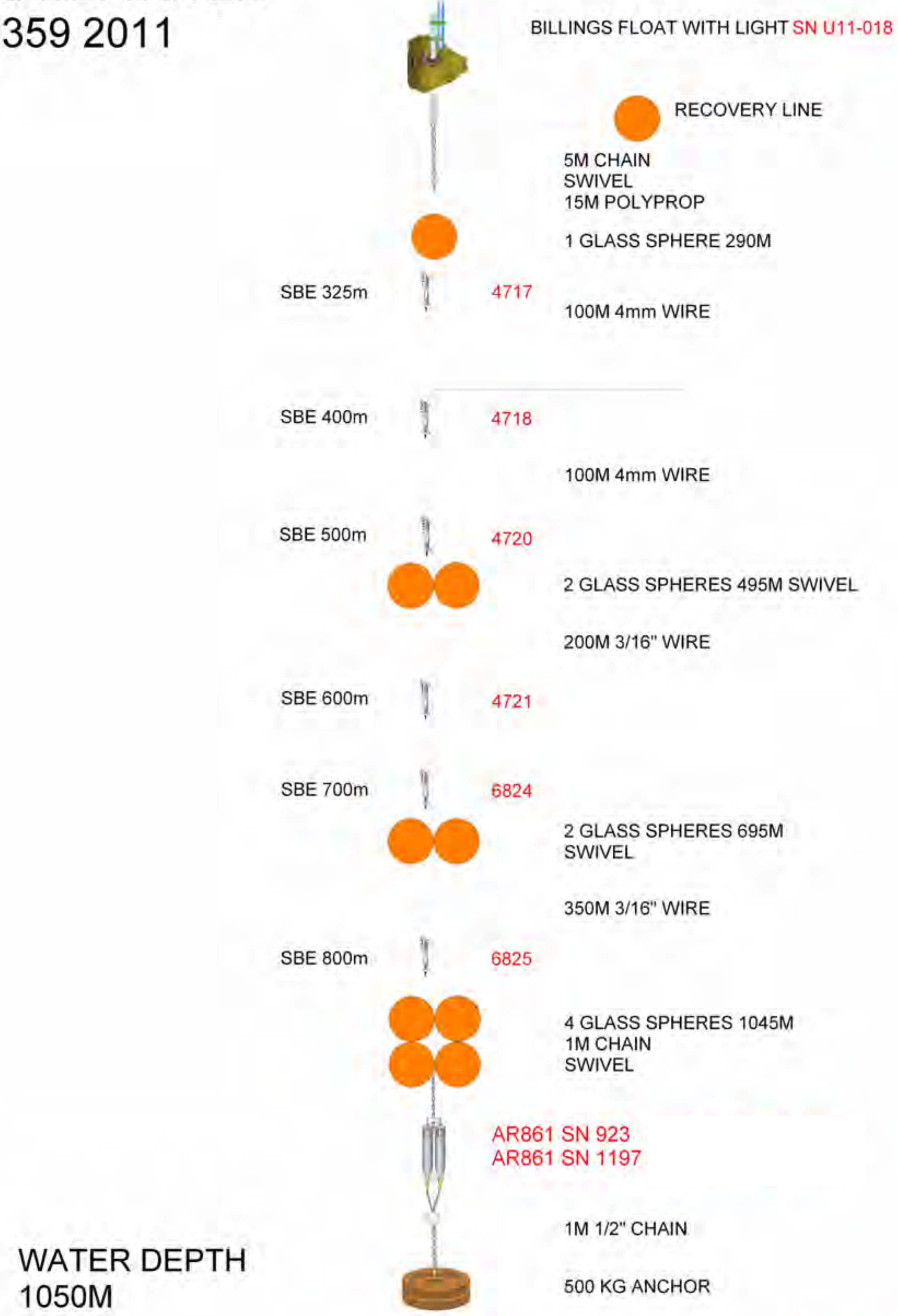
EBH2 2011/12
AS DEPLOYED
D359 2011





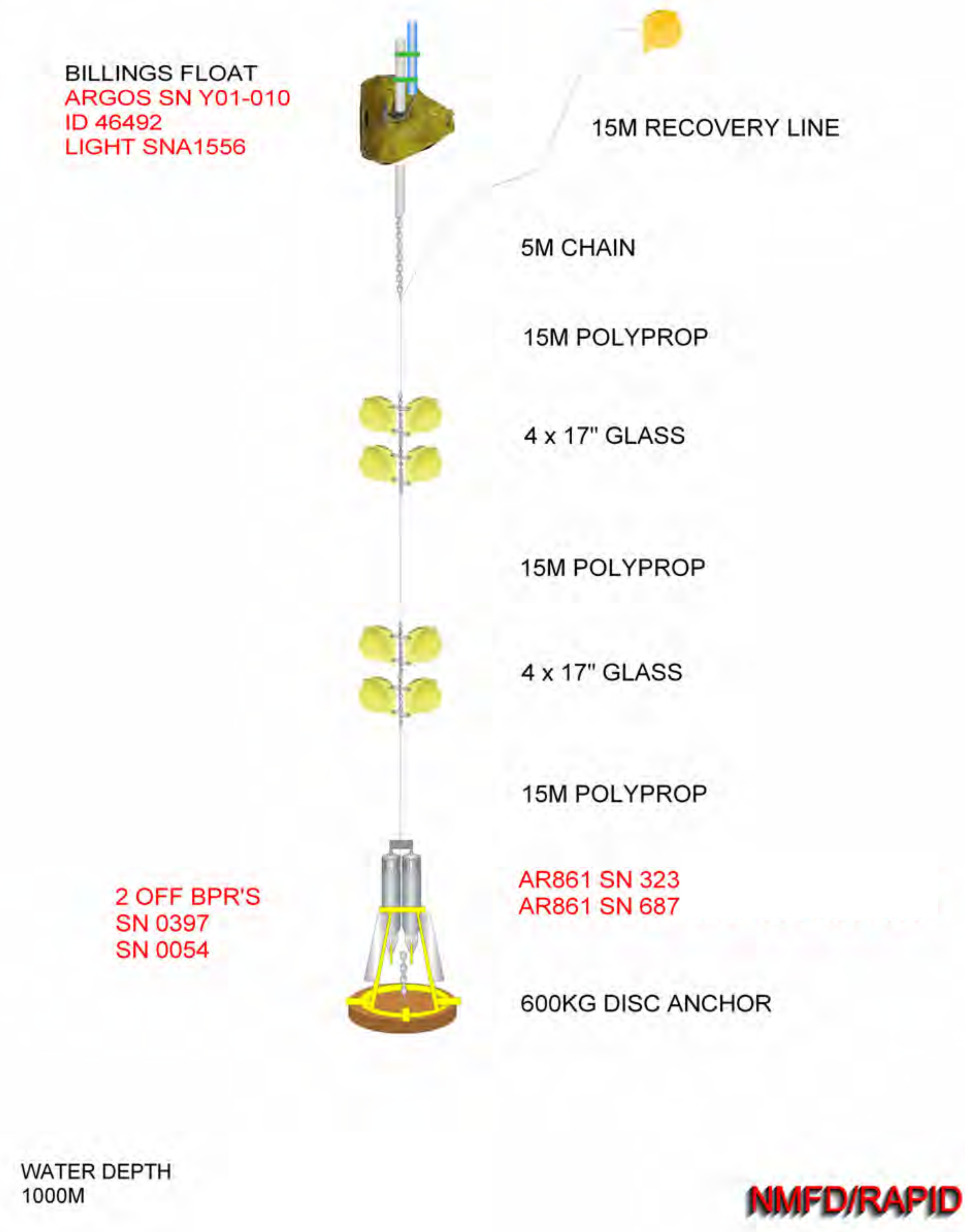
EBH3 2011/07
AS DEPLOYED
D359 2011

EBH4 2001/08
AS DEPLOYED
D359 2011

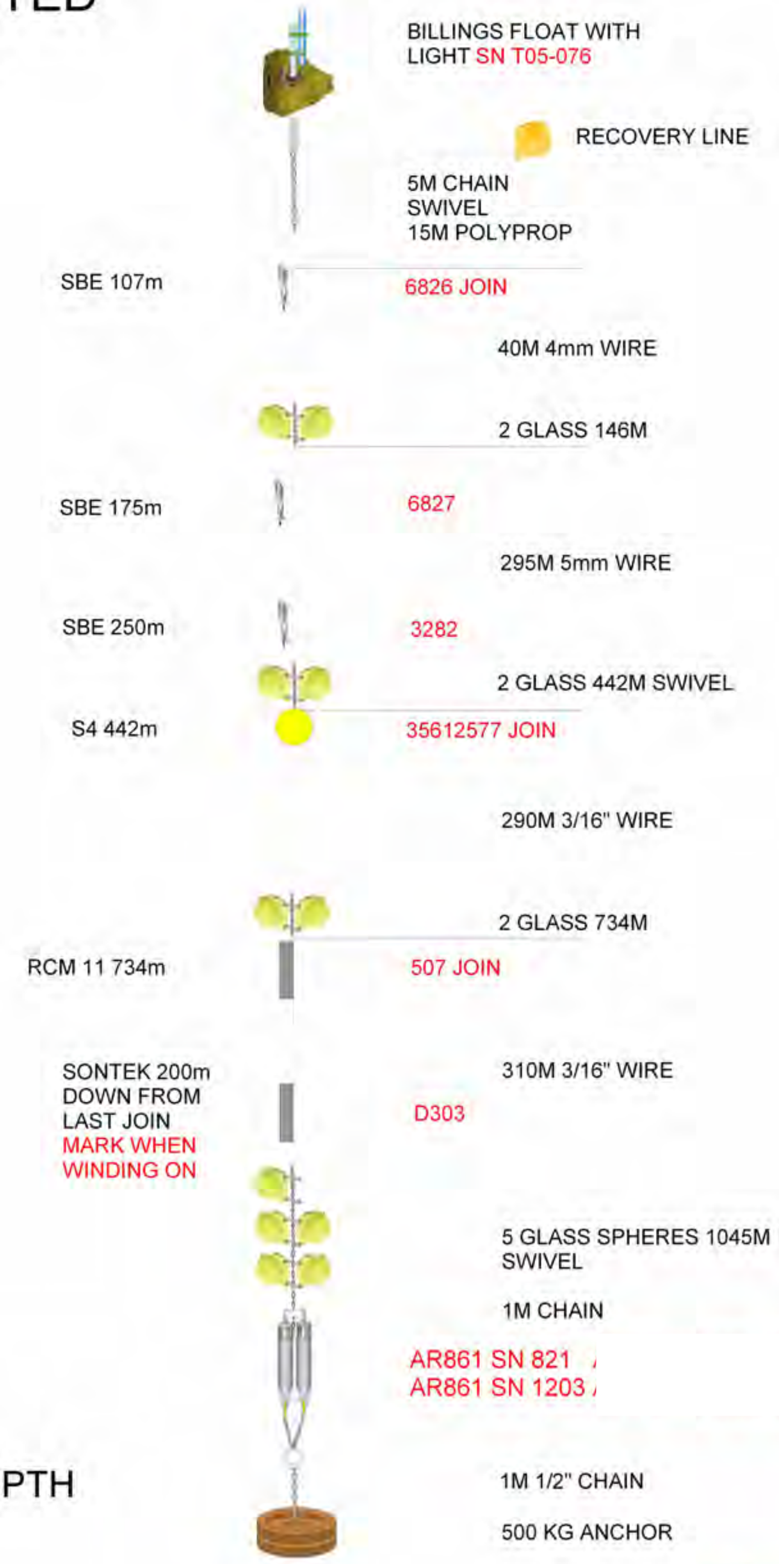


NMFD/RAPID

EBH4L2 2011/010
AS DEPLOYED
D359 2011

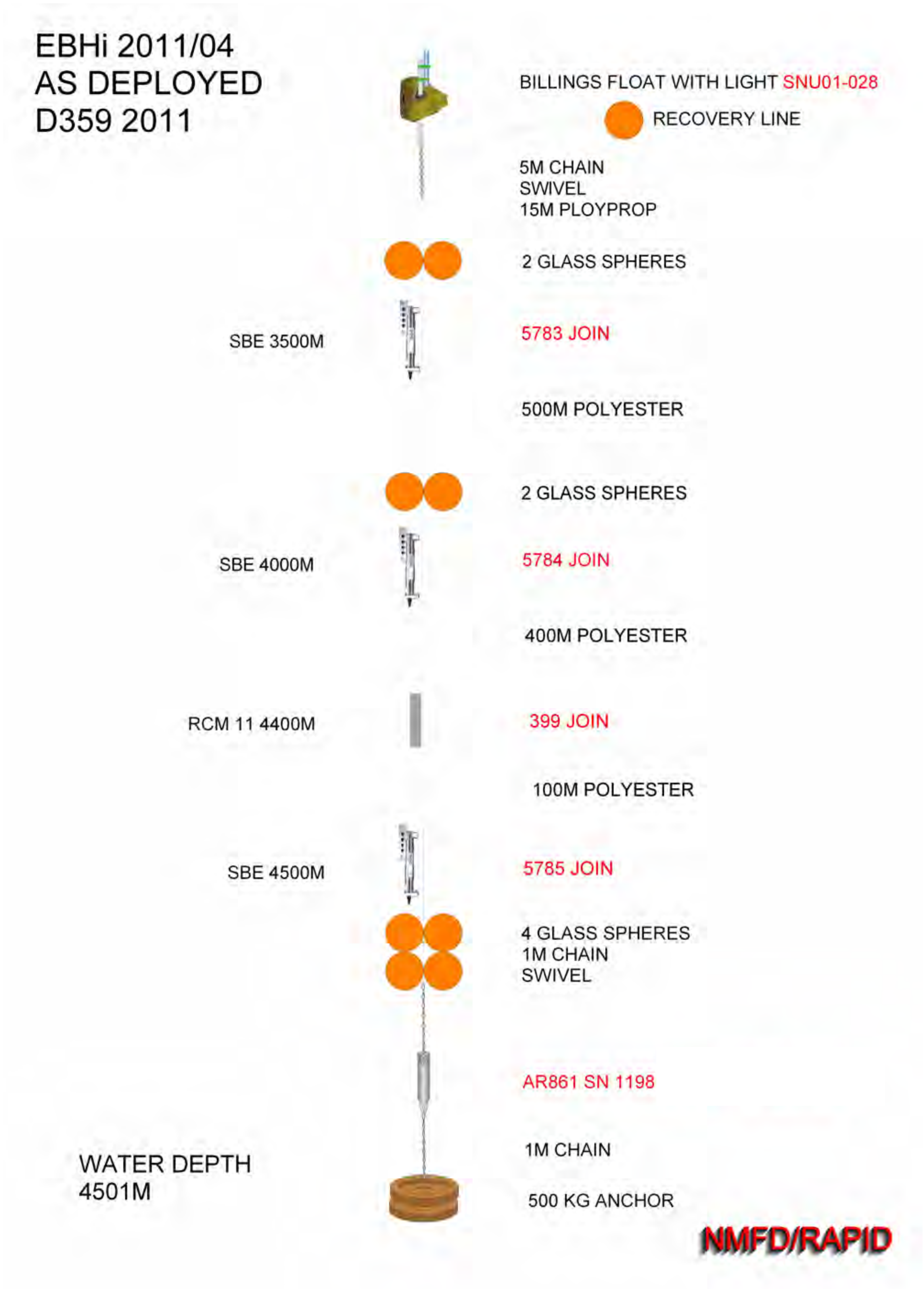


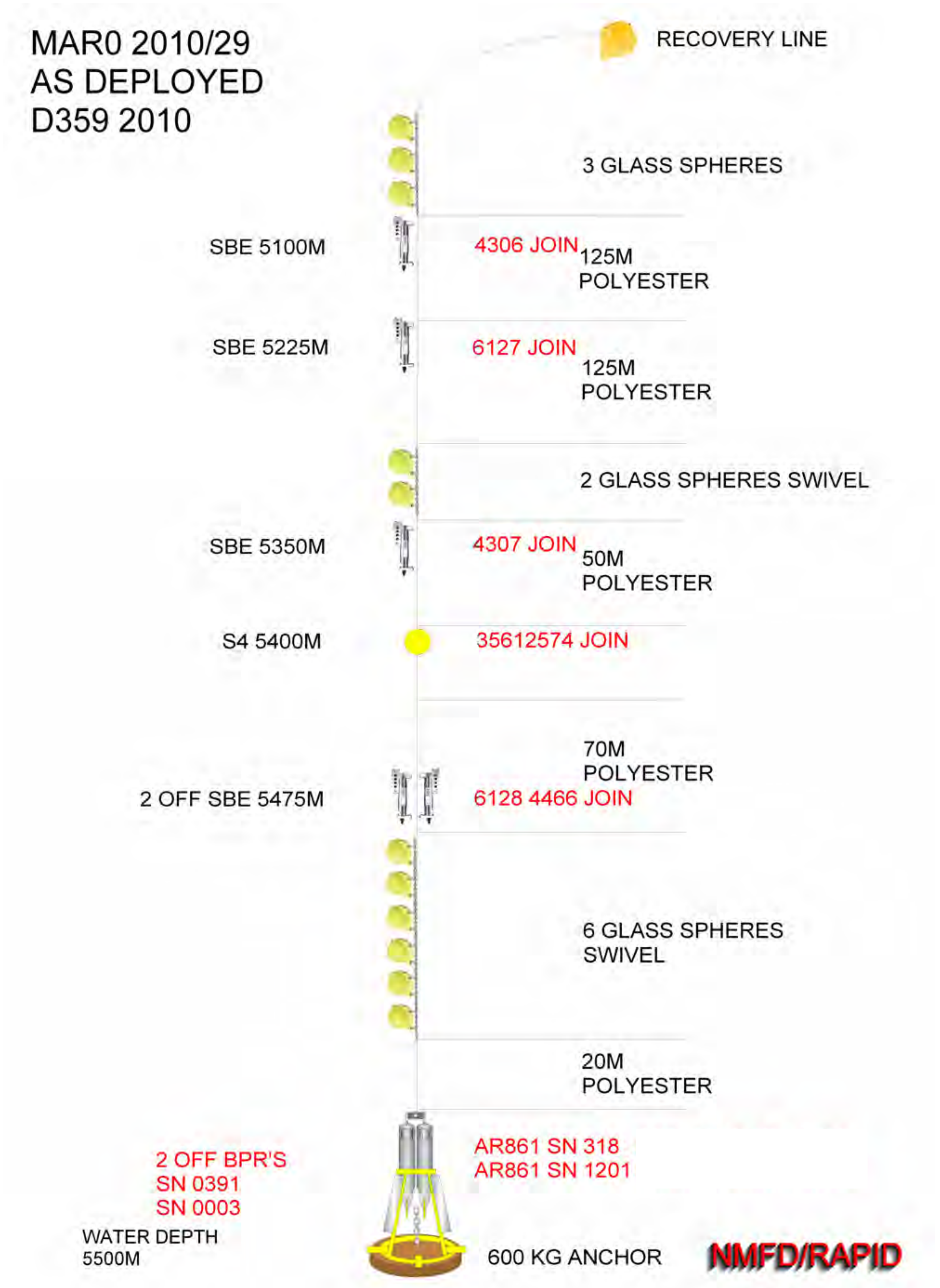
EBH5 2011/09
AS DEPLOYED
D359 2011



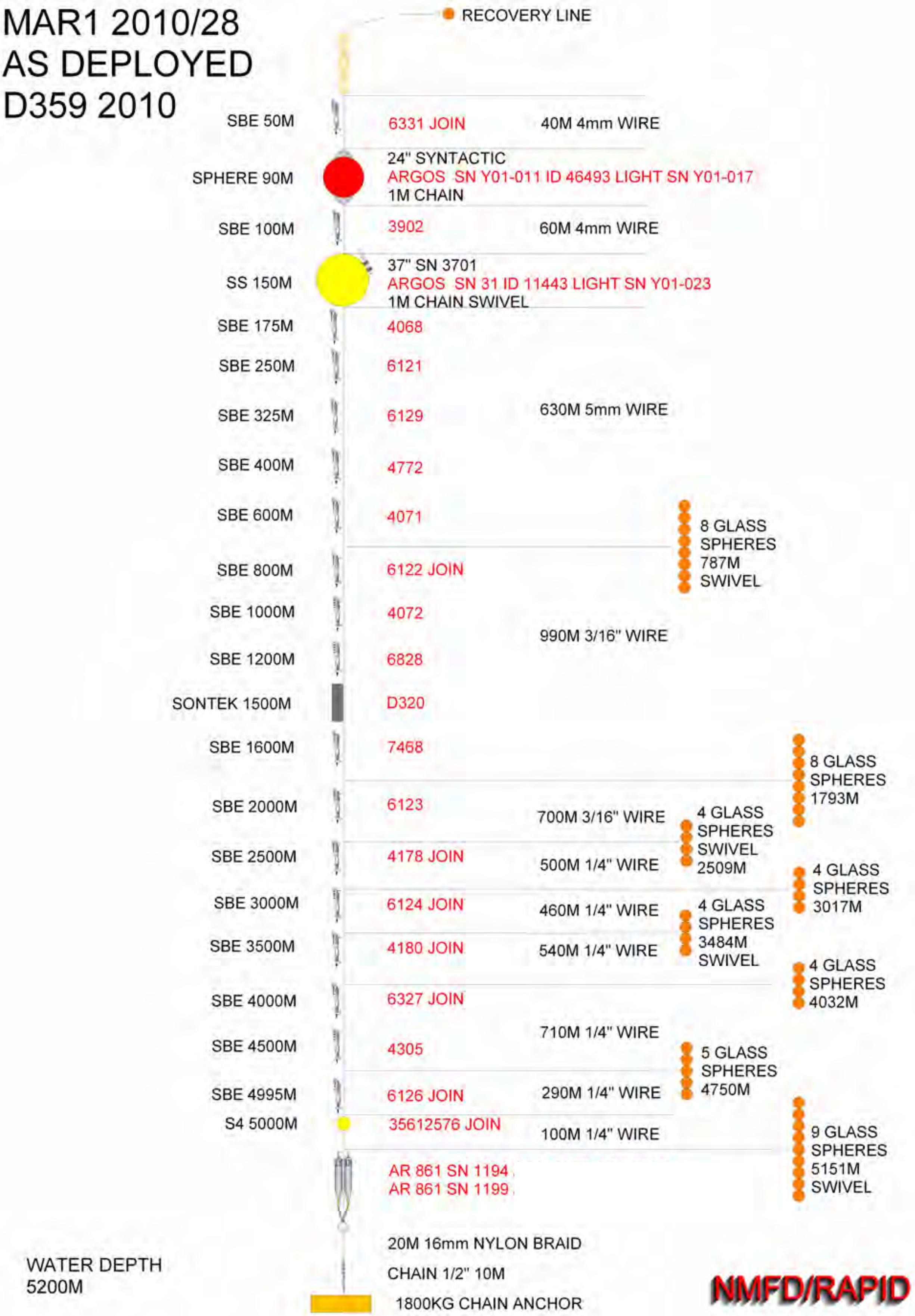
WATER DEPTH
1050M

NMFD/RAPID

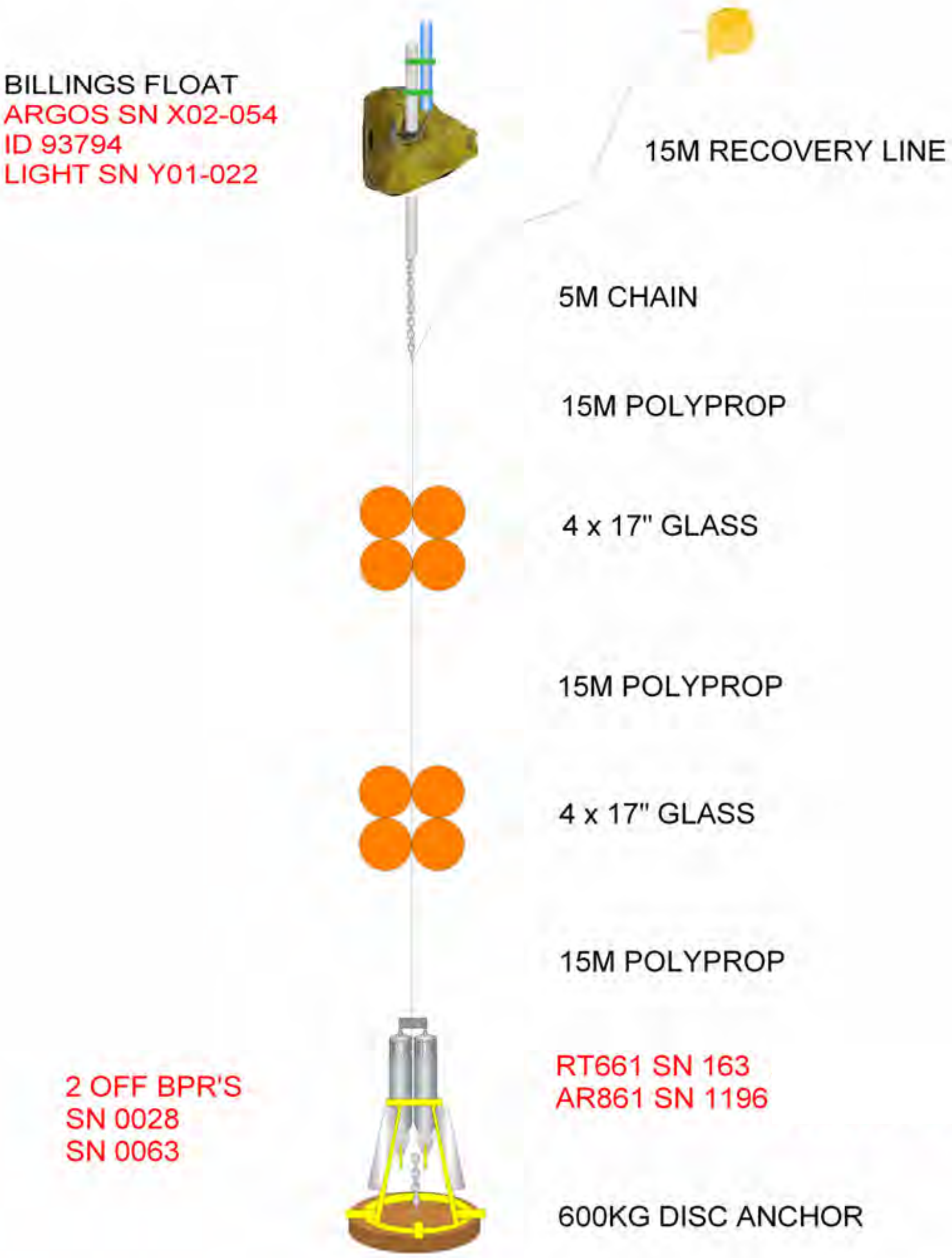

EBHi 2011/04
AS DEPLOYED
D359 2011
BILLINGS FLOAT WITH LIGHT SNU01-028
RECOVERY LINE
5M CHAIN
SWIVEL
15M PLOYPROP
2 GLASS SPHERES
SBE 3500M
5783 JOIN
500M POLYESTER
2 GLASS SPHERES
SBE 4000M
5784 JOIN
400M POLYESTER
RCM 11 4400M
399 JOIN
100M POLYESTER
SBE 4500M
5785 JOIN
4 GLASS SPHERES
1M CHAIN
SWIVEL
AR861 SN 1198
1M CHAIN
WATER DEPTH
4501M
500 KG ANCHOR
NMFD/RAPID


MAR0 2010/29
AS DEPLOYED
D359 2010
RECOVERY LINE
3 GLASS SPHERES
SBE 5100M
4306 JOIN
125M
POLYESTER
SBE 5225M
6127 JOIN
125M
POLYESTER
2 GLASS SPHERES SWIVEL
SBE 5350M
4307 JOIN
50M
POLYESTER
S4 5400M
35612574 JOIN
70M
POLYESTER
2 OFF SBE 5475M
6128 4466 JOIN
6 GLASS SPHERES
SWIVEL
20M
POLYESTER
2 OFF BPR'S
SN 0391
SN 0003
AR861 SN 318
AR861 SN 1201
WATER DEPTH
5500M
600 KG ANCHOR
NMFD/RAPID

MAR1 2010/28
AS DEPLOYED
D359 2010



MAR1L6 2010/27
AS DEPLOYED
D359 2010



WATER DEPTH
5200M

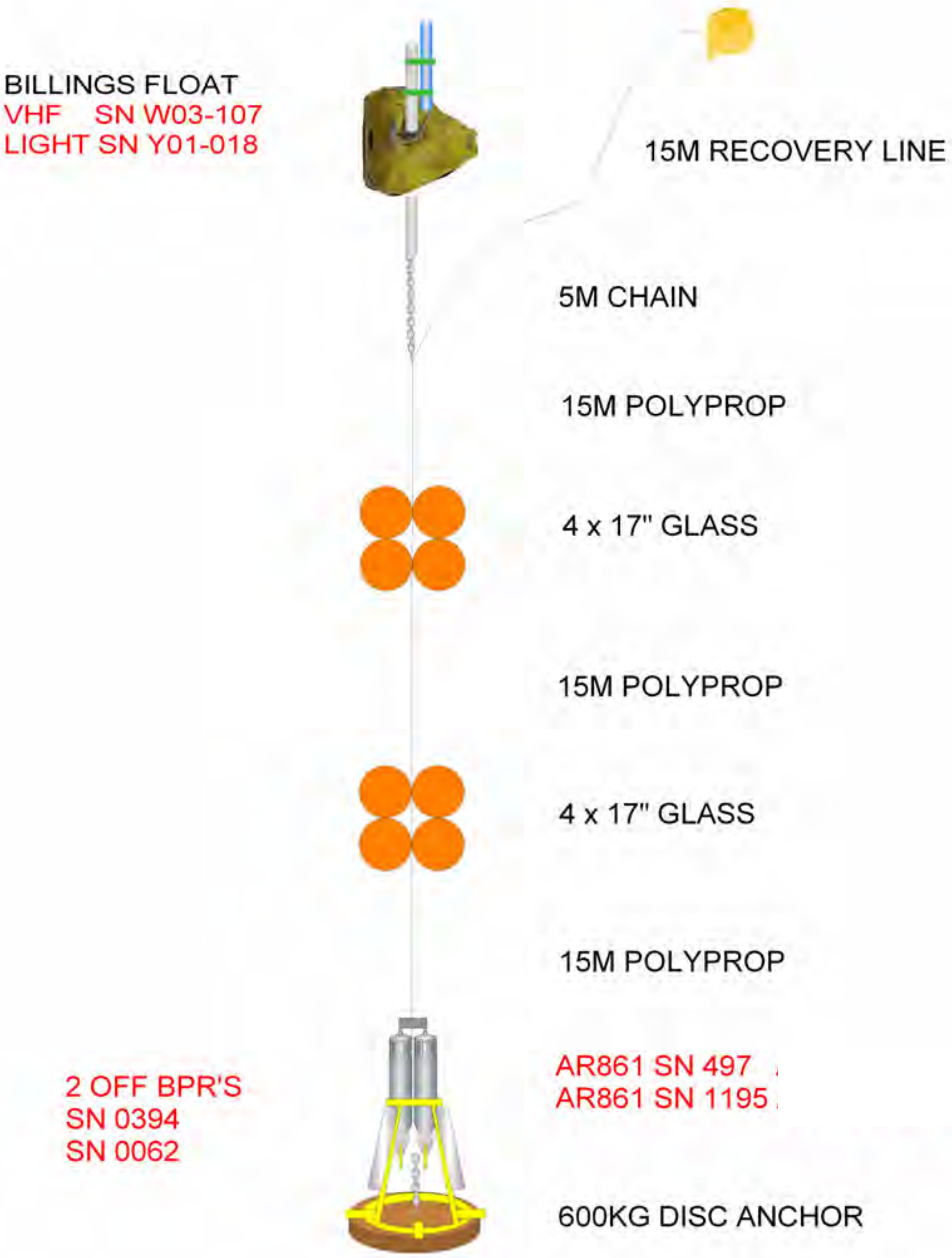
NMFD/RAPID

MAR2 2010/30
AS DEPLOYED
D359 2010

WATER DEPTH
5200M

MAR3 2010/32
AS DEPLOYED
D359 2010

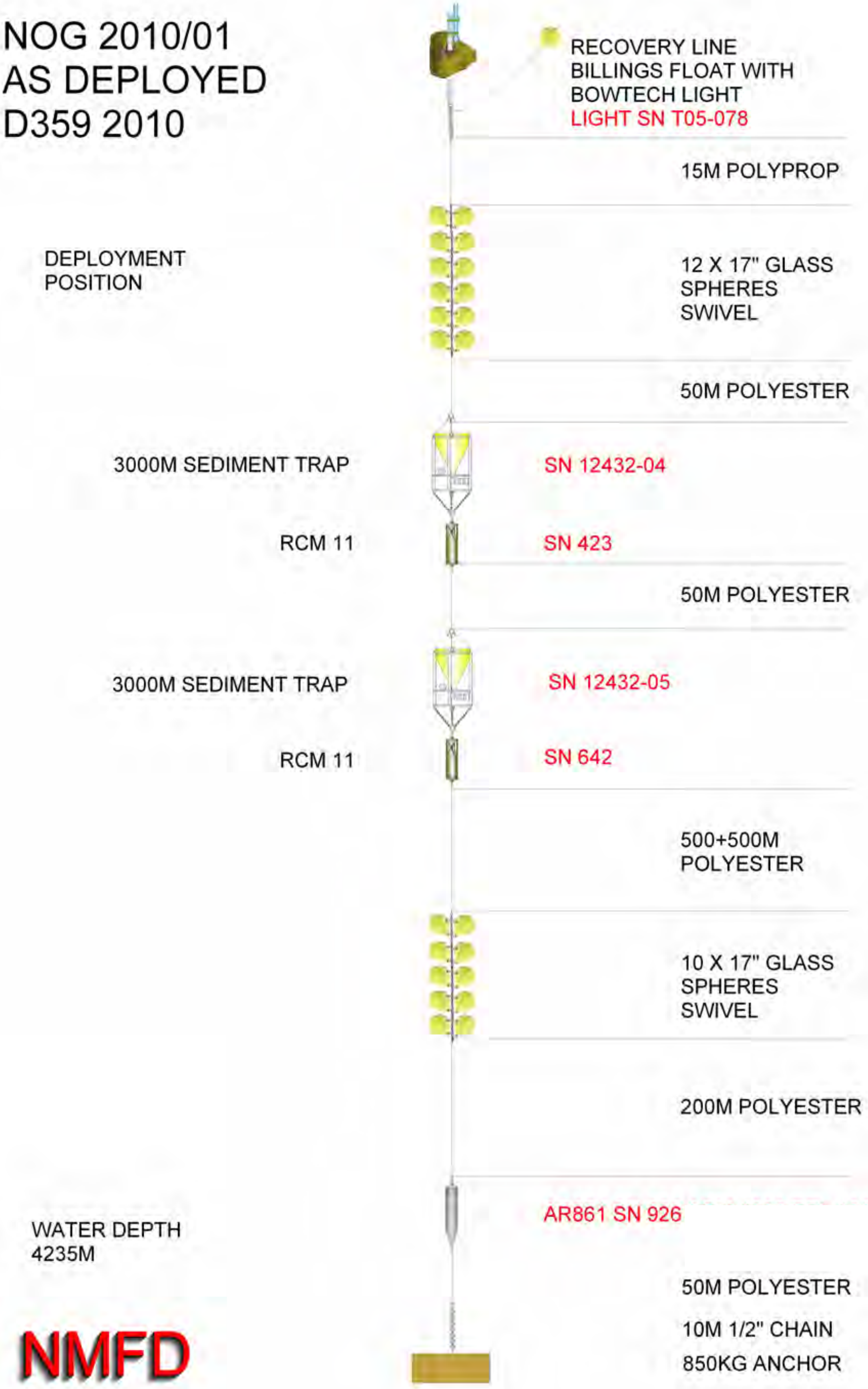
MAR3I6 2010/31
AS DEPLOYED
D359 2010



WATER DEPTH
5050M

NMFD/RAPID

NOG 2010/01
AS DEPLOYED
D359 2010



Appendix E: Mooring Recovery Logsheets

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **MAR0** Cruise **D359**

NB: all times recorded in GMT

Date 27/12/10

Site arrival time 12:48

Time of first ranging 12:26 - ~~too fast~~ ship too fast

Time of release 12:5043 13:51 @ surface - ~~top~~ was all up by 13:56

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

Ⓐ
① rope 200
this rope end has yellow @ hook end
red 2 inches away
deep end has no tape ~~yellow~~
next shallow has
Ⓑ no tape
~~deep end~~
has microcat tape right
rope 180 next to eye.

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			~14:07
RECOVERY LINE			
3 X GLASS SPHERES	✓	glass on board	14:10
SBE37 ①	5241 ✓	Marked just below + above w/ yellow tape	14:10 - took a while
SBE37 ②	4184 (p-cap) ✓	Marked above/below w/yellow	14:19
2 X GLASS SPHERES-Swivel below		~10-20m below microcat	14:21
SBE37 ③	6830 ✓	~~[illegible]~~red is centered. yellow above & below	14:25
SBE37 ④	5778 ✓	~1.2 m apart/dirty }	14:30
SBE37 ⑤	4462 (p-cap) ✓	tape above + below each! }	
6 X GLASS SPHERES	✓		14:34
ACOUSTIC RELEASE	925 ✓		
ACOUSTIC RELEASE	930 ✓	surf	14:38
BPR	0039, 0014 ✓		
TRIPOD ASSEMBLY			14:38

Ascent rate ~80-95 m/min

Time at end of recovery ____________

Rom 1839

Ranging

Time	Range 1	Range 2	Command /comment
1226	2978	—	
1230	7496	10006	
1241	—	—	
124146	—	—	
124230	—	7339	
124330	—	—	
124420	1864 ×	1091 × V8.4	
124447	3451 ×	2387	

① Microcat was below glass ~1.5m.

② Red tape was just below

⑤ red at bottom clamp - just above join bottom mcat ~ 4 inches

4462 was on band before 5778 ⇒ shallower by ~1.2m ~10" between the ends of 2 mcats

