National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

# National Oceanography Centre

## Cruise Report No. 14

## RRS *James Cook* Cruise JC064

10 SEP - 09 OCT 2011

RAPID moorings cruise report

*Principal Scientist*

S A Cunningham

*Editors*

G McCarthy & J Collins

2012

National Oceanography Centre, Southampton
University of Southampton Waterfront Campus
European Way
Southampton
Hants SO14 3ZH
UK

Tel: +44 (0)23 8059 6175
Email: gerard.mccarthy@noc.ac.uk

# *DOCUMENT DATA SHEET*

| *AUTHOR* | *PUBLICATION DATE* |
|---|---|
| CUNNINGHAM, S A et al | 2012 |

*TITLE*

RRS *James Cook* Cruise JC064, 10 Sep - 09 Oct 2011. RAPID moorings cruise report.

*REFERENCE*

Southampton, UK: National Oceanography Centre, Southampton, 183pp.
(National Oceanography Centre Cruise Report, No. 14)

*ABSTRACT*

This cruise report covers scientific operations conducted during RRS *James Cook* Cruise JC064. Cruise JC064, departed from Falmouth on Thursday 1st September 2011 arriving Santa Cruz de Tenerife Saturday10th September to pick up extra members of the scientific party and arriving again in Santa Cruz on the 9th October. 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 array as deployed in 2011-2012 consists of a total of 17 moorings, 16 landers and a single inverted echo sounder. 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 JC064 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, gyro heading and ships speed relative to the water using an electromagnetic log). Water velocity profiles from 15m to approximately 800m/300m depth were obtained using a ship mounted 75/150 kHz acoustic Doppler current profiler. Seawater 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.

Seven APEX argo floats supplied by the Met Office were deployed at preassigned locations, filling gaps in the network.

*KEYWORDS*

*ISSUING ORGANISATION*

**National Oceanography Centre**
**University of Southampton Waterfront Campus**
**European Way**
**Southampton SO14 3ZH UK**
Tel: +44(0)23 80596116 Email: nol@noc.soton.ac.uk

*Page intentionally left blank*

# Contents

# List of Figures

# List of Tables

# 1 Ship's and Scientific Personnel

| | |
|---|---|
| Stuart Cunningham | Principal Scientist RAPID, NOC |
| Gerard McCarthy | RAPID Research Scientist, NOC |
| Cristian López | Visiting Scientist, Universidad de Las Palmas |
| Eleni Tzortzi | Ph.D. Student, NOC |
| Patrick Farrell | Visiting Scientist, Imperial College, London |
| Rob McLachlan | NMFSS, Head of Moorings |
| Chris Crowe | NMFSS, Instrument Technician |
| Dave Childs | NMFSS, Instrument Technician |
| Rhys Roberts | NMFSS, Engineering |
| Jon Seddon | NMFSS, Engineering |
| Jason Scott | NMFSS, Engineering |
| Jeff Benson | NMFSS, CTD |

Table 1: Scientific Personnel

| | |
|---|---|
| John Leask | Master |
| Philip Gauld | 1st Officer |
| Malcolm Graves | 2nd Officer |
| Vanessa Laidlow | 3rd Officer |
| George Parkinson | Chief Engineer |
| John Thomson | 2nd Engineer |
| Geraldine OSullivan | 3rd Engineer |
| Philip Appleton | Senior ETO |
| Vivian Wythe | Deck Engineer |
| Duncan Lawes | EPRO |
| Paul Lucas | Purser |
| Kevin Luckhurst | CPO Deck |
| Philip Allison | PO Deck |
| Steve Smith | CPO Scientific |
| Gary Crabb | AB |
| John Hodgson | AB |
| John Dale | AB |
| Steve Day | AB |
| Darren Caines | Head Chef |
| Amy Whalen | Chef |
| Peter Robinson | Steward |
| Roger Herbertson | A/Steward |

Table 2: Ship's Personnel

# 2 Itinerary

Cruise JC064, departed from Falmouth on Thursday 1st September 2011 (this leg was also referred to as JC063) arriving Santa Cruz de Tenerife Saturday 10th September to pick up extra members of the scientific party. The ship departed Santa Cruz on the same day and arrived again in Santa Cruz on the 9th October.

# 3 Introduction

**Stuart Cunningham**

The Atlantic Meridional Overturning Circulation (AMOC) at 26.5°N carries a northward heat flux of 1.3 PW. Northward 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 (Bindoff et al., 2007). 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 & Coauthors, 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 Atlantic at 26.5°N 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 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

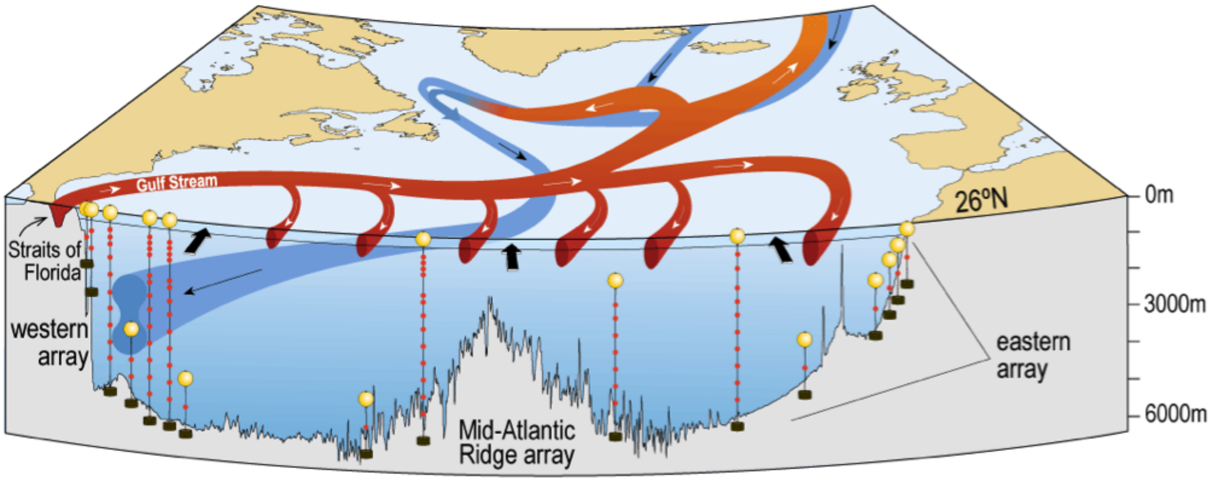



Figure 1: Schematic of the principal currents of the Atlantic meridional overturning circulation. The vertical lines across the Atlantic at 26.5°N indicate moorings instrumented to measure the vertical density profiles. The Gulf Stream (red) transport is measured by a submarine cable in the Straits of 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.

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.

## 3.2 Array Specification

The array as deployed in 2011-2012 consists of a total of 17 moorings, 16 landers and a single inverted echo sounder. Figure 2 and Figure 3 show the eastern boundary and mid-Atlantic moorings as deployed on cruise JC064. The western boundary moorings (Figure 4) were serviced in the Spring of 2010 during cruise OC459-1 and will be serviced again in Spring 2012 from the RV Ronald H. Brown. 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. Bottom landers instrumented with pressure recorders are indicated by L in the name. ADCP indicates an Acoustic Doppler Current Profiler mooring.

### 3.2.1 Eastern Boundary Sub-array

The Eastern Boundary sub-array currently consists of one tall mooring EB1, consisting of eighteen CTDs and two current meters, and a series of shorter CTD moorings EBHi, EBH1, EBH2, EBH3, EBH4, and EBH5 that step up the slope reducing the influence of