* Add to sheets - line item for add'l notation/align w/diagram

* Estimate of winch speed near start & stop. Check for element on board. Times of what

S/n
1864
↓
1839
1864

37 min

124545	5907	2414x	4.4V
124610	2501 x	903X	
	3249 x	812 x	
124830	5485	5484	V8.2
124930	—	—	
125043	5484	5483	released on diag
125145	5414	5399	release OK ✓
125230	—	5312	
125330	5245	5230	
125430			
133130			
1340	1132	1126	

ETA surface 1053

104245 950.7 945.9] 51m/min
4345 899.5

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **MAR1** _ drift. Cruise **D359**

NB: all times recorded in GMT

Date 24/12/10

Site arrival time Spotted 1129

recovery of remainder

Time of first ranging ______

Time of release ______

26/12/10 - 2nd part
hooking @ 11:34 → 11:37
lost @ 11:40

@ 11:58:42 **Latitude** 21.8049 **Longitude** -50.0920

(record positions at time of pickup only if likely to be very different from deployment position)

@ 11:55 (new hook)
In position
hooked @ 11:56

ITEM	SER NO	COMMENT	TIME
TRIMSYN FLOAT		✓	
RECOVERY LINE		✓	
3 X TRIMSYN		✓	12:01:~~24~~
SBE37	4461 ✓	greenish, fishing line	12:01:~~18~~
24" STEEL SPHERE	274	barnacles	12:06
ARGOS BEACON	T04044 ID 46243 ✓	flooded	
LIGHT	S01-189 ✓		
SBE37	4464 ✓	quite greenish, thick fishing line little crabs	12:06
ARGOS BEACON	? ~~6~~ 274	ID 60202	
LIGHT			
37" STEEL SPHERE	✓	2nd crane to lift, barnacles lingots	12:21
1M CHAIN SWIVEL			
SBE37	5779 ✓	greenish - tangled yellow + red	12:20
SBE37	5780 ✓	greenish	12:27
~~SBE37~~ *	~~5781 ✓ 1228~~	1232 end of wire	~~1228~~
SBE37	5782 ✓ 25	tangled! ~~Sht~~ sheared	12:25
SBE37	5783 ✓ 22	frayed/rusted	12:22
SBE37	5784 ✓		12:16
8 X GLASS SPHERES SWIVEL	✓	1st recvd on 2nd recovery	12:01
SBE37	4718 ✓	came up w/glass	12:01
SBE37	5785 ✓		12:19
SBE37	5786 ✓		12:30
SBE37	5787 ✓	on tape	12:37
8 X GLASS SPHERES	✓	tangles!	12:48
SBE37	5240 ✓		13:00
4X GLASS SPHERES	✓		13:15

24/12 ↑
↓ 26/12

2 wires coming

12:12 knot in yellow wire

12:13 ! top red wire broke on ~~inboard side~~ of dbl band

No cable tie on the shackle-

12:19 resume recovery - more longline

* Wire parted immediately above SBE37 5781

25/12/10 Arrived 0855

Time of first ranging 0856

~~s/n 408~~

SWIVEL			1315
SBE37	5788 ✓	tangled w/glass	1315
4 X GLASS SPHERES			13;37
SBE37	5789 ✓	tangled with glass	13:36
4 X GLASS SPHERES SWIVEL			13:56
SBE37	5776 ✓	on tape	13:56
4 X GLASS SPHERES			14:23
SBE37	3282 ✓	on tape	14:23
SBE37	3284 ✓	on tape	1438
5 X GLASS SPHERES			14:45
SBE37	4179 ✓		14:54
S4	35612577 or 36512577 ✓		14:54
9 X GLASS SPHERES			15 00
SWIVEL			
ACOUSTIC RELEASE	908 ✓		
ACOUSTIC RELEASE	822 ✓		

Ascent rate ________

Time at end of recovery ________ sighted @ 10:29

Ranging

	Time	Range 1	Range 2	Command /comment
908	10:17	5262	5261	Release OK
	10:18:03	—	—	
	10:19 00	—	—	
	10:20	—	4961	
	10:21	—	—	
822	102330	4660	4650	
	102430	—	8376	
	1026	—	—	
	102645	—	—	
	102730	—	8110	
	102830	4223	—	
	103850	—	3245	

Ranging from 0.5nm

M

S/n	time	Response		
908	0856	series of no reply or nonsense ranges 10456, 369		
822	0902	1156	391	
		n/a	n/a	
		9045	–	vertical, v=12.8
		11596	–	
	0906	11573		
	0913	–	9079	
		–	–	
		9093	–	

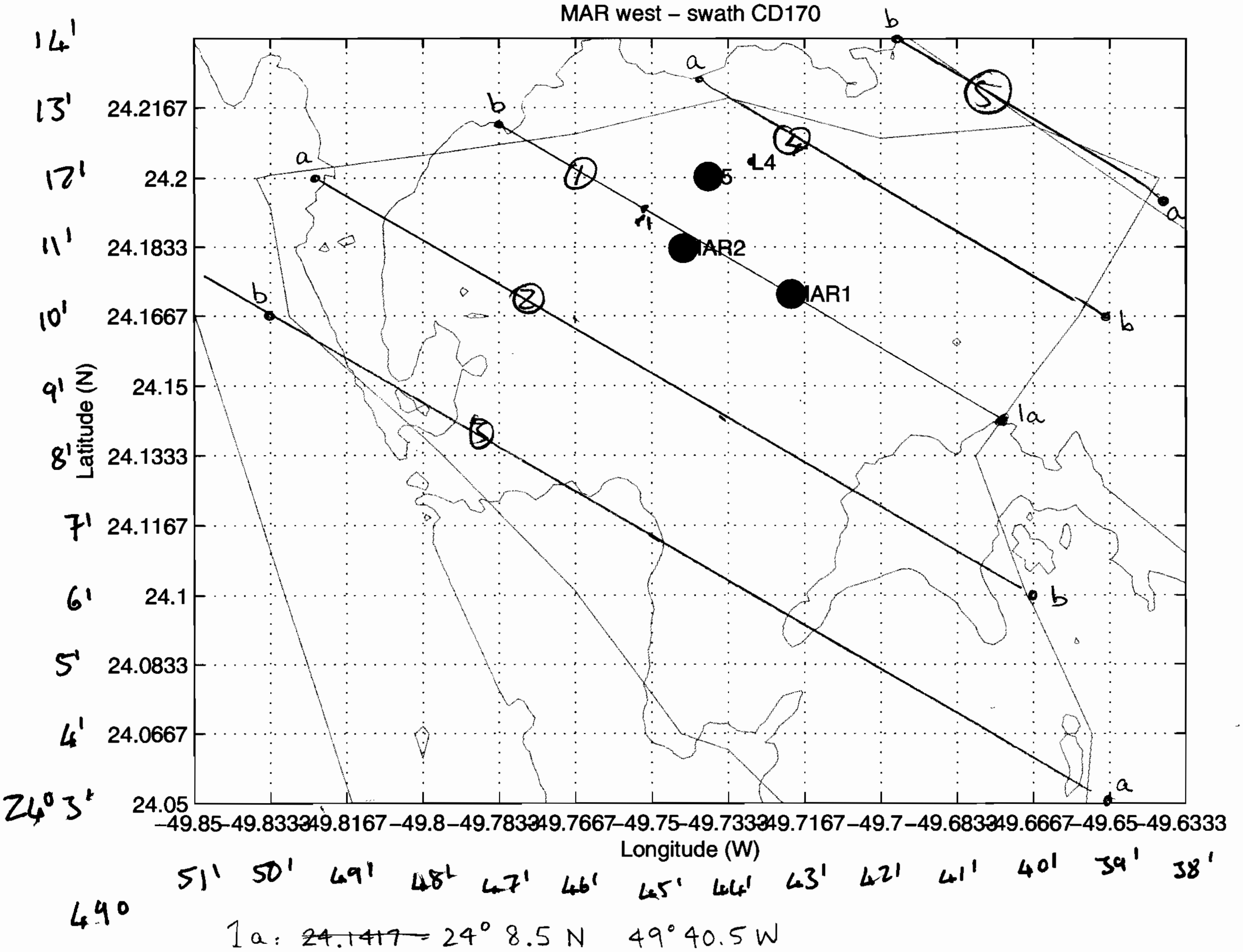
0920 moving to MARI location

822	0930	10461	–	
		2420	13075	Vertical, v=8.4
		–	1094.7	
		–	–	

Now laying x-ducer.