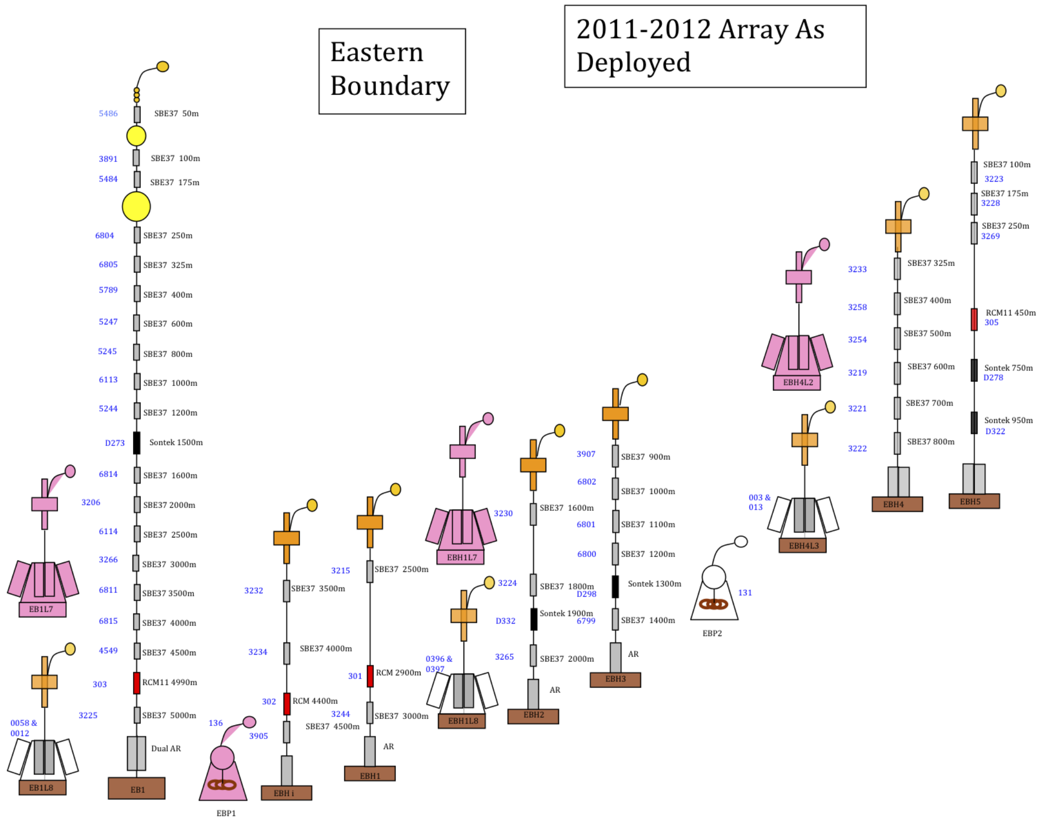



Figure 2: Eastern boundary sub-array as deployed after January 2011. The pink landers were serviced on this cruise

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, comprising one bottom pressure recorder each and two at the site of EBH4/EBH5. EBH4L was deployed close to the site of EBH4/EBH5 as a replacement for the Inverted Echo Sounder with a pressure sensor (PIES) instrument that could not be redeployed during this cruise. The landers are serviced in alternate years so that each recovery provides a two-year record with a year overlap with the previous lander to remove instrument drift. There is currently one PIES deployed in the eastern boundary sub-array, EBP2, which was serviced on D359. Data from the PIES are downloaded annually through acoustic telemetry. EBP1 was recovered on this cruise and not redeployed.

### 3.2.2 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 is a recent addition to the array and consists of five CTDs, one current meter 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 eighteen CTDs, with MAR2 acting as a backup to 1000m

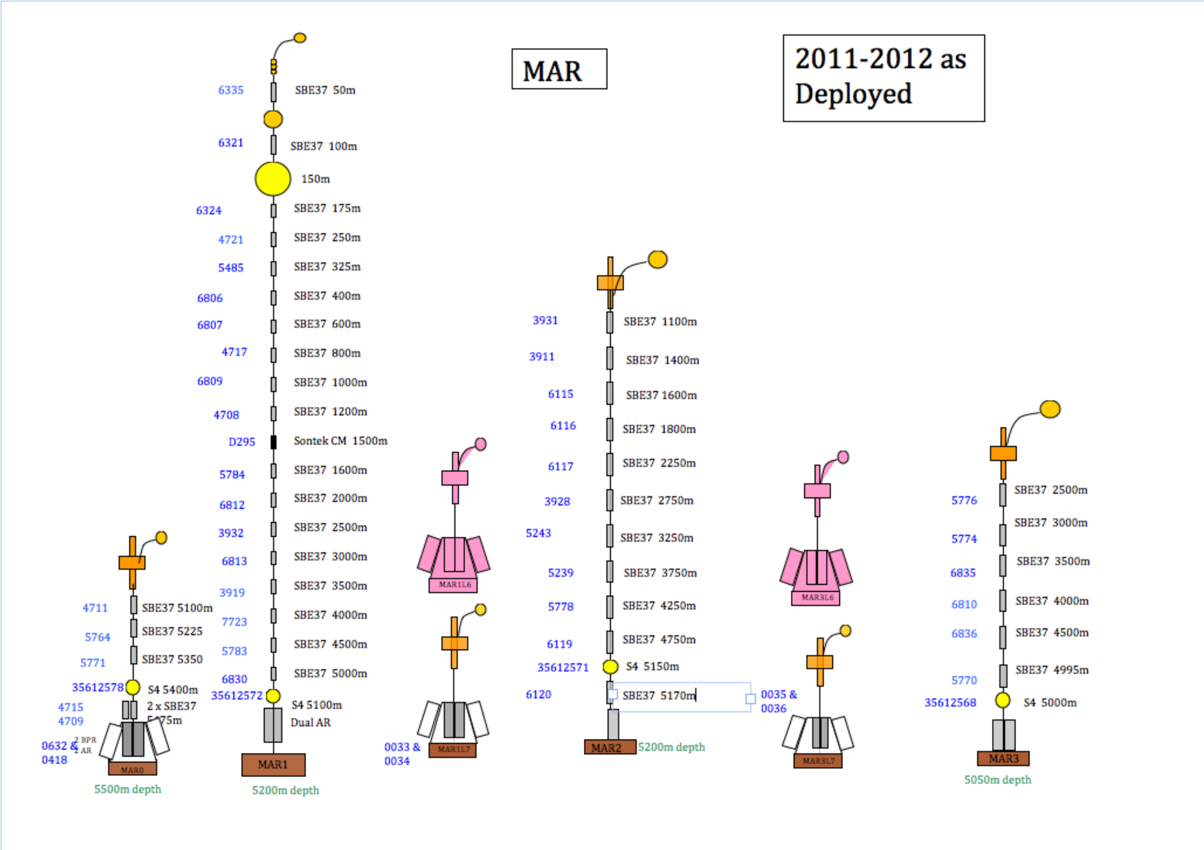



Figure 3: The Mid-Atlantic Ridge sub-array after January 2011. The pink landers were refurbished on this cruise.

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.

### 3.2.3 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 May 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 and two bottom pressure recorders, which combined with MAR0 measures the contribution to the MOC of deep water below 5200m including the AABW. There are again four landers in this sub-array; two at the site of WB2 (two BPRs each); and two at the site of WB4 (one BPR each).