		R1	R2	Diag
822	0945	–	–	–
	46	–	–	–
	4645	–	–	–
	4725	–	–	–
908	4853	–	11694	–
		–	–	

1 nm ticks
2.7nm = 22mm



1a:	~~24.1417~~ 24° 8.5 N	49° 40.5 W
1b:	24° 12.75'N,	49° 47' W
2a:	24° 12' N,	49° 49.5'W
2b:	24°06' N,	49° 40'W
3a:	24° 03'N	49° 39' W
3b:	24° 10'N,	49° 50' W
4a:	24° 13.5'N,	49° 44.5' W
4b:	24° 10' N,	49° 39' W
5a:	24° 11.6'N,	49° 38.3' W
5b:	24° 14'N	49° 41.75' W

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **MARL3-->MAR1L4** Cruise **D359**

NB: all times recorded in GMT

Date 25/12/10 **Site arrival time** 1501

Time of first ranging 1704

Time of release 1707 c 1960 surface

Latitude ______ **Longitude** ______

(record positions at time of pickup only if likely to be very different from deployment position) Pass One @ 19:15

- sliding a round
- using hook

dropped @ 19:18 - hook opened?*

- went under 19:21

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		1915 Caught ~~[illegible]~~ grapple/hook @ 1916	19:15
RECOVERY LINE		float on board	1926
LIGHT	U01-024 ✓		
VHF BEACON	W03-107 ✓		
BILLINGS FLOAT		Was under~~wat~~water	1933
5M CHAIN		chain up.	19:32
4 X GLASS SPHERES	yellow	was underwater	1935
4 X GLASS SPHERES	hardhat	Cases crushed/deformed all 4	19 38
ACOUSTIC RELEASE	924 ✓	triangle up @	1940
ACOUSTIC RELEASE	922 ✓		
BPR	~~0396~~ 0035		
BPR	0012 ✓		
TRIPOD ASSEMBLY			

Ascent rate 20-25 m/min

Time at end of recovery ______

*Can we bring our own hooks + pole for recovery? These look OLD.

Ranging

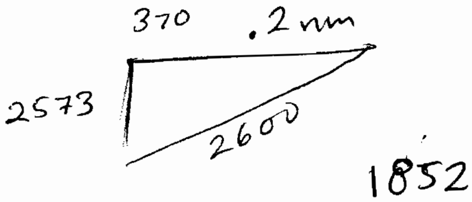
	Time	Range 1	Range 2	Command /comment
	~~150215~~	~~2775~~	~~13429~~	~~Vert, V=8.5V~~ wrong release
924	1504	–	9006	
	1505	5259	5257	V
	1506	5255	–	V
				Release OK
	150730	5243		ship doing 2kts
	150830	5224	5220	
	150930	5183		
	151040	5160	5154	

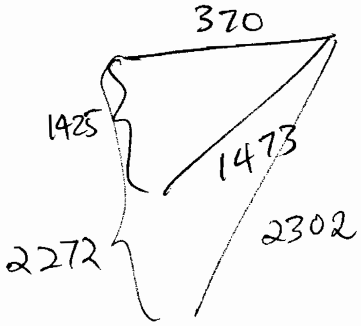
151530	5025	5020	155435	4163
151637	5003		160935	3805 –
151735	4982	4980	1625	3478
151835	4962	4962	1640	3148
151935	4943	4939	1649	NR
152435	4841		1651	2874
153935	4505			

25 m/min

	[m]	[m]
1651	2874	
17:01	—	—
17:02	2616	2613
17:15	—	—
17:15	—	—
17:16	2302	2301
17:25	2018	2018
* 17:42	1744	1741
17:54	1473	
* 18:00	1362	1358
18:15	1070	
18:30	752	
1845	457	
	274	
1854	246	
	244	
1855	239	
1855	234	
1856	230	
1858	200	
1859	180	

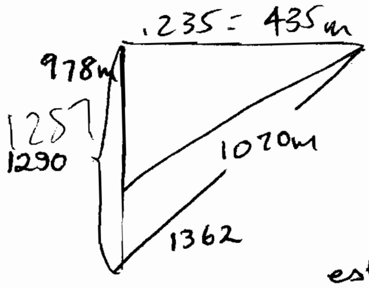
start
22 m/min





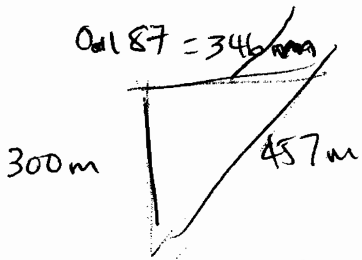
actual rise rate 22.3 m/min

63 min to go
or ETA 18:57 as of 17:58



$\Delta z = 312$m
$\Delta t = 15$min = 208 m/min

est 47 min to recovery
ETA 19:02 as of 18:15



rate
22.6

ETA 1858 as of
18:45

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **MAR2** Cruise **D359**

NB: all times recorded in GMT

Date 25/12/10 **Site arrival time** ______

Time of first ranging 10:17 10:32 sited

Time of release 10:15 11:15 all up

Latitude ______ **Longitude** ______

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		hooked at 11:32	11:33
RECOVERY LINE			
LIGHT	S01-187	} on 2 pack	11:36
ARGOS	W03-084 ID 82954	} never appeared upright tangled w/	11:36
BILLINGS FLOAT		~~2 pack~~	
4 X GLASS SPHERES		yellow, 4,	11:35
SWIVEL			
SBE37	5762 ✓		11:36
SBE37	5766 ✓		11:49
4 X GLASS SPHERES SWIVEL		} tangled	12:00
SBE37	5767 ✓		12:00
3 X GLASS SPHERES		} tangled	12:20
SBE37	5768 ✓	out of water @	12:19
3 X GLASS SPHERES SWIVEL			12:40
SBE37	5770 ✓		12:40
SBE37	5771 ✓		12:58
3 X GLASS SPHERES SWIVEL		} tangled	13:14
SBE37	5763 ✓		13:13
3 X GLASS SPHERES			13:32
SWIVEL		} tangled	
SBE37	5773 ✓		13:32
SBE37	5774 ✓		13:55
SBE37	5775 ✓		14:05
9 X GLASSS SPHERES SWIVEL			14:06
S4	35612578 ✓		

on deck unless otherwise specified

lost attach

ACOUSTIC RELEASE 319

Ascent rate ____________

Time at end of recovery ____________

Ranging

Time	Range 1	Range 2	Command /comment
1015	5248	369.9	Vertical
1015	5247	5247	vertical
1017	5247.1	5247.4	release ok
10:17:45	5195.1	5178.3	
1018:30	—	—	
10:19:15	5050.4	5037.7	
10:20	4978.1	4967.8	
102045	4917.8	—	
102130	4852.3	4840.1	
102215	4786.2	—	
~~1023~~			
10:48	2310		

269m / 3 min

90 m/min

single + 3 glass packs vis @ 11:04

big glass up 11:11

11:15

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **MAR3** Cruise **D359**

NB: all times recorded in GMT

Date 31/12/10 DOY 365 **Site arrival time** 0908

Time of first ranging ___________

Time of release ___________

Latitude ___________ **Longitude** ___________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			
RECOVERY LINE			
LIGHT			
BILLINGS FLOAT	W03-090		
2 X GLASS SPHERES			
SWIVEL			
SBE37	6328		
3 X GLASS SPHERES			
SBE37	5487		
3X GLASS SPHERES			
SBE37	5488		
3 X GLASS SPHERES			
SWIVEL			
SBE37	6329		
3 X GLASS SPHERES			
SBE37	6330		
SBE37	6334		
S4	35612573		
7 X GLASS SPHERES			
SWIVEL			
ACOUSTIC RELEASE	243		

Ascent rate ___________

Time at end of recovery ___________

Ranging

No response from release. Tried blind fire, and waited for 90 mins. Later systematically searched 16 nm^2 region centred on MAR3. Nothing found.

See CR for details.

	Time	Range 1	Range 2	Command /comment	
	0908	–	–	From 1.5nm @ MAR3L4	port se
23° 51.43 41° 6.21'	0912	–	10976	n/a nonsense main out	stbd se
	0914	–	–	"	port se
23° 51.41' 41° 6.22'	0915	6819	–	nc	
	11:42:45	–	–		P
	114330	–	–		P
	114430	–	–		S
	114530	–	–		S
	114630	–	–		P
	~~Superducer~~				
	115740	–	–		P
	115820	–	–		
	1159	–	~		
23° 52.09 41° 5.52'	1200	6145.1	–		
	120030	–	–		
	120130	–	–		superducer
	1210	297.		V.08	
	1211	88	79.	V 1.6	
	121120	–	–		
	1212	–	956.8		
	12:12	–	–		
	12:13:31	–	–		
	12:14	–	–		
	12:14:50	–			
	12:15		2730		
23° 52.05 41° 5.48	1217		9940		SD
	1220	–	–		
	1226	–	–		P

(Check-to range MAR3L6 w/superducer
15A6 5030m 5028m V9.0

	1228	–	–
	1229	–	–
	1230	–	–
	1231	–	–
	1232	–	–
	1233	–	–
	1234	–	–
	1235	–	–
23° 52.33 41° 5.21	1236	6169.7	–
23° 52.36 41° 5.18	1237	5650.	–
	123835	–	–
	123820	–	–
	123900	–	–
	1240	–	

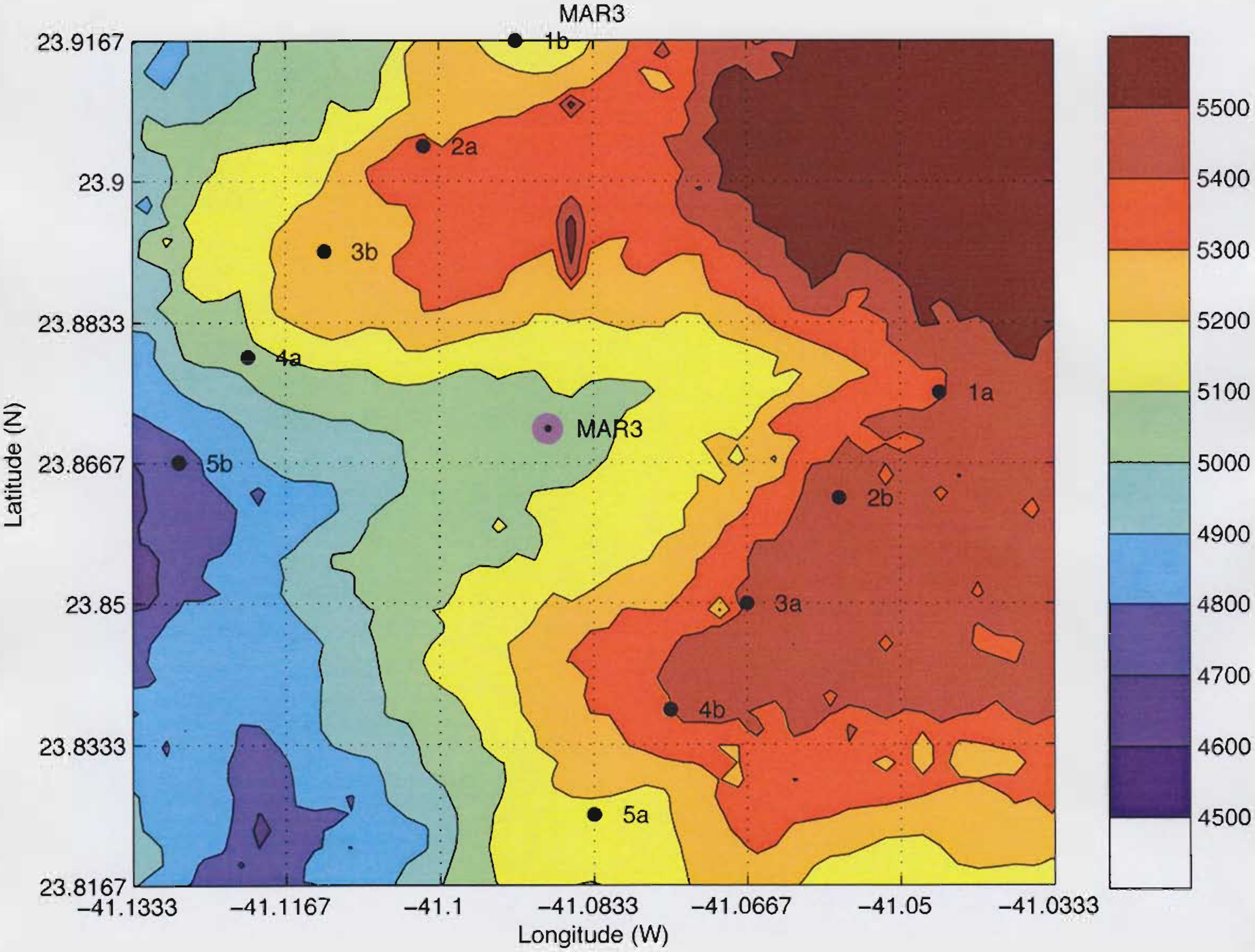
} steaming across site

1241	–	–
1242	–	–
1244	–	-

12:46:41 release sent
no response

2.5 cables
to NE
superducer

1301	9519	–
131851	1429	
132120	12404	


MAR3
23.9167
23.9
23.8833
23.8667
23.85
23.8333
23.8167
Latitude (N)
−41.1333
−41.1167
−41.1
−41.0833
−41.0667
−41.05
−41.0333
Longitude (W)
1b
2a
3b
4a
5b
MAR3
1a
2b
3a
4b
5a
5500
5400
5300
5200
5100
5000
4900
4800
4700
4600
4500

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **MARL4→MAR3L4** Cruise **D359**

NB: all times recorded in GMT

Date 31/12 day365 **Site arrival time** 0854

Time of first ranging 0856

Time of release 0858 10:08 on surface

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	✓	billys upright - antenna missing	10:18
RECOVERY LINE	✓	Came up w/2 glass	
LIGHT	W03-097 ✓		
VHF BEACON	U01-023 ✓	broken antenna	
BILLINGS FLOAT	✓		10:23
5M CHAIN	✓		
2 x GLASS SPHERES	✓		10:22
3 x GLASS SPHERES	✓		10:25
ACOUSTIC RELEASE	921 ✓		
BPR	414 ✓	bubble wrapped	
TRIPOD ASSEMBLY			10:28

Ascent rate ~70m/min

Time at end of recovery 10:28

Ranging

Time	Range 1	Range 2	Command /comment
0856	–	–	
0857	4999	5000	
0858	5001.2		Release OK
0859	4941	4931	
0900	4873	4862	ca 70m/min
0901	4802	4791	71m/min
091730	3663.7	3655.6	v, 8.2v
18 30	3591.3	3582.6	72m/min
19 30	3520.9	3513.7	70m/min

ETA surface 1008 — actual time 10:08

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EB1** Cruise **D359**

NB: all times recorded in GMT

Date 6/1/11 , 006 **Site arrival time** 0100

Time of first ranging 0724 first pass 08:55

Time of release 0748

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME 0/6
RECOVERY FLOAT			08:59
RECOVERY LINE			
TRIMSYN X 3		disgusting	09:03
SBE37	3251 ✓	overgrown - furry, 'green'	09:05
24" STEEL SPHERE and ARGos BEACON	W03-82	- chafed wire - red	09:09
SBE 37	3486 ✓	*1 data connector bashed in, 'green'	09:09
SBE 37	3890 ✓	clean	09:16
ARGOS BEACON	285 ✓	U11-018 flasher	09:19
37" McLa STEEL SPHERE	✓		"
1M CHAIN SWIVEL	✓		"
SBE 37	3891 ✓		09:24
SBE37	3892 ✓	*2 appears to be flooded/on yellow wire	09:28
SBE37	3893 ✓		09:30
4 X 17" GLASS FLOAT		3 orange, 1 yellow - tangles, nick/bend/cut in yellow. can't see which	09:35
SBE37	3900 ✓		09:43
4 X 17" GLASS FLOAT			09:48
SBE37	3901 ✓		09:51
SBE37	3903 ✓		09:57
4 X 17" GLASS FLOAT			10:02
SBE37	3904 ✓	above mark ~1/2 m	10:06
4 X 17" GLASS FLOAT			10:14
SBE37	3910 ✓		10:18
SBE37	3911 ✓		10:29
4 X 17" GLASS FLOAT			10:39
SBE37	3912 ✓		10:46
SBE37	5486 ✓		11:00
4 X 17" GLASS FLOAT			11:10

Switch 1 kt

New Winch drum ↓ 11:26

*1 able to straighten

*2 getting warm - put in workshop

11:57 popping noise & bubbles out of water

SBE37	3916 ✓	*3 getting hot? no, fine	11:32
4 X 17" GLASS FLOAT	✓		11:43
SBE37	3918 ✓	~1 m above mark	11:48
4 X 17" GLASS FLOAT	✓		12:01
SBE37	5484 ✓		12:01
8 X GLASS FLOAT		inst b4 glass, 2 imploded	12:2
SBE37	6335 ✓		12:16
SWIVEL			
ACOUSTIC RELEASE 1	248 ✓		12:23
ACOUSTIC RELEASE 2	687		

down to ½ kt for glass 2x4

Ascent rate ________

Time at end of recovery 12:23

14A5 1449

Ranging

Time	Range 1	Range 2	Command /comment
7:24:15	9230.7	5049.5	V 8.4 , Port
7:25	5052.6	5053.9	V 8.5
7:40	—	5069.2	V -12.7
07:40:45	5071.9	5072.2	V 8.5
0746	—	—	no answer to release cmd
30	—	—	release but no confirm
0748	4841	4828	release OK
4930	—	4669	

248

687

79.5] m/min

ETA 0847

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBL1→EB1L5** Cruise **D359**

NB: all times recorded in GMT

Date 6/1/11, day = 006 **Site arrival time** 1314

Time of first ranging 1217 [from 3nm]

Time of release 1312

Surf @ ~~20~~ 14.20

2nd pass @ 14:26

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

w/running thrus

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		Orange 14:38 hooked	14:39
RECOVERY LINE			
VHF BEACON	~~W03-009~~ W03-099	broken antenna	14:43
LIGHT	W03-096	all tangled	
BILLINGS FLOAT		14:44	
5M CHAIN			
4 X GLASS SPHERES			
4 X GLASS SPHERES			14:51
ACOUSTIC RELEASE	923 ✓		
ACOUSTIC RELEASE	927 ✓	Popped black case - dirty!	14:54
BPR	0004 ✓	flooded + corroded	
BPR	0388 ✓		
TRIPOD ASSEMBLY			

rusty-

doing ~0.2kt (~1/2 kt) ahead on bow thrust

0.3 up to 0.5

Ascent rate ____________

Time at end of recovery ____________

927 Top endcap is no duplex.

Ranging

	Time	Range 1	Range 2	Command /comment
923	1217	8433	9998	/49 cmd rubbish
927	1219	-/-	-/-	
1837	12:48	3867	—	
	12:49:20	—	4508.7	—
1861	12:50:47	—	13618.5	V -12.8
	12:51:47	—	—	
927	1308	— — —	— — 8702	/
923	1311	5035	5056	V, 8.2V
923	131245	5055.7	5047.1	ok
	13 45	4998	4986	
	1445	4924	4913	V, 8.2V
	15 1545	4857	4842	

ETA 1422 GMT

PIES - Serial No: 136

CRUISE D359 **MOORING** **EBP1**

Date 6/1/11 **DOY** 006

Site Arrival Time : 1612

Setup Distance (nm) : on site

WARNING: no telemtery between 2330 to 0000 GMT

PIES Firmware no:

CLEAR 76 **TELEM 65** **RELEASE 8**

BEACON 73 **XPND 69**

Range (m)

Deployment (year & doy) 15/11/08 Last download to 29/10/09, DOY 302

norecs (now-deploy-3) 64+365+5 -3 = 431

PIES telemetry duration (norecs/34)*15mins 190mins / 3hrs 10mins

1st ping hear at (GMT) 162040 then 3 more @16s intervals

CLEAR cmd: 2-ping reply? (y/n) @162334 yes

TELEM cmd sent at (GMT) 162500

Start telemtery at (GMT) 1746

DS-7000 Gain 6866 6666

Notes (conditions/modifications during transmission)

wd=5093m ; ttw 3.4s (v=1500m/s)

Remote mode ch1

CLEAR @ 1716 Trouble with cables, laptop, deck unit (2 ping)

CMD mode ch1

CLEAR @ 173955 (2 ping) : 174045 TELEM receiving data

Waiting 18:24:11 - no pings.. 18:26:47

Switched back to remote @ 18:27:15 - still no new data, 18:28:16.