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, that were

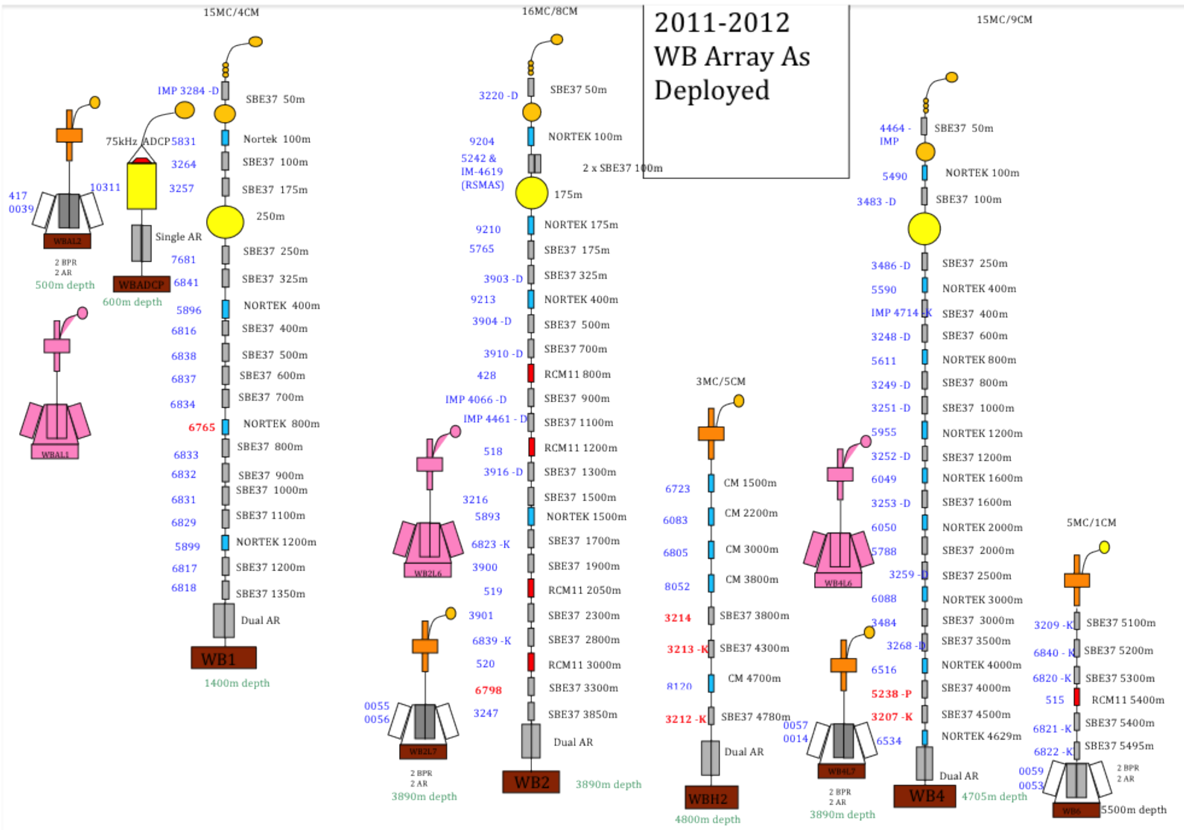


Figure 4: The Western Boundary sub-array after March 2011

serviced on KN200-4. 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.

## 3.3 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/* and *http://www.rsmas.miami.edu/users/mocha/index.htm*). Data may also be obtained directly from *http://www.bodc.ac.uk/*.

# 4 Computing

**Jon Seddon**

## 4.1 Level C and TECHSAS

The Ifremer TECHSAS system is described at *www.noc.soton.ac.uk/nmf/wiki/TECHSAS*. The Level-C system logs the Techsas UDP packets in the Level-C binary format. It allows ASCII dumps of the data to be rapidly generated at custom intervals or averaging periods. The TECHSAS NetCDF files were the primary files used during this cruise; the logging system performed well during the cruise with the following exceptions:

1. The EM log was not logged on this cruise

2. From the start of the cruise on 10th September until it was restarted at 11:44 on the 12th September, the Techsas data logger did not write any data to the Surfmet, DPS116 or Seapath files. The instruments were showing as green on the Techsas screen, but the data size was not incrementing. A close watch was kept on the data size for the rest of the cruise. Data were still written to the Level-C system and so a Matlab script was written to generate NetCDF files from the Level-C data. The regenerated files were given the standard NetCDF filenames but with the suffix *.regen*.

3. A bug was identified by the scientific party in the Techsas CNAV module. In the CNAV NetCDF files the latitude and longitude were not written in decimal degree format and instead in the format [D]DD.MMmmmmmm, where the numbers before the decimal place DD or DDD are the degrees, the most significant two decimal places MM are the minutes and the remaining decimal places are the decimal minutes. Therefore a latitude or longitude in the NetCDF file of 12.34567890 actually represents 12° 34.567890'. The Level-C files and UDP broadcasts of the CNAV data were not affected and were generated correctly in decimal degree format. The NetCDF documentation was amended to reflect this bug and British Oceanographic Data Centre (BODC) informed that it had been present since CNAV data was first recorded on cruise JC052 in September 2010. The CNAV module is being fixed at National Oceanography Centre Southampton (NOCS).

4. A fault that prevented the Vigor routers firewall from blocking out going traffic was identified. This fault was reproduced on the Test Ship network at NOCS and the manufacturers are helping to fix the problem. Inbound traffic is still protected by the Sonicwall firewall in Aberdeen and the Network Address Translation (NAT) feature on the Vigor router.

# 5 Underway Data Processing and Calibration

**Cristian López, Eleni Tzortzi, Jon Seddon**

## 5.1 ADCP

**Cristian López**

During the cruise, horizontal velocities were calculated using the two vessel-mounted Acoustic Doppler Current Profilers (ADCPs) onboard RRS James Cook. These instruments, installed on the port drop keel, are 75kHz and 150kHz Ocean Surveyor (OS) instruments supplied by Teledyne RD Instruments.

For good data, referencing with an accurate source of heading and position is needed. In this cruise, Posmv was determined as the source for both ship's position and attitude. The newer CNAV GPS should prove more accurate in the future once the bugs associated with CNAV are sorted out (Section 4.1).

The instruments can be operated with the keel either retracted or lowered. The keel up position allows greater ship speed, but also exposes the instrument to more bubbles, which significantly reduces its profiling range. The keels were retracted throughout the cruise to optimise ship's speed.

Each instrument works with a different frequency. While the 75 kHz has the advantage of a deeper scope, it lacks a finer resolution. The 150 kHz instrument reaches a shallower depth but it is characterised by an improved vertical resolution. With the keel up, the regular depth penetration for the 75 kHz adcp was 800 m, while the 150 kHz reached to 400m.

### 5.1.1 Data Acquisition

The data from the two instruments were acquired using the RD Instruments VmDas software package version 1.42. This software is installed on two PCs in the main laboratory. The software allows data acquisition in a number of configurable formats and performs preliminary screening and transformation of the data from beam to Earth coordinates.

To start acquiring data with VmDas, several things have to be set and checked. First, the VmDas program needs to be opened from the Start Menu. Then, under the file menu, collect data should be clicked. Subsequently it is set up with the edit data options under options menu.

The actual recording starts by clicking the blue record button in the top left of the screen. The data collection stops when clicking the blue stop button next to the record one. Stopping and restarting the logging with these two buttons should start a new sequence dataset. During the cruise, it was restarted once every 1-2 days in order to spare the data size in different ensembles to make post processing faster. Leaving it on the same file for more than 3 days makes the file become large and the processing slower.

Every time the set up needs to be changed (e.g. dropping keels, or activating bottom track), the recording has to be stopped and restarted. Once the recording has started, some things need to be checked in order to assure good measurements. The log-files document any problems such as buffer overload, timeouts or resetting of the ADCP. If the size increases suddenly over 10KB, some error might be occurring and needs to be checked. An increase in data files size should be noted as an indication of data being logged. It is most important to make sure the sequence increases with every dataset every time it is restarted and that no data are being overwritten.

A logsheet was made to keep track of every time a dataset was stopped and restarted, including notes such as whether bottom track was activated, some interesting features and logging errors and gaps.

### 5.1.2 VmDas configuration

The configuration was set using one of the four .txt files made for this cruise (one file for every type of measurement: 75 or 150 kHz, bottom track on or off. All narrow band and keel up). In case keel down or broadband were used, a different setup file should be made. The used configuration was:

- Communications ADCP Input: COM1, 9600, N, 8, 1. COM7, 19200, N, 8, 1. COM8, 4800, N, 8, 1. Communication Parameters: Enable serial. Comport: COM1. Baud rate: 9600. No parity. Data bits: 8. Stop bits: 1.