} over 4 min, no new data

~~Try reducing~~ Checking distance to EBP1 site .01 nm

183030 sent CLEAR - ~~Renamed~~ Moved data files to new dir → data-till-1830

183215 sent TELEM restarted matlab, changed all gain to 5 except ch2=8

Matlab restarted @ 183430. No spurious MSB.

Data block ends 184523 ; MSB at 184643 ~ sampling 27

Spurious MSB @ ~18:48 ~sampling 30

Expect next data block end @ 19:00:23 } early

MSB @ 18:57:00 - @ sample 51 only ~12 min later - no year day

Expect next data block end @ sample 51+34 = 85 ~ 19:09-19:11

1902 spurias MSB | 193030 yd=398

CLEAR cmd required if entire telmetry file not transmitted (y/n)

Routine IES tau sampling resumed at (GMT)

Tau rollovers? (y/n) **Data quality**

Press rollovers? (y/n) **Data quality**

CLEAR 215658 stopped recording

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBL1→EB1L5** Cruise **D359**

NB: all times recorded in GMT
Date 6/1/11 , doy = 006 **Site arrival time** 1314
Time of first ranging 1217 [from 3nm]
Time of release 1312

Surf @ 14:20
2nd pass @ 14:26

Latitude ____________ **Longitude** ____________
(record positions at time of pickup only if likely to be very different from deployment position)

w/ running thrust

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		Orange 14:38 hooked	14:39
RECOVERY LINE			
VHF BEACON	~~W03-009~~ W03-099	broken antenna	14:43
LIGHT	W03-096	all tangled	
BILLINGS FLOAT		14:44	
5M CHAIN			
4 X GLASS SPHERES			
4 X GLASS SPHERES			14:51
ACOUSTIC RELEASE	923 ✓		
rusty - ACOUSTIC RELEASE	927 ✓	Popped black case - dirty!	14:54
BPR	0004 ✓	flooded + corroded	
BPR	0388 ✓		
TRIPOD ASSEMBLY			

doing ~0.2kt (~1/2 kt) ahead on bow thrust
0.3 up to 0.5

927 Top endcap is no duplex.

Ascent rate ____________
Time at end of recovery ____________

Ranging

	Time	Range 1	Range 2	Command /comment
923	1217	8433	9998	1/49 cmd rubbish
927	1219	-/-	-/-	
1837	12:48	3867	—	
	12:49:20	—	4508.7	—
1861	12:50:47	—	13618.5	V -12.8
	12:51:47	—	—	
927	1308	— — —	— — 8702	—
923	1311	5035	5056	V, 8.2V
923	131245	5055.7	5047.1	ok
	13 45	4998	4986	
	1445	4924	4913	V, 8.2V
	15 1545	4857	4842	

ETA 1422 GMT

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBHi** Cruise **D359**

NB: all times recorded in GMT

Date 8/1/11 **Site arrival time** 11:45

Time of first ranging 11:27:50 first pass ~ 12:55

Time of release 11:45:53

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			12:57
RECOVERY LINE		Confusion w/glass pos	
LIGHT			
BILLINGS FLOAT	?		1308
5M CHAIN			
2 X GLASS SPHERES			1310
SWIVEL			
SBE37	5485 ✓	whacked - sheared back	1314
2 X GLASS SPHERES		tangle	1329
Seaguard	218 or 114	Cut rope to continue	1329
SBE37	3277 ✓		1331
SBE37	3484 ✓		1345
4 X GLASS SPHERES			1345
1M CHAIN			
SWIVEL			
ACOUSTIC RELEASE	821 ✓		1345

doing 0.8 thru water

Ascent rate ____________

Time at end of recovery 13:45

Surfaced 1234 (~~[illegible]~~ ~~[illegible]~~)

Last pass @ 1240

Ranging

Time	Range 1	Range 2	Command /comment
11:27:50	—	4650.4	—
11:28:50	4632	4629.7	V 4.9 X
11:29:50	4614.6	4612.8	V 8.6
11:30:50	4600.	4597.5	V 8.5
11:45:10	4510.5	4511.0	V 8.6
11:45:53	4512.3	4512.5	Released
11:46:44	—	—	
11:47:25	—	2893.3	-
11:48:10	4346.4	—	
11:49:10	—	—	
11:50:10	—	—	
(s) 11:51:10	2488.1	1717.9	Release OK
11:52:10	3351.	4014.7 +	

(S)	~~11:53:10~~	~~3866~~	~~3934. 2~~	
(P)	11:54:10	3862	3852.	
	11:55:10	9068 x	3761.5	
	11:56:10	3696	3686	
	11:57:10	3613	3604	
	11:58:10	3531	3522.6	

ETA top 12:25 GMT

RAPID-WATCH MOORING LOGHSEET RECOVERY

Mooring **EBH1** Cruise **D359**

NB: all times recorded in GMT

Date 10 Jan 11 **Site arrival time** ________

Time of first ranging 9.32

Time of release ________

Latitude ________ **Longitude** ________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			
RECOVERY LINE			
LIGHT	S01-184	mooring not recovered.	
BILLINGS FLOAT			
5 m CHAIN SWIVEL			
4 X 17" GLASS			
SBE37	3272		
2 X 17" GLASS			
SBE 37	3274		
2 X 17" GLASS			
1M CHAIN SWIVEL			
ACOUSTIC RELEASE	260		

Ascent rate ________

Time at end of recovery ________

Ranging

Time	Range 1	Range 2	Command /comment
9 3243	432 x	7280. x	V 8.4
0934	256 x	3282.6 x	V 8.4
0935	953 x	3987.9	H -11.3 x
0936	1104 x	329.8 x	V 8.4
0939	—	5572 x	V - 12.7 x
0940	—	7367 x	V - 12.8 x
0942	6995 x	6200 x	V 8.4
094238	1861 x	—	
094345	2725 x	13373 x	V 8.5
0945	4162	2300 x	V.8.4
09:49:15	6959 x	2384 x	-11.4 x
09:50	7647 x	6194.8 x	84
09:51:15	8384 x	6201 x	-11.3 x
09:53	2000 x	1231 x	V 8.4
09:54	10539 x	13800 x	V 8.4
09:56:16	3180 ✓	2377 x	
0955	3031		

Superducer

	09:56:46	4074 x	2385. x	8.4
	09:57:15	4219.4 x	2382.3	8.4
	10:05:03	–	–	
	10:05:43	–	–	
	10:06:24	–	–	
	10:07:04	6568 x	11666 x	–
	10:08:03	5098	–	
	10:08:35	–	–	

Release at (blind – no reads) – last year 31min to surface

	$\boxed{10:11:13}$	–	4881.7	–
	10:12:04	–	–	
	10:12:43	–	–	
	10:13:27	–	–	
	10:14:10	–	1613 x	–
	10:15	2071 x	8680 x	–
	10:15:40	–	–	
	10:16:21	$\boxed{2528.7}$	4237 x	–
	10:16:55	9063 x	–	
	10:17:35	–	3486 x	Release OK
	10:18:32	–	–	
	10:19:34	7554 x	4732 x	Release OK
	10:20:00	4305 x	$\boxed{2052}$	Release OK
	10:20:55	9910 x	6114 x	
	10:21:30	3740 x	$\boxed{1902}$	
	10:22:14	4394 x	8339 x	Release OK
	10:22:35	5872 x	11179 x	Release OK
	10:23:35	2324 x	3328 x	–
	10:24:03	–	3977 x	Release OK
	10:24:38	$\boxed{1933}$	2823 x	Release OK
	10:25:06	3132 x	10822 x	Release OK
	10:25:51	10823 x	12950 x	–
↑	10:26:46	10052 x	10020 x	–
1455	10:27:35	7806 x	–	
1449 ↓	10:28:40	2334	12210	–
	10:29:31	–	–	
	10:30:14	$\boxed{1153}$	–	
	10:30:48	–		

	Superducer	range	range	comments
	10:31:48	9996	–	
1455	10:32:30	4470	1900	Release OK
	10:33:01	–	–	
	10:33:44	–		
	10:35:29	–	–	
	10:36:14	10936	–	
	10:36:52	–	–	
	10:			
inside P	10:39:29	1932×	4965×	V -11.4
	1040	$\boxed{1245}$×	$\boxed{475}$	V 8.5
	104220	$\boxed{584}$	7433×	V 8.4
	104256	2175×	5217×	V 8.4
	104342	1868×	1097.4×	V 8.5
	10 4405	3842×	2383.3×	V -11.3
	10:44:40	$\boxed{434}$	3471×	V 8.4
	10:45:09	1197×	$\boxed{432.8}$	V.84
	10:45:35	1017×	4054	V 8.4
	10:48:55	3316×	2388.6	V 8.4
	10:49:30	5916.2×	2384.7	V 8.4
	10 50 55	2382.3	3300	V 8.4
			3865	V 8.4
	10 51 30	–		
	10:52:19	1263.8	4912	release ok
	10:53:00	2175.0	1405.3	ok
	10:53:20	3748.8	2384.4	ok
	10:53:50	3823.8	2390.2	ok
	10:54:20	1592	822.0	ok
		726.7		
	10 55.04	274		
	10:56:39	370		
	10:57:22	513		
	10:58:08	586.9		
	10:58:47	966.8	190.9	
	10 59:35	1364.5	591.3	

11:00:05	3412	2391.7	ok
11:00:40	2524	1752	ok
10:01:20	1716.4	942.2	ok
11 01:45	2095	1324	ok
11:02:12	906.1	3941	ok
11:02:31	1897.7	1134.3	ok
10:03:20	3446.4	2389.3	ok
11:03 48	558	3590	
11:04:00	1058.4	286.3	ok
11:04:35	2507.1	1736.0	ok

EBH1 [redacted] superduces @ new EHH1 site

15:10:29	–	–	
15:11:10	–	–	
15:11:55	–	–	
15:12:35	–	–	
15:14:10	–	–	
15:15:00	–	11550.6	–
15:16:10	–	–	
15:17:44	–	–	
15:18:25	–	–	
15:19:10	–	–	
15:20:00	–	–	
15:21:30	–	6956.7	V -12.7
15:22:15	–	13148.9	–
15:23:30	–	–	
15:25:05	–	–	
15:26:00	–	–	
15:26:45	–	–	

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBL2→EBH1L5** Cruise **D359**

NB: all times recorded in GMT

Date 10 Jan 11 **Site arrival time** 11:50

Time of first ranging 09:47 Top surf 11:51:45

Time of release 11:10:27 all up w/in ~30 sec

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

5 trans

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			12:02
RECOVERY LINE			
LIGHT	S01 – 181		~~12:07~~
VHF BEACON	T01 – 144		
BILLINGS FLOAT			12:08
5M CHAIN			
2 X GLASS SPHERES		tangles	12:07
3 X GLASS SPHERES			12:11
ACOUSTIC RELEASE	368 ✓		12:14
BPR	0396 ✓		
TRIPOD ASSEMBLY			

Ascent rate 72m/min

Time at end of recovery 12:14

Ranging WD 3000m

switch deck units

Time	Range 1	Range 2	Command /comment
0947	1807 ×	6884.5 ×	V 60.4 ×
0948	2512 ×	3131	V 0.8 ×
0948:30	3119.3	3116	V 8.2
11:05:38	2468.1 ×	1700 ×	V 8.4
11:06:00	567.2 ×	3005.0 ✓	V 8.2
11:06:23	2273.4 ×	1502. ×	V 8.4
11:06:44	1393.2 ×	622.4 ×	V 8.4
11:07:30	1694.7 ×	924.9 ×	V 8.4
11 09:14	3003	2725	V 8.4
11:09:43	488 ×	3002.	
11:10:27	1641 ×	868 ×	Release OK
11:10:55	446 ×	2978	} 90 m/min
11:11:35	338 ×	2933	"
11:12:45	855 ×	2850.1	
11:13:35	1836 ×	1111.3 ×	
11 14	2542.8	1840.7	
11 1610	2611	2230	
11:16:30	2585	2578	
11 1847	678 ×	2412.7	

11:22:07	2177.5	2170.3 –
11:26:03	1845.2	1076.6 –
11:31:25	1502.8	1494.8
11:37:05	342	1091.6

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBH2** Cruise **D359**

NB: all times recorded in GMT

Date 11/1/11

Site arrival time 2145 (10/1/11)

Time of first ranging 0722

Time of release 072230

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			7:57
RECOVERY LINE		Confusion about where glass is?	
LIGHT BEACON			
BILLINGS FLOAT	T05-079 ✓	Ran over? caught on prop.	8:04
5M CHAIN			
2 GLASS SPHERES			8:04
SWIVEL			
SBE 37	3269 ✓		8:04
2 GLASS SPHERES			8:42
SBE 37	3270 ✓	bent pins	8:42
SBE 37	3271 ✓		8:52
2 GLASS SPHERES			8:52
1M CHAIN SWIVEL			
ACOUSTIC RELEASE	258 ✓	little bit rusty	8:52

8:15 Trying to hook free line out to release. Cut inboard and hopefully pull free of prop.
8:22 free end cleated off
Try to use crane to push of the prop.

Ascent rate ____________

Time at end of recovery ____________

Ranging

Time	Range 1	Range 2	Command /comment
22:41:25	2029	-12.7V.	
42	2028	2027	8.5V VENT.
0722	2030	2032	8V V
072230	2106	2107	release OK
072300	2030	2023	
072500	1457	1944	] 71m/min
072600	1880	1872	

ETA 0746 light 0743 (flashing brightly)

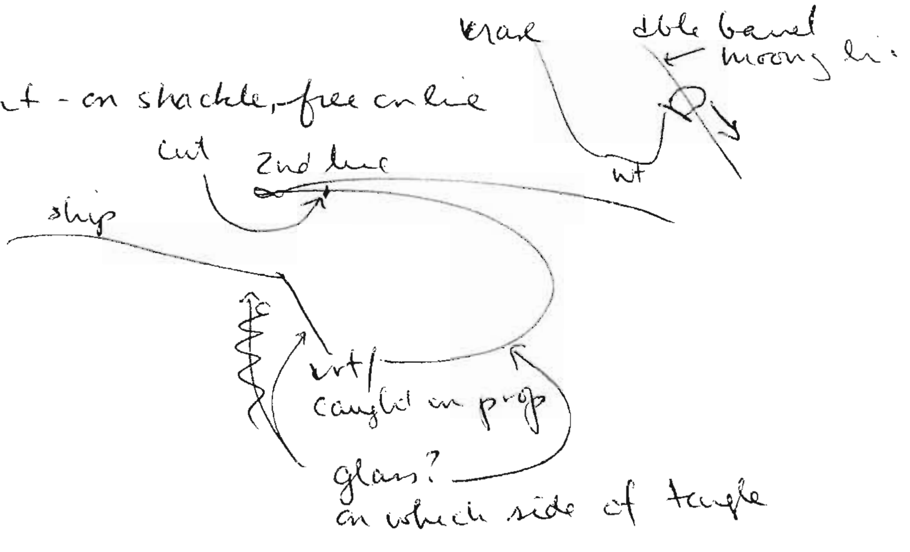
All up 0750

8:27 Trying putting a heavy weight on line to try to pull down off the prop - trying 70kg to outweigh the 50kg glass buoyancy.

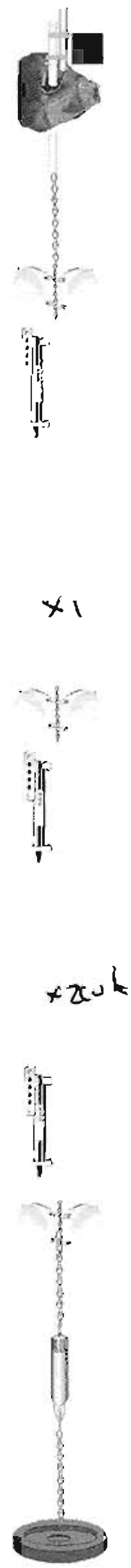
8:36 dropped weight - on shackle, free on line

8:39 Cut line

8:42 weight glass + SBE !



EBH2 2009/31
TO RECOVER
D359 2010



BILLINGS FLOAT WITH LIGHT SN T05-079

RECOVERY LINE

5M CHAIN

2 GLASS SPHERES
SWIVEL

SBE 1600M

3269

200M OF 8mm
POLYESTER

put 2 big hooks + recovery line
with shackle here.

x1

Let go, ~~the~~ lines slid down
to glass sinking them
& pulling glass stem of
rudder/prop or whatever it was
jammed on

2 GLASS SPHERES

SBE 1800M

3270

200M POLYESTER

x2 cut here & tied off onboard

Section x1 to x2 recovered
then joined to bottom section
& recovered

SBE 2000M

3271

2 GLASS SPHERES
1M CHAIN
SWIVEL

AR861 SN258

1M CHAIN

500 KG ANCHOR

WATER DEPTH
2011M

NMFD/RAPID

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBH3** Cruise **D359**

NB: all times recorded in GMT

Date 11 Jan 11 **Site arrival time** 13:29

Time of first ranging 13:21

Time of release 13:23:45

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			13:50
RECOVERY LINE			
LIGHT BEACON	A1556		
BILLINGS FLOAT	~~A1556~~		13:58
5M CHAIN SWIVEL			
2 MINI TRIMSYN			13:58
SBE37	3259 ✓		13:58
2 MINI TRIMSYN		Stuff growing on rope whitish	14:06
SBE37	3264 ✓	branching structures	14:06
2 MINI TRIMSYN			14:11
SBE37	3265 ✓		14:11
2 MINI TRIMSYN			14:16
SBE37	3266 ✓	small 1/2" patch of corrosion	14:16
SBE 37	3268 ✓	fan-stuff growing on it	14:25
2 GLASS SPHERES			14:25
1M 1/2" CHAIN			
ACOUSTIC RELEASE	916 ✓	Stuff growing on it	14:26

~0.6 kt thru water

Ascent rate ____________

Time at end of recovery 14:26

Ranging

Time	Range 1	Range 2	Command /comment
13:21:58	—	1504	V -12.7
13:22:34	1504	1503	V 8.5
13:23:45	1503	1502	Release OK
13:24:48	1447	1440	
13:25:45	1385	1378	

Release

} 60m/min

ETA 13:48 Top @ 1360

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBH4** Cruise **D359**

NB: all times recorded in GMT

Date 12/1/11 **Site arrival time** 0500

Time of first ranging 11/1/11 @ 17:04

Time of release 0714 on 12/1/11

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

hook @ 8:21

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	✓	o	8:21
RECOVERY LINE			
LIGHT		can't see) can't see flashing	
BILLINGS FLOAT	T05-076 ✓	Y	8:26
5M CHAIN SWIVEL			
1 GLASS SPHERE	✓	Y	8:26
SBE37	3252 ✓		8:31
SBE37	3253 ✓	missing ~~cap~~ locking sleeve	8:36
SBE37	3254 ✓		8:38
2 GLASS SPHERES SWIVEL	✓	Y	8:38
SBE37	3255 ✓		8:44
SBE37	3256 ✓		8:47
2 GLASS SPHERES	✓	Y	8:47
SWIVEL			
SBE37	3257 ✓		8:52
4 GLASS SPHERES	✓	Y L	8:59
1M CHAIN SWIVEL			
ACOUSTIC RELEASE	364 ✓		8:59

0.8 kts

Ask ½ kt

Ascent rate ____________

Time at end of recovery 08:59

Ranging

Time	Range 1	Range 2	Command /comment
11/1/11 1704GMT	1678	1683.1	✓ 8.5
064230	1502.7	1503.8	✓ 8.5
071530	1837	1837	✓ 8.5
071419	1841	1842	Release OK
0715	1825	1822	
0716	1779	1774	] 51m/min 0.51a away. Start range
0717	1748	1747	
0719	1717	1718	

1832(EH5)

07:30	1492	8840	
07:32:08	1108	1105	V 8.5
07.33:22	—	1204.0	Release OK
07:34:22	—	—	
07.35:42	932.6	925.2	
07:37	1494	—	
07:38	614	600	Rel ok

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBH5** Cruise **D359**

NB: all times recorded in GMT

Date 12/1/11 **Site arrival time** 09.15

Time of first ranging ____________

Time of release 09:33:30

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
LIGHT BEACON	↑ –	not working	"
BILLINGS FLOAT	S01-191	Heavy marine growth.	1030
5M CHAIN SWIVEL		✓	"
RECOVERY FLOAT		✓	"
RECOVERY LINE		✓	"
SBE37	3248	✓ bit of growth - not too bad	"
2 GLASS SPHERES		yellow	1038
SBE37	3249	✓	1038
SBE37	3483	✓ 2m down from mark - slipped?	1041
2 GLASS SPHERES		yellow not loose on wire though,	1046
S4	35612571	✓ yellow	1046
2 GLASS SPHERES		} tangled	1056
S4	35612572 ✓	200m pulled in by hand	1056
4 GLASS SPHERES		orange	1106
SWIVEL			"
1M CHAIN			"
ACOUSTIC RELEASE	~~[illegible]~~	s/n 918	"

Ascent rate 80 m/min

Time at end of recovery ____________

Ranging

Time	Range 1	Range 2	Command /comment
1705	–	2969.2	V 12.7
~~17~~06	2733	2744	"
093130	1229.4	1229.5	V 8.5
093330	–	1219.5	Release OK
09:3430	1167.1	1159.8	"
09:35:30	1086	1079.0	"
09:36:30	1000.8	992.6	"
09:37:30	934.9	928.1	"
09:38:30	867.6	890.7	

11/1/11

Release

} 60 m/min

} 81 m/min

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBM1** Cruise **D359**

NB: all times recorded in GMT

Date 13/11/11 **Site arrival time** ________

Time of first ranging ____________

Time of release ____________

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	**SER NO**	**COMMENT**	**TIME**
RECOVERY FLOAT			1842
RECOVERY LINE			1842
VHF BEACON	W03 – 102		1842
2 X 12” GLASS SPHERE			1842
SBE37	3482		1842
SONARDYNE LRT RELEASE	245798-004 AI008, F1		1843

Ascent rate ____________

Time at end of recovery ____________

Ranging 008/1

Time	**Range 1**	**Command /comment**	
1253	FAIL x 10	Rel, done Fail	2ca north
	FAIL		
1308	FAIL x 10	Rel, done Fail	2ca east.
	FAIL		
1323	FAIL x10	Rel, done Fail	2ca south
	FAIL		
1330	Fail x 10	Rel, done Fail	2ca west.
	Fail		
12/11/11 1830-	Fail x 10	no ranges	

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBM4** Cruise **D359**

NB: all times recorded in GMT

Date 13/1/14 **Site arrival time** 1113

Time of first ranging ____________

Time of release ____________

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			
RECOVERY LINE			
VHF BEACON	W03-101		
2 X 12" GLASS SPHERE			
SBE37	3480		
SONARDYNE LRT RELEASE	AI 011, F1 245798-002		

Ascent rate ____________

Time at end of recovery ____________

Ranging 011/1

	Time	Range 1	Command /comment	
	1113	FAIL×10	rel FAIL, done	2ca north
	1116	FAIL×5		?
	1135	FAIL×10	rel FAIL, done	2ca east
	1154	FAIL×10	rel FAIL, done	2ca south
	1215	FAIL ×10	rel FAIL,	2 ca west
12/1/11	1949	Fail ×10	no ranges	

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBM5** Cruise **D359**

NB: all times recorded in GMT

Date 13/1/11 **Site arrival time** 0500

Time of first ranging 0729

Time of release 0741

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			0810
RECOVERY LINE			
VHF BEACON	W03 – 113		
2 X 12"GLASS SPHERE			
SBE37	3220		
SONARDYNE LRT RELEASE	252343-006 AI 012, F2		

Ascent rate ____________

Time at end of recovery ____________

Ranging

Time	Range 1	Command /comment
0729	206.7	
073815	276.4	1
073845		Release Enable, 340.4 Enable
	317.6, 324, 328, 334	
0741		Release 364 [illegible], done
074210	343.2	
4230	FAIL	
4250	407.4	
4315	404.4	
074430	407	surface ~0745.
12/1/11 2011	205.5, 205.6.	

RAPID-WATCH MOORING LOGHSEET **RECOVERY**

Mooring **EBM6** Cruise **D359**

NB: all times recorded in GMT

Date 13/1/11 **Site arrival time** 0916

Time of first ranging ____________

Time of release ____________

Latitude ____________ **Longitude** ____________

(record positions at time of pickup only if likely to be very different from deployment position)

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			
RECOVERY LINE			
VHF BEACON	W03 -103		
2 X GLASS SPHERE			
SBE37	3217		
SONARDYNE LRT RELEASE	AI 005, F1 252343-004		

Ascent rate ____________

Time at end of recovery ____________

Ranging 005/11

	Time	Range 1	Command /comment	
	0918	FAIL ×10	Tried release – no response onsite	
	0935	FAIL ×10	2ca to NW, Release, Fail	
	0949	FAIL ×10	Rel fail	2ca east
	1018	FAIL ×10	Rel fail	2ca south
	1158	FAIL	Rel fail	2ca west
12/1/11	2047	FAIL ×10	no ranges.	

abandon site

Appendix F: Mooring Deployment Logsheets

DEPLOYMENT

CRUISE D359 **MOORING** **MAR0**

Date 27/12/10	**DOY** 361
Site Arrival Time 1507	

Setup Distance (nm) 0.4

Start

Time	Lat N	Lon W	Depth (u/c)	Depth corr
15:44	25° 06.65'	52° 01.12'		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
16 21	25° 06.36'	52° 0.65'	5452	5512

Release s/n	Arm	Release
1201		
318		

s/n time	16:19	100m to target	
1201	567.2	581.6	
16:26:15	648	662	
16:27	739.7	753.6	128 m/min
16:28	867.5	878.8	
1710	5506.9	—	
1711	5509	5509	no diagnostic
318			
1715	—	5512.3	nd
1716	5512	5512	Horizontal V = 2.9V
1717	5512	5437.8 7 0	Ad
	1423	931	Vertical V=12.6V
1201			
1719	5512	5512	nd.

safely on seabed.

MAR0 : 27/12/10

	Mooring Element	Depth	Serial num	Comment	Time o/b
1	Recovery float and line				1545
2	Join				
3	3 Glass spheres				15:46
4	Top join 125m of 10mm polyester				
5	SBE (at top join)	5100	4306		1547
6	Bottom join 125m of 10mm polyester				1551
7	Top join 125m of 10mm polyester				
8	SBE (at top join)	5225	6127		15:51
9	Bottom join 125m of 10mm polyester				
10	2 glass spheres + swivel				15:54
11	Top join 50m of 10mm polyester				
12	SBE (at top join)	5350	4307		15:54
13	Bottom join 50m of 10mm polyester				
14	Join				
15	Current Meter S4	5400	356125574		15:55
16	Join				
17	Top join 70m of 10mm polyester				
18					
19	SBE (at bottom join)	5475	4466		15:58
20	SBE (at bottom join)	5475	6128		15:58
21	Bottom join 70m of 10mm polyester			STEAMING @ 1.4 knts. 400m to pos ~10min	
22	6 glass spheres + swivel				16:13
23	Join				
24	20m of 10mm polyester				
25	Join				
26	Acoustic Release	1201			
27	Acoustic Release	318			
28	BPR 1		0003		
29	BPR 2		0391		
30	Anchor 600kg				16 21

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **MAR1** Cruise **D359**

NB: all times recorded in GMT

Date 26/12/10 DOY 360 **Site arrival time** 16:05

Setup distance 6nm

Start time 17:06 **End time** 2206

Start Position

Latitude 24 04.32' N **Longitude** 49° 42.15' W

into water

ITEM	SER NO	COMMENT	TIME
TRIMSYN FLOAT		YELLOW	1707
RECOVERY LINE			
3 X TRIMSYN		YELLOW	17:07
SBE37	6331		17:07
ARGOS BEACON	Y01-011		
LIGHT	Y01-017		
24" SYNTACTIC SPHERE	46493	RED	17:10
1M CHAIN			
SBE37	3902		17:10
ARGOS BEACON		?	
LIGHT			17:22
37" STEEL SPHERE		YELLOW	
1M CHAIN SWIVEL			
SBE37	4068	on blk tape	17:26
SBE37	6121	on blk tape - betw clamps	17:2 ?
SBE37	6129	above blk tape ½m from inst center	17:32
SBE37	4722	above blk tape ½m "	17:34
SBE37	4071	above blk tape ½m "	17:41
8 X GLASS SPHERES SWIVEL		ORANGE	17:51
SBE37	6122	✓ just below glass string	17:52
SBE37	4072	white tape - above by ½ m.!	17:58
SBE37	6828	centered on white tape	18:04
CM Sontek	D320	Pointed down, ½m below white tape	18:13
SBE37 *	7468	JUST ABOVE JOIN*	18:27
8 X GLASS SPHERES		ORANGE	18:32
SBE37	6123	white tape, centered on white tape	18:36
4X GLASS SPHERES SWIVEL	~~4178~~	join on deck at 1852 use to estim. winch speed	18:57
SBE37	4178	@blk tape, below by ~ 1m	18:57

supposed to be 100m apart - is only 2 min if winch is 50m/min

* Missed/wasn't a mark - should have been at 1600m. Now closer to 1780m.

~4-5 min for 200m is about 40-50m/min

12 min of 40m/min - is 480m. This is a bit slower. <40m/min

Speed up to 1kn

4 X GLASS SPHERES		orange	1914
SBE37	6124		1914
4 X GLASS SPHERES SWIVEL			1928
SBE37	4180		1928
4 X GLASS SPHERES			1947
SBE37	6327		1947
SBE37	4305		2001
5 X GLASS SPHERES			2010
SBE37	6126	⇐ Below S4 on 100m length.	2022
S4	35012	576	2022
9 X GLASS SPHERES SWIVEL			2031
ACOUSTIC RELEASE 1	1199		2033
ACOUSTIC RELEASE 2	1194		2033
20M NYLON BRAID			2034
10M ½" CHAIN			2043
CHAIN ANCHOR 1800 KG			220631

On anchor site 22:00

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID ____________
Argos beacon #2 ID ____________
Anchor Drop Position
Latitude 24.16878 **Longitude** -49.71953 [redacted]
Uncorrected water depth 5155 (at anchor launch)
Corrected water depth 5205 (at anchor launch)

@ 220631
24.16848 -49.71953
24°10.11N 49° 43.17'W

24°10.17 pretriangul -49°43.17' @ 22:07:21

2047 on anchor. Towing to site, 2.6nm to go.

Ranging

~~22:13:55~~				
22:14:11	—	12036.6 —		
22:14:59	—	1719,8m	V	
22 15:43	1797	1816.	V 8,8	
22:16:30	1947	1966	V 8,8	
22:17:30	2122	2139	V 8,7	} Δ170
22:18:30	2291	2309	✓	
22:19:30	2462	6349 X	20.7	} Δ171
22:20:30	2629	2645		} Δ 167
22:25:30	3427	3445 } Δ798m		
22:30:30	4168	4185 } Δ 650m		
22:35:30	4819	4836		

22:40:30	5162
22:42	5164

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **MAR1L6** Cruise **D359**

NB: all times recorded in GMT

Date 25/12/10 **Site arrival time** 2000

Setup distance ______

Start time 20:00 **End time** 20:07

Start Position

Latitude 24° 12.23' N **Longitude** 49° 43.68' W

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		Orange	20:01
RECOVERY LINE			
LIGHT SN	Y01-022		
VHF SN	X02-054		
BILLINGS FLOAT		yellow	20:02
5M CHAIN SWIVEL?			
4 X 17" GLASS		orange	20:03
4 X 17" GLASS		orange	20:04
ACOUSTIC RELEASE 1	163		
ACOUSTIC RELEASE 2	1196		
BPR 1 ~~0063~~	0063		
BPR 2	0028		
TRIPOD ASSEMBLY			
ANCHOR ~~300KG~~ 600KG			20:0605

Release #1 arm code } RT661
Release #1 release code
Release #2 arm code
Release #2 release code
Anchor Drop Position
Latitude 24°12.22 **Longitude** 49° 43.68
Uncorrected water depth 5172 (at anchor launch)
Corrected water depth 5222 (at anchor launch)

~~20:09:36~~

~~20:10~~	~~2528~~	~~v~~	
20:10:15	470	478	103 m/min
20: 11	545		
20:12:15	677		107 m/min
20:13:20	793		

MAR 1 triangulation 28/12/10 from

NO Reliable fixes

s/n	time	range	range	diag	lat	lon	side
[redacted]	15:47	–	–		24° 11.68'	49° 44.99'	P
	15:48	–	–		~~11.68~~	44.99'	P
	15:49	5994.8	2381.1 ×	V 8.4 V	11.68'	44.99'	S
	15:50	2796 ×	2025 ×	V 8.4 V	11.69'	45.00'	S
	15:51	3547 ×	2389 ×	V 8.4 V	11.69	45.00	S
	15:52	3911 ×	2397 ×	V 8.4 V	11.70'	45.00	S
	15:53	–	–				P
	15:54	–	–				P
	15:55	–	–				P
	15:56	9639 ×	–		11.71	45.02	P
	15:57	–	–		11.713	45.03	P
	15:58	890 ×	118 ×	V 8.4	11.713	45.03	S
	15:59	1519	724	V -11.3	11.71	45.03	S
FROM	PT 1						
[redacted]	16:44:09	–	–		24° 12.30'	49° 44.35'	P
	16:45:20	–	–		24° 12.30	49° 44.34	P
	On way PT 2 to PT 3						
	17:06	–	–		24° 11.27	49° 45.28	P
	17:07:02	–	–		24° 11.27	49° 45.18	P
	17:08:25	–	6408		24° 11.27	44.98	P
	17:10	–	10072	–	24° 11.25	49° 44.74	P
	17:14:23	–	–		24° 11.15	49° 44.31	P
	17:15:23	–	–		24° 11.14	49° 44.27	P
	17:16 19	3341	1101	V 13.6	24° 11.12	49° 44.23	S
	17:17	2512	1262	V 11.0	24° 11.11	49° 44.21	S
	17:18:27	2996	1241	V 12.6	24° 11.10	44.18	S
	17:19:11	2775.5	9676	V 29.6	11.10	44.17	P
	17:20:10	–	9681	~~V~~ –	11.10	44.16	P
	17:21:30	–	–		11.103	44.145	
	17:33:45	–	–		11.04	44.01	

from MAR 2 location

at PT 3

pstar
mi_setup
~~dt mtdfinfo~~
mtposinfo([2010 12 28 17 46 09])

MAR1

s/n	time	range	range	diag	lat	lon	P/S	
	17:45:09	729		V 12.6			Superducer	
	45:42	386	1116	V 12.6			↓	
	46:09	5695	5695	V 8.7	24 11.02	-49 44.06		✓
	17:46:44	5695	5695	V 8.7	11.01	44.05		✓
	18:11:14	5218.2	2403.4	V 3.8				
	18:12:33	5357.3	5357.8	V 8.7	24° 09.71	-49° 44.073	P	
	18:15:25	5362.1	5363.5	V 8.8	24° 09.50	49° 44.04	P	
	18:18 40	5367.7	5368.0	V 8.7	24° 09.54	49° 44.03	P	✓
	1828	5367.2	5372.1	✓	~~24~~ 9.57	44.056		✓
	1839 35	5147.8	~~5~~	—	9.595	43.20		×
	18:42:01	—	5484.8	V -12.7	9.62	42.87		×
	18:46 02	5276.1	5281.0	V 8.7	9.67	42.44		✓
	18:51:08	5419.8	5425.5	V 8.7	9.60	42.15		✓
	18 54:58	5509.1	5510.0	V 8.8	9.52	42.01		✓

DEPLOYMENT

CRUISE D359 **MOORING** **MAR2**

Date 28/12/10	**DOY** 362
Site Arrival Time 1230	
Setup Distar 3nm	

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
12:52	24° 13.84	49 46.30		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
15:27:36	24° 11.69'	49° 44.99	5165	5215

Release s/n	Arm	Release
920		

Release	time	range1	range2	diagnostic	
920	15:33:	6157	6201	V 8.4	
"	15:34	–	–		
"	15:35	—	1450	V -12.7	
"	15:36	1565	1581	V 9.1	ΔZ= 157m
"	15:37	1722	1739	V 9.1	
"	15:38	1876	1892	V 9.1	ΔZ= 154m
"	15:39	2028	2045	V 9.1	ΔZ = 152m
"	15:40	2179	2195		ΔZ = 151m
"	15:41	2329	2343		ΔZ = 150m
920	16:01	3175	266 X	V 12.9 x	S
"	16:02	3729	2392 x	V 1.8 x	S
"	16:03	5096	5116	V 9.1	P
	16:05:15	5160	5160	V, 9.0	

MAR2

Date 28/12/10

	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float with light				1252
2	5m chain				"
3	Recovery line and float				"
4	4 glass spheres with swivel			orange	1254
5	Join: Top of 700m 3/16" wire				"
6	SBE at join	1100	4070		"
7	SBE at mark	1400	4466	Time 200m out = 5mins	1305
8	SBE (no mark)	1600	3934	To this instrument	1311
8	Join: Bottom of 700m 3/16" wire				1320
9	4 glass spheres with swivel	1787		yellow	"
10	Join: Top of 450m 3/16" wire				"
11	SBE at join	1800	6137		"
12	Join: Bottom of 450m 3/16" wire				1535
13	3 glass spheres	2244		orange	"
14	Join: Top of 495m of 3/16" wire				"
15	SBE at join	2250	6320		"
16	Join: Bottom of 495m 3/16" wire				1550
17	3 glass spheres with swivel	2745		orange	1550
18	Join: Top of 990m of 3/16" wire				1550
19	SBE at join	2750	6322		1550
20	SBE at mark	3250	4470		1404
21	Join: Bottom of 990m of 3/16" wire				1420
22	3 glass spheres with swivel	3741		orange	1420
23	Join: Top of 500m of 3/16" wire				1420
24	SBE at join	3750	6323		1420
25	Join: Bottom of 500m of 3/16" wire				1436
26	3 glass spheres with swivel	4246			1436
27	Join: Top of 890m of 3/16" wire				1436
28	SBE at join	4250	6325		1436
29	SBE at mark	4750	6326	centered on white tape	1450
30	Join: Bottom of 890m of 3/16" wire				15:08
31	4 glass spheres with swivel	5142			1508
32	Join: Top of 20m of 3/16" wire				"
33	S4 current meter at join	5150	35612565		1508
34	SBE at mark	5160	4471	below tape	1510
35	Join: Bottom of 20m of 3/16" wire				1513
36	5 glass spheres with swivel	5170			1513
37	Join: Top of 10m of 3/16" wire				"
38	Join: Bottom of 3/16" wire				~~15:19~~ ~1522
39	Acoustic release		920		~~15:19~~ ~1522
40	10m 1/2" chain				
41	Anchor 1000 kg	5200			15:27 :30

exactly 5 mins of veer. Then 5 mins to bottom!

1.4 nm ~1:15 min

went slow - [illegible] on reeler

less than a knot ~:50

MAR 2

s/n	time	range	range	diag	lat	lon	P/S	Good
	FROM	PT 1			24°	49°		
920:	16:39	5350	5351	V 9	12.478	44.60	P	✓
	16:40	5351	5351	V 9.0V	12 28.8	44 36.04	P	✓
	16:41	5354	5354	V 9.1	12 29.10	44 36.00		✓
	On way to	PT 2			~~24° 11.5~~	~~49° 45.5~~		
	16:57 06	2419 ×	621 ×	V 12.6	24° 11.50	49° 45.36	P	×
	16:58:02	5223.6	5227.0	V 9.1	24° 11.46	49° 45.40	P	✓
	~~17:00:00~~	5257	5260	V 9.1	24° 11.38	49° 4548	P	✓
	17 59 30							
	On way to	PT3						
	17:12:03	5380	5386	V 9.1	24° 11. 28	49° 44.48	P	✓
	17:13:04	5418	5424	V 9.1	24° 11.18	49° 44.40	P	
s/n 1834	17:24:53	5567.3	5568.2	V 9.0	24° 11.1	49° 44.123	P	

DEPLOYMENT

CRUISE D359 **MOORING** **MAR3**

Date 31/12/10	**DOY** 365
Site Arrival Time	
Setup Distar 3.1 nm	

Start

Time	Lat N	Lon W	Depth (u/c)	Depth corr
15:13	23°44.02	41° 03.60'		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
17:46:30	23° 51.41	41° 05.85	5008	5049

Release s/n	Arm	Release
1202		
922		

Release	time	range1	range2	diagnostic
1202	17:49:41	-	659.9	-12.7
	17:50:45	796.5	6825.	7.6
	17:51:44	959	—	
	17:52:45	1128	1146	9.5
	17:55:45	1603		9.5
	17:58:45	2060	2078	9.5
	18:01:45	2509	2522	9.5
	18:04:45	2908	2923	9.5
	18:07:45	3321	3334	9.5
	18:10:45	3724	3739	9.5
	18:12:45	3993	4011	9.5
	18:14:45	4257	4274	9.5
	18:17:45	4521	—	9.8
	18:20	4950	4969	9.5
	18:22	5036.8	5037.3	V 9.5
	18:23	5037.4	5036.7	V 9.5

} 170 m/min

} 180 m/mi

Seabed

MAR3

Date 31/12/10 start@ 15:13

	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float with light		X01-048	YELLOW	15:20
2	5m chain				
3	Recovery line and float				15:20
4	2 glass spheres with swivel	2500	~~6125~~	ORANGE	15:21
5	Join: Top of 500m 3/16"				
6	SBE at join		6125	✓	15:22
7	Join: Bottom of 500m 3/16"				15:41
8	3 glass spheres	3000		ORANGE 15:41	~~[illegible]~~
9	Join: Top of 500m 3/16"				"
10	SBE at join	3000	3933	✓ 15:41	
11	Join: Bottom of 500m 3/16"				"
12	3 glass spheres	3500		ORANGE	15:56
13	Join: Top of 500m 3/16"				'
14	SBE at join	3500	6333	✓	15:57
15	Join: Bottom of 500m 3/16"				
16	3 glass spheres + swivel	4000		ORANGE	16:13
17	Join: Top of 500m 3/16"				
18	SBE at join	4000	6332	✓	16:13
19	Join: Bottom of 500m 3/16"				
20	3 glass spheres	4500		ORANGE	16:29
21	Join: Top of 540m 3/16"				
22	SBE at join	4500	4472.	✓	16:29
23	SBE at mark	5000	7363 ✓		16:45
24	Join: Bottom of 540m 3/16"				
25	S4	5015	35612564	✓	16:51
26	8 glass spheres with swivel	5017			16:53
27	10m 3/16"				
28	AR1		1202		17:01
29	AR2		922		
30	10m of 0.5" chain				
31	Anchor (1000kg)	5050			17:46 ?

3.1 nm @15:20 0.5knot

speed to 0.75knts

16:02 2.6 nm to target

16:26 2.2nm increase to 1kt

/

16:55 1.5nm

incr spd to 2knts gradually

17:17 1 nt to target

17:46 ok to go

15 min for 500m of wire → winch speed: ~33m/min No - 15 min includes time attaching glass / instruments

0

0

DEPLOYMENT

CRUISE D359 **MOORING** **MAR3L6**

Date	31/12/10	**DOY**	365
Site Arrival Time	08:55		
Setup Distar	2 cables		

+ before recovery
~~2 cables~~

Start

Time	Lat N	Lon W	Depth (u/c)	Depth corr
1108	23° 51.51'	41° 05.67'		

11:08
3 cables away

End

Time	Lat	Lon	Depth (u/c)	Depth corr
11:33:10	23°51.76'	41°05.76'	5000	5045

Release s/n	Arm	Release
497		
1195		

Release	time	range1	range2	diagnostic
~~11:37~~	11:37	—	—	
497	11:38	—	623.4	V -12.7
	11:39	708.3	721.4	V 9.1
	11:40	828.0	838.1	V 9.1

} 120m/min

Release	time	range1	range2	diagnostic

MAR3L6

Date 365 31/12/10

	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float, light & flag		W03-107, light Y01-018		11:15
2	5m chain				
3	Recovery line				
4	4 glass spheres			ORANGE	11:16
5	15m polyprop				
6	4 glass spheres			ORANGE	11:17
7	15 m of polyprop				
8	BPR1		0394		
8	BPR2		0062		11:33
9	AR1		497		
10	AR2		1195		

1.5 cables @0.75 kts

0	Recovery float	ORANGE	11:15
1	Billings float	YELLOW	

DEPLOYMENT

CRUISE D359 **MOORING** **NOGST**

Date	1/1/2011	**DOY**	001
Site Arrival Time	overnight.		
Setup Distar	1 nm		

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
1349	23° 45.2'	41° 05.9'		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
14:59:00	23° 46.29	41° 5.90	4244	4265

hard to read.. ☐

Release s/n	Arm	Release
926	☐	1855

Release	time	range1	range2	diagnostic
926	1514	—	1482.9	V, 12.7
	15	2050.6	2059.9	V, 9.1
	16	2146.5	2154.9	V, 9.1
	1540	4140	4140	V, 4.0

]96 m/min

NOGST

Date 1348 @ 1nm 0.55kts

		Mooring Element	Depth (m)	Serial num	Comment	Time o/b	
	1	Billings float, light & flag		T05078	redeploy	13:49	
	2	5m chain					
	3	Recovery line					
	4	15m polyprop					
	5	12 glass spheres			YELLOW	13:50	
	6	50m polyprop					
	7	Sediment trap		12432-04		1357	
	8	RCM current meter	423	~~642~~		1357	
	9	50m polyprop		✓			
	10	Sediment trap	3000	12432-05		14:03	
	11	RCM current meter	642	~~423~~		14:03	0.75 kts
	12	500m polyprop				join 1416 @ deck	.68nm
13m	13	500m polyprop			(14:31 join)	1417 in water	1 hr
5m	14	10 glass spheres			YELLOW	1434.	
5m	15	200m polyprop			1439 join		
5m	16	AR		926		14:45	
	17	Anchor (850kg)				14:59:01	100

~28 min to go

Started around 1428?
no - first noticed @ approach of #13.

1433 - double barrel

1434 funny noises on stopping from an outboard (pay out) direction ~~motion~~.
and take in,
slightly grinding
~ < 1 sec duration

towing from 14:45

1037m @ 14:27

~

14:29 1kt

815m @ 14:34

675m @ 14:38 switch to 0.75 kt

555m @ 14:41

500m @ 14:45

400m @ 14:49

increase to 1kt

300m @ 14:52

200m @ 14:54

100m @ 14:57

DEPLOYMENT

CRUISE D359 **MOORING** **EB1**

Date ~~d359~~ 07/Jan/11 **DOY** 007

Site Arrival Time 08:39

Setup Distar 5 nm

Start

Time	**Lat**	**Lon**	**Depth (u/c)**	**Depth corr**
0915				

End

Time	**Lat**	**Lon**	**Depth (u/c)**	**Depth corr**
13:13:35	23° 45.54	24° 09.36	5047	5093

Release s/n	**Arm**	**Release**
822		
921		

Release	**time**	**range1**	**range2**	**diagnostic**
822	13:17:40	780.8 →		9.5V
	13:18:20	883	3112.1 ×	8.5V
	13:18 50	480.6×	992	V 1.4
921	13:19:40	1115	3863 ×	V 8.4
	13:20:40	1297	981 ×	V 8.4
	13:21:40	1471	1488	V 9.4

} 182 m/min

} 174m/min

EB1

Date

	Mooring Element	Depth (m)	Serial num	Comment	Time o/b
1	Trimsyn recovery float and line			YELLOW	0915
2	3xTrimsyn floats			YELLOW	0916
3	50m of 4mm wire (red)				
4	SBE at top join	50	5240		0916
5	24" syntactic, argos, light	100		RED	0917
6	65m of 4mm wire (red)				
7	SBE at top join	100	5241		0918
8	37' steel sphere, argos light	170		YELLOW	0927
9	325m 5mm wire				
10	SBE at top join	170	5762		0927
11	SBE	250	5763		0931
12	SBE	325	5766		0935
13	SBE	400	5767		0939
14	4 glass + swivel	510		ORANGE	0945
15	290m 3/16" wire (black)				
16	SBE	600	5768		09489
17	4 glass + swivel	805		ORANGE	0958
18	330m 3/16" wire (black)				
19	SBE at top join	800	5770	1m below mark	0958
20	SBE	1000	5771		1004
21	4 glass + swivel	1135		ORANGE	1009
22	400m of 3/16" wire (black)				
23	SBE	1200	5773		1012
24	Sontek POINT DOWN!	1500	D301	pointed down ✓	1024
25	4 glass	1540		ORANGE	1027
26	750m of 3/16" wire (black)				
27	SBE	1600	5774		10:30
28	SBE	2000	4774		10:41
29	4 glass swivel	2300			10:51
30	1000m of 3/16" wire (black)				
31	SBE	2500	5776		10:57
32	SBE	3000	5778		1111
33	4 glass spheres swivel	3300	[redacted]		1121
34	600m 1/4" wire (white)				
35	SBE	3500	[redacted]	5779	1127
36	4 glass spheres	3900			1139
37	590m 1/4" wire (white)				
38	SBE	4000	5780	~	1142
39	4 glass spheres	4500			1158
40	430m 1/4" wire (white)				
41	SBE	4500	5781	~3m below mark	12 00
42	60m 1/4" wire				
43	20+40m, 1/4" wire (white)				
44	SBE	5000	4710		12:23
45	~~Sontek (downward facing~~)	5000	395	point up (above SBE)	12:23
46	8 glass + swivel	5050			12:34
47	AR1		921		12:35
48	AR2		822		"
49	Anchor (1450kg)	~~5090~~			131348

RCM upward

44. NO MARK

41. Reeled back in for inst below join NO MARK

½ kt speed

up to 1 kt

10:00
4.3 nm
to target

(could use better brackets for sontek)

10:32
3.6 nm
to target

up to 1.25 kts
- tension is a bit up so Steve doesn't want faster

3 nm @
10:58

2.3 nm @
11:28

2 nm @
11:41
going ~1.5kts over ground

1.4 nm @
12:09

1 nm @
12:22

1240m @ 12:37

1000m @ 12:42

750 @ 12:48

1500m @
12:31

Speed calc { @ 10:58 ~~Has taken~~ 2nm and 1:45 to do 2500m
2500m to go at same speed (1:45) is ~2 nm. Would be towing for 1nm or ~1 hr.
(conservative.

2500 m @ 50m/min is 0:50

Speed calc @ 11:45 going 1.5 kts for 2nm ~ 1:20. 1000m wire ~ 50m/min ~ 20 min 2.5 hr for top to 4000m

EBI triangulatin

s/n	time	range	range	diag	lat	lon	P/S
822	13:48:00	—	—		23° 43! 32.	024° 11' 11.89	P
Arm [redacted]	13:49:00	2558.5×	—				
[redacted]	13:49:40	—	—				
921 [redacted]	13:50:33	—	—				
Arn [redacted]	13:51:20	—	—				
[redacted]	13:52:10	—	—				
[redacted]	13:53:15	—	—				P
822 [redacted]	13:55:40	3500 ×	2363 ×	V 8.6			S
Ar [redacted]	13:56:05	7172.2?	6201 ?	V 8.4			S
[redacted]	13:56:45	—	—				P
92 [redacted]	13:57:45	—	—				P
A [redacted]	13:58:30	—	—				P
[redacted]	13:59:15	—	8807.2	—			P
Superducer							
822	14:0.5	7293.3	7293.5	V 9.4			
Am [redacted]	14:05:36	7292	7291.2	V 9.4			
921	14:06:25	7289.8	7289.9	V 9.4			
2nd position							
822	14:47:10	1000 ×	235×	− 11.3			P
	1447:35	1846 ×	2665 ×	H 62.9			
	1448:19	7060.1	13811.4×	8.4V			
	14:49:01	7262.	1018.5 ×	8.4V			
921	1449 40	3327.1	2395.3	8.4V			
	14:50.05	3710	2147.9	9.7V			
	14:50:30	3975.3	1888	11.2			
Superducer							
822	14:53:49	—	× 11290.5				
	14:54:35	7307.0	7308.0	V 2.3			
	14:55:10	7313.6	× 1104.4	V 21.5			
	14:55:40	7318.0	× 2084.6	V 16.2			
921	14:56:45	× 3007.4	× 2746.8	V 12.6			
[redacted]	14 56:20	× 6531.8 ×	3337.4×	V 2.5			
	14:57:10	4675.1	1235.3				

EB1 Triangulati 921 Am

s/n	time	range	range	diag	lat	lon	P/S
822	15:42:02	6633.4	3309.6 ×	V 5.8			
Am	~~1542:0~~	88.1 ×	2051×				
	15:43	6409.2	6628.0'	9.4			
	15:43:35	2830 ×	2044.2×	8.5			
	15:44:01	6620.4	6618.8				

DEPLOYMENT

CRUISE	**D359**		**MOORING**	**EB1L7**
Date	6/1/11		**DOY**	006
Site Arrival Time	15:05			
Setup Distance (nm)	1 cables? - mooring fully assembled on back deck			

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
15:05				

mid-assembly
assembling

End

Time	Lat	Lon	Depth (u/c)	Depth corr
15:28:50	23°48.05'	24° 06.90'	5057	5104

Release s/n	Arm	Release	
			Diag
924		1855	1849
319		1455	1449

Release	time	range1	range2	diagnostic
15:35:46 ↔	1838	1145 2.8 ×	—	
	15:36:30	—	—	
	15:37:15	—	1051.6	V -12.7
	15:38:15	—	—	
	15:39:15	5053.8 ×	× 5054.1	V 9.5
	15:40:15	1375.0	× 474.4	V 12.7
	15:40:45	1433.8	1447.2	V 9.5
	15:41:45	1554.0	1567.8	V 9.5
	15:43	1706.7	1718.7	V 9.4
	15:43:30	1768.1	didn't see	V9.4

} Δz = 59 m/30s
} 120 m/min

} 124 m/m

BOTH RELEASES
OK

EB1L7				**Date**	
	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float, light & flag			YELLOW	15:23
2	5m chain				
3	Recovery line				
4	4 glass spheres			ORANGE	15:24
5	15m polyprop				
6	4 glass spheres			YELLOW	15:25
7	15 m of polyprop				
8	BPR1	0054			
9	BPR2	0061			
10	AR1	319			
11	AR2	924			
12	Tripod, anchor (300kg)				

up to 1kt

Drop @ 15:28:50

1. light S01-187
1. VHF U01-023

1 cable setup distance

0. Recovery float - ORANGE 15:23

PIES - Serial No: 136

CRUISE D359 **MOORING** **EBP1**

Date 6/1/11 **DOY** 006

Site Arrival Time : 1612

Setup Distance (nm) : on site

WARNING: no telemtery between 2330 to 0000 GMT

PIES Firmware no:

CLEAR ☐ **TELEM** ☐ **RELEASE** ☐

BEACON ☐ **XPND** ☐

Range (m)

Deployment (year & doy) 15/11/08 Last download to 29/10/09, DOY 302

norecs (now-deploy-3) 64+365+5 -3 = 431

PIES telemetry duration (norecs/34)*15mins 190mins / 3hrs 10mins

1st ping hear at (GMT) 162040 then 3 more @16s intervals

CLEAR cmd: 2-ping reply? (y/n) @162334 yes

TELEM cmd sent at (GMT) 162500

Start telemtery at (GMT) 1746

DS-7000 Gain 6866 6666

Notes (conditions/modifications during transmission)

wd=5093m ; ~~ttw~~ 3.4s (v=1500m/s)

Remote mode ch1

CLEAR @ 1716 Trouble with cables, laptop, deck unit (2 ping)

CMD mode ch1

CLEAR @ 173955 (2 ping) : 174045 TELEM receiving data

Waiting 18:24:11 - no pings.. 18:26:47

Switched back to remote @ 18:27:15 - still no new data, 18:28:16.

} over 4 min, no new data

~~[illegible]~~ Checking distance to EBP1 site .01 nm

183030 sent CLEAR - ~~Renamed~~ Moved data files to new dir → data-till-1830

183215 sent TELEM restarted matlab, changed all gain to 5 except ch2=8

Matlab restarted @ 183430. No spurious MSB.

Data block ends 184523 ; MSB at 184643 ~ sampling 27

Spurious MSB @ ~18:48 ~sampling 30

Expect next data block end @ 19:00:23 } early

MSB @ 18:57:00 - @ sample 51 only ~12 min later - no year day

Expect next data block end @ sample 51+34 = 85 ~ 19:09 - 19:11

1902 spurious MSB 1193030 yd=388

CLEAR cmd required if entire telmetry file not transmitted (y/n)

Routine IES tau sampling resumed at (GMT)

Tau rollovers? (y/n) **Data quality**

Press rollovers? (y/n) **Data quality**

CLEAR 215658 stopped recording

DEPLOYMENT

CRUISE	**D359**		**MOORING**	**EBHi**

Date 8/1/11

DOY 008

Site Arrival Time 1400

Setup Distance (nm) 0·5nm

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
1418	24 56·13	21 16·33	4473	4504

End

Time	Lat	Lon	Depth (u/c)	Depth corr
1438 20	24 56.39	21 16·13	4474	4505

Release s/n	Arm	Release
1198		

DIAG

Release	time	range1	range2	diagnostic
☐	1450 55	/	1443·6	
	51 55	1568·0	1574·6	V 8·7
	52 55	1664·3	1382?	V8·5
	5355	17673	17763	V 8·7
	164700	5223.2	5223·4	V 8·7

] 86
] 101
] 98 m/min

EBHi

Date 8/1/11

	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float with light		u01-028		1418
2	5m chain				
3	Recovery line and float				
4	2 glass spheres with swivel	2500			141410
5	500m of 8mm polyester				
6	SBE at top join	3500	5783		"
7	2 glass				142810
8	400m of 8mm polyester				
9	SBE at top join	4000	5784		142815
10	RCM at bottom join	4400	399		143420
11	100m of 8mm polyester				143600
12	SBE at bottom join	4500	5785		"
13	4 glass + swivel, 1m chain				1437
14	AR	1198		0881 / 0855	"
15	Anchor (500kg)				143820

DEPLOYMENT

CRUISE	D359		**MOORING**	**EBH1**
Date	10 Jan 2011		**DOY** 010	
Site Arrival Time	14:20			
Setup Distance (nm)	4.5 cables			

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
14:20	27°16.47'	15° 25.53'		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
15 02 22	27° 16.89	75° 24.98	3004	3012

Release s/n	Arm	Release
930	☐	☐

Release	time	range1	range2	diagnostic
930	15:08:26	–	794.9	V -12.7
	15:09:00	826.3	836.4	V 9.4
	15:13:33	1315.3	1326.1	V 9.4
	15:17:09	1706.9	1716.5	V 9.4
	15:20:54	2116.5	2126.9	V 9.4
	15:24:30	2496.1	2506.7	V 9.4
	15:27:45	2839.9	2850.6	V9.4
	15:28:30	–	–	
	15:29:20	2981.6	2981.2	V 9.3
	15:30	2981.3	2981.0	V 9.4

EBH1

Date 10/1/11

	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float with light			YELLOW	14:28
2	5m chain				
3	Recovery line and float				
4	4 glass spheres with swivel	2500		ORANGE	14:28
5	250m of 8mm polyester				
6	SBE at top join	3500	5787		14:28
7	2 glass			ORANGE	
8	150m of 8mm polyester				
9	RCM at bottom join	2900	426		
10	100m of 8mm polyester				
11	SBE at bottom join	3000	5786		14:42
12	3 glass + swivel, 1m chain			ORANGE	
13	AR	930			
14	Anchor (500kg)				15:02:25

1864 arm

① W03-099 VHF
W03-096 Light

14:37 600m to target
14:43 2.3c ~420m
14:46 2c
14:58 120m
15:00 100m
15:46 60m

DEPLOYMENT

CRUISE	D359		**MOORING**	**EBH1L7**
Date	10/Jan/11		**DOY**	000
Site Arrival Time	1330			
Setup Distance (nm)	3.5 cables			

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
1330	27 16·43	15 25·35		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
135927	27° 16.61	15° 24.94	3002	3010

Release s/n	Arm	Release
824		1655
281		1455

Release	time	range1	range2	diagnostic
824	14:02:35	3340 ×	416.4	V 9.0 ?
	14:03	452	463.	V 2.6 ×
281	14:03:40	214 ×	541.4	V 2.9 ×
	14:04	567.8	579.9	V 5.6 ×
	14:04:20	606.4	312.4 ×	8.4
	14:04:50	666.2	649.8 ×	V 8.4
	14:05:10	706.1	716.6	V 9.0

Descend @
114 m/min

	EBH1L7			**Date** 10/1/11	
	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float, light & flag			YELLOW	13:31
2	5m chain				
3	Recovery line				
4	4 glass spheres			ORANGE	13:32
5	15m polyprop				
6	4 glass spheres			ORANGE	13:32
7	15 m of polyprop				
8	BPR1	0060			
9	BPR2	0064			
10	AR1	824			
11	AR2	281			
12	Tripod, anchor (300kg)				13:59:18

⓪ Orange recovery float ——— 13:31

① flasher S01-181

① VHF #T01-144

- need next tank
- S.P. to change
downloads
· casts

DEPLOYMENT

CRUISE	D359		**MOORING**	**EBH2**
Date 11 Jan 11			**DOY** 011	
Site Arrival Time				
Setup Distance (nm)				

Start

Time	Lat N	Lon W	Depth (u/c)	Depth corr
0933	27°36·70'	14°12·74'		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
09:47:30	27° 36.88	14° 12.66	2018	2023

Release s/n	Arm	Release
819	☐	1655

Release	time	range1	range2	diagnostic
819	09:50:15	7712.8 ×	10005.0 ×	H 29.9 ×
	09:51:15	514.5	527.7	V 9.0
	09:52	590.7	601.4	V 9.0
	09:53	—	—	
	09:54	785.2	794.4	V 9.0
	09:57	1072.8	1083.3	V 9.0
	09:59	1267.5	1277.7	V 9.0
	10:03	1659.8	1669.7	V 9.0
	10:04	1757.7	1270.8 ×	V 11.7 ×
	10:05	1856.0	1866.7	V 9.0
	10:06	1954.4	1964.0	V 9.0
	10:07	2038.5	2038.5	V 9.0
	10:07:30	2038.6	2038.1	V 8.9

Descending
at 97 m/min

EBH2

Date

	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float with light		T05-079		9:33
2	5m chain				
3	Recovery line and float				9:33
4	2 glass spheres with swivel	1600			9:34
5	200m of 8mm polyester				
6	SBE at top join	1600	4473		9:34
7	2 glass				19:39
8	100m of 8mm polyester				
9	SBE at top join	1800	5775		0939
10	RCM at bottom join	1900	443		0942
11	100m of 8mm polyester				
12	SBE at bottom join	2000	4475		0944
13	3 glass + swivel, 1m chain				09:47:28
14	AR				
15	Anchor (500kg)				

Recovery

DEPLOYMENT

CRUISE	**D359**		**MOORING**	**EBH3**

Date 11 Jan 11 **DOY** 11

Site Arrival Time

Setup Distance (nm) 2.5cables

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
15:03	27° 48.24	13° 44.98		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
15:30:05	27°48.47	13°44.80	1418	1423

Release s/n	Arm	Release
253	☐	1455

Release	time	range1	range2	diagnostic
253	15:33:30	–	547.8	V -12.7
	15:34:00	577.1	589.0	V 9.0
	15:35	694.9	706.7	V 9.1
	15:36	812.7	824.8	V 9.1
	15:37	928.1	939.9	V 9.0
	15:38	1041.8	1052.9	V 9.0
	15:39	1153.3	1164.0	V 9.0
	15:40	1270.5	1278.2	V 9.0
	15:41	1379.2	1390.6	V 9.0
	15:42	1414.6	1413.9	V 9.0
	15:42:30	1414.6	1414.7	V 9.0

} 82 m/min X

} 118 m/min

} 114 m/min

} 111.5 m/min

EBH3

Date 11/1/11

	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float with light		~~A556~~	S01-189 Yellow	1502
2	5m chain				
3	Recovery line and float			Orange	15:02
4	2 mini trymsyn (2000m rated)			Yellow	15:03
5	100m of 8mm polyester				
6	SBE at top join	900	4708		15:03
7	2 mini trymsyn			Yellow	15:05
8	100m of 8mm polyester				
9	SBE at top join	1000	4709		15:05
10	2 mini trymsyn			Yellow	15:07
11	100m of 8mm polyester				
12	SBE at top join	1100	5782		15:07
13	2 mini trymsyn			Yellow	15:09
14	100m of 8mm polyester				
15	SBE at top join	1200	4711		15:09
16	RCM at bottom join pt. up	1300	444		15:11
17	100m of 8mm polyester				
18	SBE at bottom join	1400	4715	}	
19	3 glass + swivel, 1m chain			Orange }	15:30:05
20	AR		253	}	
21	Anchor (500kg)			}	

15:13 waiting for mark

2.5 cables
setup

2 cables - 400m @ 15:10
1.7 cables @ 15:14 ~10m too deep
1 cables @ 15:20
100m @ 15:25
50m @ 15:27
20m @ 15:29

DEPLOYMENT

CRUISE	D359		**MOORING**	**EBH4**

Date 12/1/11 | **DOY** 011

Site Arrival Time 1145

Setup Distance (nm) 0·8

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
1235	27 50·74	13 33·28	1082	1086

End

Time	Lat	Lon	Depth (u/c)	Depth corr
133545	27 50·99	13 32·46	1046	1050

Fish

Release s/n	Arm	Release
923		1855
1197		0855

Release	time	range1	range2	diagnostic
923	1338:40	440,2	453,2	V 9.5
Arm	13:39:00	—	—	
	13.40:00	602.6	—	
1197	13:41:00	—	733	V -12.7
	13:42:00	804.7	814.5	V 8.9
	13:43:00	902.0	911.8	V 8.9
	134630	1083.6	1083.3	V 8.8
	134700	1082.0	1081.7	V 8.8
923	1358	1085·8	1083·8	V 9·4

Fish depth
1044
Hull depth
1053

EBH4

Date 12/1/11

	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float with light		U11-018		1235
2	5m chain				"
3	Recovery line and float				"
4	1 glass sphere	290		orange	1235 30
5	100m 4mm wire				
6	SBE	325	~~4717~~	4719	1239
7	100m 4mm wire				
8	SBE	400	~~4719~~	4717	1245
9	SBE	500	4720		1251
10	2 glass + swivel	500		orange	1251
11	200m 3/16" wire				
12	SBE	600	4721		
13	SBE at bottom join	700	6824		1301
14	2 glass + swivel	700		orange	1301
15	350m of 3/16" wire				
16	SBE	800	6825		1305
17	~~4~~ glass + swivel, 1m chain			5 glass, orange	
18	AR1 ~~[illegible]~~ AR2				
19	Anchor (500kg)				

ARM REL

AR1 s/n 923

AR2 s/n 0147

⚓ 1046m u/c

DEPLOYMENT

CRUISE	D359		MOORING	**EBH4L2**

Date 12 Jan 11 | DOY 012

Site Arrival Time 1630

Setup Distance (nm) 0

Start

Time	Lat	Lon	Depth (u/c)	Depth corr
16:30	27 52.25	13 30.85		

End

Time	Lat	Lon	Depth (u/c)	Depth corr
16:35:15	27° 52.30	13° 30.81	1005	1009

1.5 nm @ 16:13:

Release s/n	Arm	Release
323	☐	1455
687		1655

Release	time	range1	range2	diagnostic
323	16:38:20	–	433.5	V -12.7
	16:39:00	477.5	490.1	V 9.4
	~~16:40:00~~			
	16:39:40	556.0	567.1	V 9.4
	16:40	595.7	607.5	V 9.4
687	16:41:00	712.4	724.2	V 9.5
	16:42:00	832.4	842.6	V 9.5
	16:43:00	950.9	964.9	V 9.4
	16:44:00	1012.5	1012.3	V 9.4
	16:45:	1013.6	1013.7	V 9.4

} 118 m/min

	EBH4L2			Date	
	Mooring Element	**Depth (m)**	**Serial num**	**Comment**	**Time o/b**
1	Billings float, light & flag			YELLOW	16:31
2	5m chain				
3	Recovery line & float			ORANGE	16:31
4	4 glass spheres			ORANGE	16:32
5	15m polyprop				
6	4 glass spheres			ORANGE	16:33
7	15 m of polyprop				
8	BPR1		0004		16:35:17
9	BPR2		0002		
10	AR1		323		
11	AR2		687		
12	Tripod, anchor (300kg)				

1. Light A1556
Argos beacon Y01-010 : Installed facing down,

0.4 cables 16:31

DEPLOYMENT

CRUISE	**D359**		**MOORING**	**EBH5**
Date	12 Jan 2011		**DOY** 012	
Site Arrival Time		14:39		
Setup Distance (nm)		8 cables		

Start

Time	**Lat**	**Lon**	**Depth (u/c)**	**Depth corr**
1439	27 49.99	13 33.45		

End

Time	**Lat**	**Lon**	**Depth (u/c)**	**Depth corr**
154800	27° 50.56	13° 32.66	1056	1060

Release s/n	**Arm**	**Release**
1203	[redacted]	[redacted]
821	[redacted]	[redacted]

Release	**time**	**range1**	**range2**	**diagnostic**
1203	15:54:00	–	848.3	V -12.7x
Arm [redacted]	15:54:30	873.2	864.5	V 8.7
821	15:55:00	928.1	939.4	V 9.6
Arm ~~821~~	15:55:30	979.4	995.4	V 9.5
[redacted]	15:56:00	1039.1	1050.5	V 9.6
	15:56:30	1069.5	1070.1	V 9.5
	15:57:00	1069.5	1069.5	V 9.5

} 111 m/min

EBH5

Date 12/1/11

	Mooring Element	Depth (m)	Serial num	Comment	Time o/b
1	Billings float with light		T05-076	YELLOW	1439
2	5m chain				
3	Recovery line and float			ORANGE	1439
4	40m of 4mm wire				
5	SBE at top join	107	6826		1440
6	2 glass	146		YELLOW	1443
7	295m of 5mm wire				
8	SBE	175	6827		
9	SBE	250	3282		1448
10	2 glass	442		YELLOW	1457
11	290m of 3/16" wire				
12	~~Sontek~~ S4 @ top join	442	35612577		1457
13	2 glass	734		YELLOW	1509
14	310m of 3/16" wire				
15	~~Sontek at top join~~ RCM	734	507	Pointing up	1509
16	~~RCM~~ Sontek	934	D303		1515
17	5 glass + swivel, 1m chain	1045			
18	AR x2		1203 & 821		15:47:55
19	Anchor (500kg)				

8 cab @ 14:39
6.5 cab @ 14:55
5 cab @ 15:09
4 cab @ 15:18

Set up @ 15:24
Speed to 1kt @ 15:24

RCM below glass, beams point out sideways
head is facing up

3 cab @ 15:28
requested 1.25kt

2 cables @ 15:32
1 cab @ 15:37
100 m @ 15:40
waypt @ 15:42

EBH5
TO DEPLOY
D359 2010

BILLINGS FLOAT WITH LIGHT SN
T05-076

RECOVERY LINE

1M CHAIN
SWIVEL

SBE 107m
6826

JOIN

40M 4mm WIRE

2 GLASS 146M

SBE 175m
6827

295M 5mm WIRE

SBE 250m
3282

2 GLASS 442M SWIVEL

Sontek CM 442m
D291
(down)

S4
35612578

JOIN

290M 3/16" WIRE

2 GLASS 734M

Sontek CM 734m
D303 (down)

switch

36-40
temp 8-10

JOIN

310M 3/16" WIRE

RCM 200m
DOWN FROM
LAST JOIN
507 (up)

RCM
was
35-38
temp 7->

5 GLASS SPHERES 1045M
SWIVEL

1M CHAIN

double
release

AR 861 821
SN
ARM
REL

1203
am?

1M 1/2" CHAIN

500 KG ANCHOR

WATER DEPTH
1050M

~1046 m uncor is desired

NMFD/RAPID

DEPLOYMENT

CRUISE	**D359**		**MOORING**	**EBP2**	
Date 13 Jan 2011			**DOY** 013		
Site Arrival Time 1715					
Setup Distance (nm) 0					

Start

Time	**Lat**	**Lon**	**Depth (u/c)**	**Depth corr**
~~1428~~	27° 52.19'	13° 31.72'	1013	1017

142705

End

Time	**Lat**	**Lon**	**Depth (u/c)**	**Depth corr**

~~**Release s/n**~~	**Arm**	~~**Release**~~

Commands
*

	Mooring Element	**Serial num**	**Comment**	**Time o/b**
1	Recovery float		1425	~~1433~~
2	Recovery line		"	
3	PIES	131	"	~~14:35:23~~
4	Frame & anchor		"	

CLEAR
BEACON
TELEM
XPND
RELEASE

ping @ 14:30
sample ping @ 1450

PIES Setup logsheet

Mooring:	EBP2
Serial number:	131
Operator:	efw

Commands	BEACON ☐
XPND	☐
CLEAR	☐
TELEM	☐
RELEASE	☐

Connect data - plug in red turn on

Comment	Action
6.1E	On main IES menu, record the IES version date - Jan 1 2010 11:32:26

Start a log file

name

	A-1. Self-Test Menu>Engineering Data (J)
3.03	Clock Battery expect >3.0Vdc
0.90	Release Battery Drain <1.3 mA
43.46	System Battery Drain <50mA
14.9	Acoustic Driver: any value from 0-17 Vdc
14.52	Release Battery >14.3 Vdc
7.15	System Battery >6.8 Vdc
24.98	Internal Temperature = ambient Temperature
	*2. Self-Test Menu> Travel time test (**B**)*
✗	Use the 12.0 kHz echo box and speaker to simulate echo
	*3. Pressure & Temperature test (enter **D**)*
25.2	Temperature Internal (deg C)
24.401	Temperature Paros - pressure sensor (deg C)
15.161	Pressure psia
3999989.	Frequency Hz
	*4. Output power test (**G**)* 180 db.
Target 2.7	Record power level before deployment
before ping 2.32	*5a. Release relay test (**K**) with acoustic transducer pointing down*
after 2.19V ✗	Radio and flasher ON for 30 seconds? (flasher on only when dark)
✗	*5b. Release relay test (**K**) with acoustic transducer pointing up*
prev done ✗	Radio and flasher OFF?

Q to main

	B-1. Memory Card Menu (B)
	Erase all files (**E**)

15,880,192 bytes free

	C-1. Mission Setup Menu.
✓	1. Set the clock (**A**)
✓	2. Set the travel time measurement schedule (**B**): 4 pings every 10 minutes (6)

30 K in Water

17P

4D

5D

P setup menu J > A

d = 1000
lockout, 21 sec
out pw - 172 dB

	3. Set the pressure and temperature measurement schedule (A): every 10 minutes (6)
	4. Set the depth, lockout and output power level (**D**, check with Science party) watts
2016 / 1 / 11 12:00	5. Set auto-release time (**E**): for 5 years in the future
Y	6. Enable the acoustic telemetry data file (**F**)
✓	7. Enable the pressure sensor raw data file? (**J**) > C
✓	8. Enter mission statement (**K**)
✓	9. Review, save and start the mission (**G**) GO

prev done

	D. Test the ACS system using the Benthos deck unit and transducer. Set the deck unit to transmit at 12.5 kHz and receive at 12.0 kHz.
	1. Send XPND command. Received 2 ping reply?
	2. Send CLEAR command. Received 2 ping reply?
	3. Send TELEM command. Received 2 ping reply?
	4. Send CLEAR command. Received 2 ping reply?

	E. Final preparations before launch
✓	1. RESET the IES by removing and re-installing the red ON/OFF switch
ping / dbl ping	2. Listen for the double "ping" that signifies that the IES is ready to be launched
✓	3. Secure the locking rings on the red & yellow cable ends, and push them inside the hard hat
	4. During the remaining time prior to launch, listen/confirm the proper timing of the travel time measurements (every 10 minutes)

disconnect
data cable
put in ends &
locking

PIES Deployment Logsheet

Cruise:	d359
Mooring:	EBP2
PIES Serial number:	131
Operator:	efw
Laptop:	Darwins

- Connect computer
- Speakers
- Transducer over side
- Echo sounder off

Acoustic Tracking Operations (8.1.3 in the manual)

Set up Benthos deck unit in RANGING mode with 12.5kHz as the output frequency and 12.0kHz as the receive frequency. The interrogation pulse should be >20 milliseconds long. Send the XPND command.

- Send CMD
- SWITCH RANGING
- 6sec?
- REP

START
STOP

Time	Command (XPND)	Range	Comment
14:43:55	XPND	1 ping	1.1688 sec
			1.1973
			1.205
			1.21
			1.22
			1.23
			0.8271
		Every 6 sec	1.3284
			1.3645
			1.3910
			1.3858
			1.3945
			1.3912

Stop the XPND command by sending CLEAR.

Time	Command (CLEAR)	Response (2 ping)	Comment
14:46:55	CLEAR (76)	Lots of pings	
14:47:30			

14:49:43

2 pings ~ 2 sec apart

Burst Telemetry Checklist (10.8 in the manual)

In CMD
LISTEN

send TELEM

Deploy the transducer. Switch the Benthos deck unit to REMOTE mode. Send the TELEM command and verify that the IES responds with a two ping response.

IN REMOTE

Completed/Comment?	Action
	Send the TELEM command

15:02:11
15:01:29
15:01:07
15:00:43 no response

15:06:24 11

If doesn't work also reduce gain

didn't work { 14:53:46 11 ping

14:53:20 1 ping	Received the 2 ping response (repeat until response heard)
✓	Delete the burst.dat file if it exists in the telemetry\data directory
b ✗	Start Matlab and run the command PburstPDT.m to initialize the Benthos deck unit channels and initialize the computer to receive the data. PPDTb_v3.m
~~✓~~	~~When complete the matlab window will display "Waiting for marker (10.0 kHz)~~
~~✓~~	~~Observe the Matlab window. It should step through the detection of four different receiver frequencies~~ (10.0, 11.5, 12.0 12.5, 10.5 and 13.0 kHz, then loop, again waiting).
✓	When complete the matlab window will display "Waiting for marker (10.0 kHz)
	Observe the Matlab window. It should step through the detection of four different receiver frequencies (10.0, 11.5, 12.0 12.5, 10.5 and 13.0 kHz, then loop, again waiting).
	Data are saved in burst.dat?
	← Depth received
	Send CLEAR command
	Received the 2 ping response (repeat until response heard)
	Change the name of the burst.dat file to include the PIES serial number
	←moved to directory
15:50	Got Tau 8.2083
16:01	CLEAR

Update paths!

Settings: Power is 3. Gain is 4

Sample heard @ 15:10 - waiting in Matlab

For shallower water, reduce gain
See 11~~.2~~.1.2 in manual!

Note - ~~with batteries in~~ changing gain only affects AC power. Batteries must be disconnected - 11.2

Goto setup. Press MISC

13:39 · 66 - 3 pings

Appendix G: Mooring Recovery Table

Mooring Name	Sequential Mooring number	UKORS Mooring Number	Deployment Cruise	Lat	Lon	Deployment Date	Recovery Date
EBM6	4	2009/23	D344	27° 55.27'	13° 19.99'	24/10/09	LOST
EBM5	3	2009/24	D344	27° 54.67'	13° 21.65'	24/10/09	13/1/11
EBM4	4	2009/25	D344	27° 54.49'	13° 22.09'	24/10/09	LOST
EBM1	4	2009/26	D344	27° 53.67'	13° 24.36'	24/10/09	LOST
EBH4	7	2009/29	D344	27° 50.50'	13° 32.75'	24/10/09	12/1/11
EBH5	5	2009/27	D344	27° 51.01'	13° 32.38'	24/10/05	12/1/11
EBH3	6	2009/30	D344	27° 48.47'	13° 44.80'	25/10/09	11/1/11
EBH2	6	2009/31	D344	27° 36.71'	14° 12.73'	25/10/09	11/1/11
EBH1	6	2009/32	D344	27° 17.13'	15° 25.73'	26/10/09	LOST
EBH1L5	5	2008/34	D334	27° 17.15'	15° 25.69'	18/11/08	10/1/11
EBHi	6	2009/34	D344	24° 56.81'	21° 15.78'	28/10/09	8/1/11
EB1L5	5	2008/24	D334	23° 48.13'	24° 06.82'	31/10/08	6/1/11
EB1	8	2009/35	D344	23° 45.34'	24° 09.25'	30/10/09	6/1/11
MAR3L4	4	2008/25	D334	23° 51.57'	41° 06.00'	04/11/08	29/12/10
MAR3	6	2009/37	D344	23° 52.24'	41° 05.29'	04/11/09	LOST
NOGST		2009/39	D344	23° 46.29'	41° 05.90'	04/11/09	1/1/11
MAR1	6	2009/40	D344	24° 10.14'	49° 43.00'	07/11/09	24/12/10
MAR1L4	4	2008/30	D334	24° 12.23'	49° 43.70'	10/11/08	25/12/10
MAR2	5	2009/42	D344	24° 10.98'	49° 44.58'	07/11/09	25/12/10

Appendix H: Mooring deployment table with acoustic release serial numbers

			Anchor drop		Anchor seabed		Best position in Decimal degrees		Corr depth at ancho r launch (m)						
Moor	Moor Number	Deploy Cruise	Lat °N	Lon °W	Lat °N	Lon °W	Lat °N	Lon °W		date	Time GMT	Argos	Argos	Acoustic Releases s/n	
EBH4L2	201110	D359	27° 52.30'	13° 30.81'			27.8716	13.5135	1009	12/01/11	16:35	46492		323	687
EBH4L1 (EBL5)	200927	D344	27° 52.09'	13° 30.87'			27.8682	13.5145	1009	25/10/09	09:11			917	
EBP2		D359	27° 52.19'	13° 31.12'			27.8699	13.5186	1017	13/01/11	14:27				
EBH4	201108	D359	27° 50.99'	13° 32.46'			27.8498	13.5411	1050	12/01/11	13:35			923	1197
EBH5	201109	D359	27° 50.56'	13° 32.66'			27.8427	13.5443	1060	12/01/11	15:48			1203	821
EBH3	201107	D359	27° 48.47'	13° 44.80'			27.8078	13.7467	1423	11/01/11	15:30			253	
EBH2	201112	D359	27° 36.88'	14° 12.66'			27.6147	14.2110	2023	11/01/11	09:47			819	
EBH1L7	201105	D359	27° 16.61'	15° 24.94'			27.2768	15.4157	3010	10/01/11	13:59			824	281
EBH1	201106	D359	27° 16.89'	15° 24.98'			27.2815	15.4163	3012	10/01/11	15:02			930	
EBH1L6 (EBL4)	200933	D344	27° 17.17'	15° 25.76'			27.2862	15.4293	3009	26/10/09	10:54			322	
EBHi	201104	D359	24° 56.39'	21° 16.13'			24.9398	21.2688	4505	08/01/11	14:38			1198	
EBP1	2008/32	D334	23° 49.38'	24° 05.99'			23.8230	24.0998	5093	15/11/08	19:57				
EB1L6 (EBL3)	2009/36	D344	23° 48.77'	24° 06.41'			23.8128	24.1068	5096	29/10/09	20:21			316	262
EB1L7	201102	D359	23° 48.05'	24° 06.69'			23.8008	24.1115	5104	06/01/11	15:28			924	319
EB1	201113	D359	23° 45.54'	24° 09.36'	23° 45.41'	24° 09.39'	23.7569	24.1565	5093	07/01/11	13:13	82952	60211	822	921
MAR3L5 (MARL2)	200938	D344	23° 51.95'	41° 05.56'			23.8658	41.0927	5060	03/11/09	15:58			826	928
MAR3L6	201027	D359	23° 51.76'	41° 05.76'			23.8627	41.0960	5045	31/12/10	11:33			497	1195
MAR3	201032	D359	23° 51.41'	41° 05.85'			23.8569	41.0976	5049	31/12/10	17:46			1202	922
NOGST	201101	D359	23° 46.29'	41° 05.90'			23.7715	41.0984	4265	01/01/11	14:59			926	
MAR1	201028	D359	24° 10.11'	49° 43.17'	24° 09.82'	49° 43.16'	24.1636	49.7194	5204	26/12/10	22:06	46493	11443	1199	1194
MAR1L6	201027	D359	24° 12.23'	49° 43.68'			24.2038	49.7279	5222	25/12/10	20:06	93794		163	1196

MAR1L5 (MARL1)	2009/41	D344	24° 12.02'	49° 44.26'			24.2003	49.7377	5227	06/11/09	21:13			370	216
MAR2	201030	D359	24° 11.69'	49° 44.99'	24° 11.82'	49° 45.16'	24.1970	49.7526	5214	28/12/10	15:27			920	
MAR0	201029	D359	25° 06.45'	52° 00.65'			25.1060	52.0108	5512	27/12/10	16:21			1201	318

Appendix I: Instruments and hardware lost

Mooring	**Item**	**s/n**	**Fate**
EBH1	9 off Glass sphere		lost
EBH1	1 off Billings float		lost
EBH1	Ixsea acoustic release	260	lost
EBH1	SBE37	3272, 3274	lost
EBH1	Novatech light	S01-184	lost
MAR3	17 off Glass sphere		lost
MAR3	1 off Billings float		lost
MAR3	S4 Current meter	35612573	lost
MAR3	SBE37	6334, 6330, 6329, 5488, 5487, 6328	lost
MAR3	Novatech light	W03-090	lost
MAR3	Ixsea acoustic release	243	lost
EB1	SBE37	3892	flooded
MAR1	SBE37	4179	flooded
EBL1	SBE26	388	flooded
EBM1, M4, M6	6 off 12" Glass sphere		lost
EBM1, M4, M6	3 off VHF Beacon	W03-101, W03-102, W03-103	lost
EBM1, M4, M6	LRT acoustic release	245798-004, 245798-002, 252343-004	lost
EBM1, M4, M6	SBE37	3482, 3480, 3217	lost
EBM1, M4, M6	3 off Trimsyn buoyancy		lost

Appendix J: RAPID mooring and hydrographic cruises, dates and cruise reports.

Cruise	Vessel	Date	Objectives	Cruise Report
D277	RRS *Discovery*	Feb - Mar 2004	Initial Deployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Discovery* Cruise D277 and D278. Southampton Oceanography Centre Cruise Report, No 53, 2005
D278	RRS *Discovery*	Mar 2004	Initial Deployment of UK and US Western Boundary Moorings	RRS *Discovery* Cruise D277 and D278. Southampton Oceanography Centre Cruise Report, No 53, 2005
D279	RRS *Discovery*	4 Apr – 10 May	Transatlantic hydrography (125 CTD stations)	RRS *Discovery* Cruise D279, Southampton Oceanography Centre, Cruise Report, No 54, 2005
P319	RV *Poseidon*	9th – 17th Dec 2004	Emergency deployment of replacement EB2 following loss	Appendix in RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
CD170	RRS *Charles Darwin*	Apr 2005	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
KN182-2	RV *Knorr*	May 2005	Service and redeployment of UK and US Western Boundary Moorings and Western Boundary Time Series (WBTS) hydrography section	RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
CD177	RRS *Charles Darwin*	Nov 2005	Service and redeployment of key Eastern Boundary moorings	RRS *Charles Darwin* Cruise CD177. National Oceanography Centre Southampton Cruise Report, No. 5, 2006
WS05018	RV *F.G. Walton Smith*	Nov 2005	Emergency recovery of drifting WB1 mooring	No report published
RB0602	RV *Ronald H. Brown*	Mar 2006	Service and redeployment of UK Western Boundary moorings and WBTS hydrography section	RV *Ronald H. Brown* Cruise RB0602 and RRS *Discovery* Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007
D304	RRS *Discovery*	May - Jun 2006	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RV *Ronald H. Brown* Cruise RB0602 and RRS *Discovery* Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007
P343	RV *Poseidon*	4th – 17th Oct 2006	Service and redeployment of key Eastern Boundary moorings	RS *Poseidon* Cruises P343 and P345. National Oceanography Centre Southampton Cruise Report No. 28, 2008.
P345	RV *Poseidon*	28th Nov – 7th Dec 2006	Emergency redeployment of EB1 and EB2 following problems on P343	RS *Poseidon* Cruises P343 and P345. National Oceanography Centre Southampton Cruise Report No. 28, 2008.
SJ06	RV *Seward Johnson*	Sep – Oct 2006	Recovery and redeployment of WB2 and US Western Boundary moorings, and WBTS hydrography section	Appendix G in RV *Ronald H. Brown* Cruise RB0701. National Oceanography Centre, Southampton Cruise Report, No 29
RB0701	RV *Ronald H. Brown*	Mar - Apr 2007	Service and redeployment of UK Western Boundary moorings and WBTS hydrography section	RV *Ronald H. Brown* Cruise RB0701. National Oceanography Centre, Southampton Cruise Report, No 29
D324	RRS *Discovery*	Oct – Nov 2007	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Discovery* Cruise D324, National Oceanography Centre, Southampton Cruise Report, No 34
SJ0803	RV *Seward Johnson*	April 2008	Service and redeployment of the Western Boundary moorings	RV *Seward Johnson* Cruise SJ0803, National Oceanography Centre, Southampton Cruise Report, No 37
D334	RRS *Discovery*	Oct-Nov 2008	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Discovery* D334, National Oceanography Centre, Southampton, Cruise Report No. 38, 2009
RB0901	RV *Ronald H. Brown*	April – May 2009	Service and redeployment of the UK and US Western Boundary moorings and the WBTS hydrography section	RV *Ronald H. Brown* Cruise RB0901, National Oceanography Centre, Southampton Cruise Report, No 39, 2009
D344	RRS *Discovery*	Oct – Nov 2009	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Discovery* D344, National Oceanography Centre, Southampton, Cruise Report No. 51, 2010
D345	RRS *Discovery*	21 Nov – 6 Dec 2009	Recovery and redeployment of US Western Boundary moorings, and WBTS hydrography section	RAPID/MOCHA Program Report (W. Johns, RSMAS).
D346	RRS *Discovery*	5 Jan – 19 Feb 2010	Transatlantic hydrography (135 CTD stations)	*Not published yet*
OC459	RV *Oceanus*	Mar – Apr	Service and redeployment of the	RV *Oceanus* Cruise OC459-1, National

		2010	Western Boundary moorings	Oceanography Centre Cruise Report, No 01, 2010
RB1009	RV *Ronald H. Brown*	28 Nov – 1 Dec 2010	Recovery of WB4 and WB3L3. Redeployment of WB4.	Appendix in: RV *Oceanus* Cruise OC459-1, National Oceanography Centre Cruise Report, No -01, 2010
D359	RRS *Discovery*	17 Dec 2010– 15 Jan 2011	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	*This report*
KN200-4	RV *Knorr*	13 Apr – 4 May 2011	Service and redeployment of Western Boundary Moorings and WBTS hydrography section	*RV Knorr* Cruise KN200-4, National Oceanography Centre Cruise Report, No – 07, 2011

Appendix K: Command and Configuration files for the OS75 VMADCP

i) ADCP Command file
Bottom track version (for water track set BP to 0)

```
;-----------------------------------------------------------------
--------------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    High resolution (broadband) and long range
profile (narrowband)
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g.
courier).
; Modified Last: 1 August 2010
;-----------------------------------------------------------------
-------------/
; Restore factory default settings in the ADCP
cr1
; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other
commands in
; this file, so that it is not made permanent by a CK command.
cb611
CF11110
; Set for narrowband single-ping profile mode (NP), fifty (NN)
16 meter bins (NS),
; 8 meter blanking distance (NF)
NN065
NP00001
NS1600
NF800
; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1500 meters (BX)
BP001
BA030
BC170
BE1000
BX15000
; output velocity, correlation, echo intensity, percent good
WD111100000
; One and a half seconds between bottom and water pings
TP000150
```

```
; Two seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas
Communication options
TE00000200
; Set to 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
EZ10211010
; Output beam data (rotations are done in software)
EX00000
; Set transducer misalignment (hundredths of degrees)
EA00000
; Set transducer depth (decimeters)
ED00053
; Set Salinity (ppt)
ES36
EV0
EI0
EJ0
; Disable Fish rejection
WA255
; low correlation threshold
WC120
; save this setup to non-volatile memory in the ADCP
CK
```

ii) VmDas Configuration file

Bottom track version (for water track change D359_075_bt.txt to D359_075_wt.txt)

```
[Version Info]
VmDasVersion=Version 1.46
Option Table Version=1
[Expert only options]
SaveOnlyChangedOptions=TRUE
TurnedOffBeam=0
PashrImuFlagUseNormalInterpretation=TRUE
[ADCP Port Setup]
AdcpComPortName=COM1
AdcpComBaudRate=9600
AdcpComParity=NOPARITY
AdcpComStopBits=1
AdcpComDataBits=8
AdcpConfigFilename=C:\RDI\ADCP\D359_OS75\D359_075_bt.txt
ADCPSoftBreak=FALSE
TimeoutNoRespCmd=1000
TimeoutHaveCharCmd=100
TimeoutNoRespSlowCmd=10000
TimeoutHaveCharSlowCmd=10000
```

```
TimeoutNoRespBreak=3000
TimeoutHaveCharBreak=2000
TimeoutNoEns=0
[NMEA Port Setup]
NmeaNavComEnable=TRUE
NmeaNavComPortName=COM2
NmeaNavComBaudRate=4800
NmeaNavComParity=NOPARITY
NmeaNavComStopBits=1
NmeaNavComDataBits=8
NmeaRPHComEnable=TRUE
NmeaRPHComPortName=COM3
NmeaRPHComBaudRate=19200
NmeaRPHComParity=NOPARITY
NmeaRPHComStopBits=1
NmeaRPHComDataBits=8
Nmea3ComEnable=FALSE
Nmea3ComPortName=None
Nmea3ComBaudRate=4800
Nmea3ComParity=NOPARITY
Nmea3ComStopBits=1
Nmea3ComDataBits=8
Nmea Nav Ethernet Enable=FALSE
Nmea Nav IP Addy=0.0.0.0
Nmea Nav Ethernet Port=5678
Nmea Nav Ethernet Connection Type TCP-UDP=1
Nmea Nav Ethernet Service Type Server-Client=1
Nmea Nav Ethernet Broadcast flag=FALSE
Nmea RPH Ethernet Enable=FALSE
Nmea RPH IP Addy=0.0.0.0
Nmea RPH Ethernet Port=5679
Nmea RPH Ethernet Connection Type TCP-UDP=1
Nmea RPH Ethernet Service Type Server-Client=1
Nmea RPH Ethernet Broadcast flag=FALSE
Nmea3 Ethernet Enable=FALSE
Nmea3 IP Addy=0.0.0.0
Nmea3 Ethernet Port=5680
Nmea3 Ethernet Connection Type TCP-UDP=1
Nmea3 Ethernet Service Type Server-Client=1
Nmea3 Ethernet Broadcast flag=FALSE
[NMEA Comm window]
NoDataTimeout(ms)=5000
AutoOpen=TRUE
NumNmeaDisplayedOnErrRecovery=10
[Serial Port for Binary Ensemble Data Output]
BinaryEnsembleOutputComEnable=FALSE
BinaryEnsembleOutputComPortName=None
BinaryEnsembleOutputComBaudRate=9600
BinaryEnsembleOutputComParity=NOPARITY
BinaryEnsembleOutputComStopBits=1
BinaryEnsembleOutputComDataBits=8
BinaryEnsembleOutputDataType(0:none;1:enr;2:enx;3:sta;4:lta)=0
```

```
BinaryEnsembleOutputRefVelType(0:none;1:Bottom;2:Mean)=0
BinaryEnsembleOutputStartBin=1
BinaryEnsembleOutputEndBin=4
BinaryEnsembleOutputMeanStartBin=1
BinaryEnsembleOutputMeanEndBin=4
BinaryEnsembleOutputLeader(0:no;1:yes)=FALSE
BinaryEnsembleOutputBottomTrack(0:no;1:yes)=FALSE
BinaryEnsembleOutputNavigation(0:no;1:yes)=TRUE
BinaryEnsembleOutputVelocity(0:no;1:yes)=TRUE
BinaryEnsembleOutputIntensity(0:no;1:yes)=TRUE
BinaryEnsembleOutputCorrelation(0:no;1:yes)=TRUE
BinaryEnsembleOutputPercentGood(0:no;1:yes)=TRUE
BinaryEnsembleOutputStatus(0:no;1:yes)=TRUE
BinaryEnsembleOutputNetEnable=FALSE
BinaryEnsembleOutputIPPortNumber=5433
=0.0.0.0
BinaryEnsembleOutputConType=1
BinaryEnsembleOutputSvcType=1
BinaryEnsembleOutputBcast=FALSE
[Serial Port for ASCII Ensemble Data Output]
AsciiEnsembleOutputComEnable=FALSE
AsciiEnsembleOutputComPortName=None
AsciiEnsembleOutputComBaudRate=9600
AsciiEnsembleOutputComParity=NOPARITY
AsciiEnsembleOutputComStopBits=1
AsciiEnsembleOutputComDataBits=8
AsciiEnsembleOutputDataType(0:none;1:enr;2:enx;3:sta;4:lta)=0
AsciiEnsembleOutputRefVelType(0:none;1:Bottom;2:Mean)=0
AsciiEnsembleOutputStartBin=1
AsciiEnsembleOutputEndBin=4
AsciiEnsembleOutputStoreToDisk(0:no;1:yes)=FALSE
AsciiEnsembleOutMeanStartBin=1
AsciiEnsembleOutputMeanEndBin=4
AsciiEnsembleOutputLeader(0:no;1:yes)=TRUE
AsciiEnsembleOutputBottomTrack(0:no;1:yes)=TRUE
AsciiEnsembleOutputNavigation(0:no;1:yes)=TRUE
AsciiEnsembleOutputVelocity(0:no;1:yes)=TRUE
AsciiEnsembleOutputIntensity(0:no;1:yes)=TRUE
AsciiEnsembleOutputCorrelation(0:no,1:yes)=TRUE
AsciiEnsembleOutputPercentGood(0:no;1:yes)=TRUE
AsciiEnsembleOutputStatus(0:no;1:yes)=TRUE
BinaryEnsembleOutput Ascii NetEnable=FALSE
BinaryEnsembleOutput Ascii IPPortNumber=5433
BinaryEnsOutAscii IP=0.0.0.0
BinaryEnsembleOutput Ascii ConType=1
BinaryEnsembleOutputAscii SvcType=1
BinaryEnsembleOutputAscii Bcast=FALSE
[Serial Port for Speed Log Output]
SpeedLogComEnable=FALSE
Speed Log ComPortName=None
Speed Log ComBaudRate=9600
Speed Log ComParity=NOPARITY
```

```
Speed Log ComStopBits=1
Speed Log ComDataBits=8
SpeedLogDataSource=STA
SpeedLogWLSource=WP
SpeedLogWLStartBin=3
SpeedLogWLEndBin=5
BinarySpeedLog NetEnable=FALSE
BinarySpeedLog IPPortNumber=5434
BinarySpeedLog Ip Addy=0.0.0.0
BinarySpeedLog ConType=1
BinarySpeedLog SvcType=1
BinarySpeedLog Bcast=FALSE
[Fake Data Options]
AdcpSimInAirEnable=FALSE
AdcpFakeDataEnable=FALSE
AdcpFakeDataFilename=SimAdcp.enr
FakeDataTimeBetweenEnsembles=2
NMEAFakeDataEnable=FALSE
NMEAFakeDataFilename=SimNav.nmr
[File Name Components]
EnableDualRecordDir=FALSE
FileRecordPath=C:\RDI\ADCP\D359_OS75\
FileRecordBackupPath=C:\RDI\ADCP\
DeploymentName=D359_OS75
DeploymentNumber=3
MaximumFileSize=50
[Bottom Track Data Screening Options]
BTAmpScreenEnable=FALSE
BTCorScreenEnable=FALSE
BTErrScreenEnable=FALSE
BTVertScreenEnable=FALSE
BTFishScreenEnable=FALSE
BTPctGoodScreenEnable=FALSE
BTAmplitudeThreshold=30
BTCorrelationThreshold=220
BTErrorVelThreshold=1000
BTVerticalVelThreshold=1000
BTFishThreshold=50
BTPctGoodThreshold=50
[Water Track Data Screening Options]
WTAmpScreenEnable=FALSE
WTCorScreenEnable=FALSE
WTErrScreenEnable=FALSE
WTVertScreenEnable=FALSE
WTFishScreenEnable=FALSE
WTPctGoodScreenEnable=FALSE
WTAmplitudeThreshold=30
WTCorrelationThreshold=180
WTErrorVelThreshold=1000
WTVerticalVelThreshold=1000
WTFishThreshold=50
WTPctGoodThreshold=50
```

```
[Profile Data Screening Options]
PRAmpScreenEnable=FALSE
PRCorScreenEnable=FALSE
PRErrScreenEnable=FALSE
PRVertScreenEnable=FALSE
PRFishScreenEnable=FALSE
PRPctGoodScreenEnable=FALSE
PRMarkBadBelowBottom=FALSE
PRAmplitudeThreshold=30
PRCorrelationThreshold=180
PRErrorVelThreshold=1000
PRVerticalVelThreshold=1000
PRFishThreshold=50
PRPctGoodThreshold=50
[2nd Band Profile Data Screening Options]
PRAmpScreenEnable=FALSE
PRCorScreenEnable=FALSE
PRErrScreenEnable=FALSE
PRVertScreenEnable=FALSE
PRFishScreenEnable=FALSE
PRPctGoodScreenEnable=FALSE
PRAmplitudeThreshold=30
PRCorrelationThreshold=180
PRErrorVelThreshold=1000
PRVerticalVelThreshold=1000
PRFishThreshold=50
PRPctGoodThreshold=50
[Transformation Options]
XformToEarth=TRUE
Allow3Beam=TRUE
BinMap=TRUE
BeamAngleSrc(0:auto,1:man)=0
ManualBeamAngle=30
HeadingSource(0:adcp,1:navHDT,2:navHDG,3:navPRDID,4:manual)=1
NMEAPortForHeadingSource=1
ManualHeading=0
TiltSource(0:adcp,1:nav,2:man)=2
NMEAPortForTiltSource=-1
ManualPitch=0
ManualRoll=0
SensorConfigSrc(0:PRfixed,1:Pfixed,2:auto)=2
ConcavitySource(0:convex,1:concave,2:auto)=2
UpDownSource(0:dn,1:up,2:auto)=2
EnableHeadingCorrections=FALSE
SinCorrectionAmplitudeCoefficient=0
SinCorrectionPhaseCoefficient=0
MagneticOffsetEV=0
BackupMagneticOffsetEV=0
AlignmentOffsetEA=0
EnableVelocityScaling=FALSE
VelocityScaleFactorForBTVelocities(unitless)=1
VelocityScaleFactorForProfileAndWTVelocities(unitless)=1
```

```
EnableTiltAlignmentErrorCorrection=TRUE
TiltAlignmentHeadingCorr(deg)=0
EAOptionSource=TRUE
TiltAlignmentPitchCorr(deg)=0
TiltAlignmentRollCorr(deg)=0
[2nd Band Transformation Options]
EnableVelocityScaling=FALSE
VelocityScaleFactorForProfileVelocities(unitless)=1
[Backup HPR NMEA Source Options]
EnableBackupHeadingSource=FALSE
BackupHeadingSource(0:adcp,1:navHDT,2:navHDG,3:navPRDID,4:manual
,5:PASHR,6:PASHR,ATT,7:PASHR,AT2)=3
NMEAPortForBackupHeadingSource=2
BackupManualHeading=0
EnableBackupTiltSource=FALSE
BackupTiltSource(0:adcp,1:nav,2:man,3:PASHR,4:PASHR,ATT,5:PASHR,
AT2)=0
NMEAPortForBackupTiltSource=-1
BackupManualPitch=0
BackupManualRoll=0
[Ship Pos Vel NMEA Source Options]
EnableGGASource=TRUE
NmeaPortForGGASource=1
EnableGGABackupSource=FALSE
NmeaPortForGGABackupSource=-1
EnableVTGSource=FALSE
NmeaPortForVTGSource=1
EnableTVGBackupSource=FALSE
NmeaPortForVTGBackupSource=-1
[Averaging Options]
AvgMethod(0:time,1:dist)=0
FirstAvgTime=120
SecondAvgTime=600
FirstAvgDistance=500
SecondAvgDistance=5000
EnableRefLayerAvg=FALSE
RefLayerStartBin=3
RefLayerEndBin=10
[Reference Velocity Options]
RefVelSelect(0:none,1:BT,2:WT,3:LYR,4:NDP,5:NAP,6:NSPD)=6
VelRefLayerStartBin=3
VelRefLayerEndBin=5
RefVelUnitVel(0:mm/s,1:m/s,2:knots,3:ft/s)=1
RefVelUnitDepth(0:m,1:cm,2:ft)=0
[User Exit Options]
UserWinAdcpEnable=TRUE
UserWinAdcpPath=C:\Program Files\RD
Instruments\WinAdcp\WinAdcp.exe
UserWinAdcpUpdateInterval(sec)=10
UserWinAdcpFileType(0:enr,1:enx,2:sta,3:lta)=3
UserAdcpScreening=FALSE
UserNavScreening=FALSE
```

```
UserTransform=FALSE
[Shiptrack Options]
ShipTrack1Source(0:Nav;1:BT;2:WT;3:Layer)=0
ShipTrack2Source(0:Nav;1:BT;2:WT;3:Layer)=1
ShipTrack1RedStickEnable=FALSE
ShipTrack1GreenStickEnable=FALSE
ShipTrack1BlueStickEnable=FALSE
ShipTrack2RedStickEnable=FALSE
ShipTrack2GreenStickEnable=FALSE
ShipTrack2BlueStickEnable=FALSE
ShipTrack1RedBin=1
ShipTrack1GreenBin=2
ShipTrack1BlueBin=3
ShipTrack2RedBin=1
ShipTrack2GreenBin=2
ShipTrack2BlueBin=3
ShipTrack1DisplaySelect(0:Lat/Lon;1:Distance)=0
ShipTrack2DisplaySelect(0:Lat/Lon;1:Distance)=0
ShipTrack1WaterLayerStartBin=3
ShipTrack1WaterLayerEndBin=5
ShipTrack2WaterLayerStartBin=3
ShipTrack2WaterLayerEndBin=5
ShipTrackDistanceUnit=0
[Narrow Band Shiptrack Options]
RadioBtnSelForShipPosition1DataType=0
RadioBtnSelForShipPosition2DataType=0
ShipTrack1RedStickEnable=FALSE
ShipTrack1GreenStickEnable=FALSE
ShipTrack1BlueStickEnable=FALSE
ShipTrack2RedStickEnable=FALSE
ShipTrack2GreenStickEnable=FALSE
ShipTrack2BlueStickEnable=FALSE
ShipTrack1RedBin=1
ShipTrack1GreenBin=2
ShipTrack1BlueBin=3
ShipTrack2RedBin=1
ShipTrack2GreenBin=2
ShipTrack2BlueBin=3
[ADCP Setup Options]
SetProfileParameters=TRUE
NumberOfBins=65
BinSize(meters)=16
BlankDistance(meters)=8
TransducerDepth(meters)=5.3
SetBTEnable(0:SendBPCmd,1:Don'tSendBPCmd)=TRUE
ADCPSetupMethod(0:Options,1:CommandFile)=1
BtmTrkEnable(0:SendBP0,1:SendBP1)=1
MaxRange(meters)=1200
SetHdgSensorType=FALSE
HdgSensorType(0:internal,1:external)=-1
SetTiltSensorType=FALSE
TiltSensorType(0:internal,1:external)=-1
```

```
SetProcessingMode=TRUE
BandwidthType(0:Wide,1:Narrow)=1
ADCPTimeBetweenEnsemblesSel=0
ADCPTimeBetweenEnsembles=0
```