- ADCP Setup

  Here the setup was configured from file, with the path: \Program files\RD instrument\VmDas\JC064\and the file names OS(inst)NB_BT-on_JC064_up and OS(inst)NB_BToff_JC064_up (for narrowband, keel up and bottom track on or off. (inst) stands for 75 or 150 type) The configuration used in this cruise was: Set profile parameters checked. Number of bins = 96 (150kHz) or 48 (75kHz). Bins size: 4m (150kHz) or 16m (75kHz). Blank distance: 4m (150kHz) or 8m (75kHz). Transducer depth: 6m (for both). Set processing mode: Low resolution long range (150kHz) or Hi resolution short range (75kHz). Bottom track was on or off, depending on the measurement nature. Maximum range set as 400m (150kHz) or 800m (75kHz).

- Recording

  Name: OS150_JC064 or OS75_JC064 (depending on the instrument frequency) Number: 01 for the first dataset. It increases by one every time the recording is stopped and restarted. If the system has to be rebooted (as happened during this cruise and due to the computer freezing) or VmDas software is restarted, it is very important to set the proper sequence number following the series in order not to overwrite previous datasets. Max size: 10MB (it start a subsequent file every time its weight overwhelms this size) Primary Path: C:\Data\JC064\Backup path: C:\RDI\ADCP

- Transform

  Heading source: NMEA/HDT. It is very important to set the correct heading source in order to get fine data and bottom track calibration. No tilt corrections enabled, all set up as 0.

- Averaging

  Temporal averaging checked. First time interval (STA): 120 seconds. Second time interval (LTA): 600 seconds. Profile ping normalization and other corrections not enabled.

- Data screening, User Exit, Sim Input

  No changes in these menus.

### 5.1.3 Output files

VmDas produces several output files with the same name structure but different extension, such as OS(inst)_JC032(nnn)_(filenumber). (ext), where (inst) is the instrument name (75 or 150), (nnn) is the dataset sequence number, (filenumber) is the number of the file in the sequence (adds a new one every 10MB according the set up) and (ext) is the extension of the file.

The different file extensions are:
.ENR: binary raw ADCP data file.
.STA: binary average ADCP data according to the set STA time.
.LTA: binary average ADCP data according to the set LTA time.
.ENS: binary ADCP data after screening for RSSI, correlation and navigation data.
.ENX: binary ADCP single-ping and navigation data after bin-mapping, transforming to Earth coordinates and screening for error velocity, vertical velocity and false targets.
.N1R: ASCII text files with NMEA navigation raw data from NMEA1 stream.
.N2R: ASCII text files with NMEA navigation raw data from NMEA2 stream.
.NMS: binary navigation data after screening and pre-averaging.
.VMO: ASCII text file with the setting used for collecting the data.
.LOG: ASCII text file all logging output and error messages.

These files are saved in the folder set in the configuration.

### 5.1.4 Speed of Sound Considerations

In order to calculate water velocities, VMADCPs require an estimated value of sound speed. The necessity of an accurate speed of sound at all times to obtain precise data is a frequent topic with differing opinions and it is often debated on several cruises.

In this section, speed of sound considerations are discussed. The speed of sound is affected by 3 principal factors; temperature, salinity and pressure. In all cases, they are directly related, so increasing one of them also rises sound speed. However, the changes due to salinity or pressure are slight compared to those related to temperature changes. Temperature has the largest effect on sound speed; a change of one degree in temperature affects up to 3 times more than a psu change of one unit (Emery, 2004).

The transducer calculates with every beam the water temperature surrounding it and extrapolates the speed of sound for a fixed salinity, since temperature is the main factor responsible for sound speed variability. The speed of sound at the transducers is used to compute the initial distance along beams, as well as to convert velocity data into engineering units (RDI, 1996). However, it is not calculated along the water column, for it is not needed. Variation of sound speed with depth does not affect measurement of horizontal currents. According to Snell's law, which says that horizontal wavenumber is conserved when sound passes through horizontal interfaces and because the frequency remains constant, sound speed variation does not affect the horizontal component of sound velocity. Since sound waves are continuous across the horizontal interface and because measurement of the horizontal currents depends directly on the horizontal sound speed, the horizontal current measurement is unaffected.

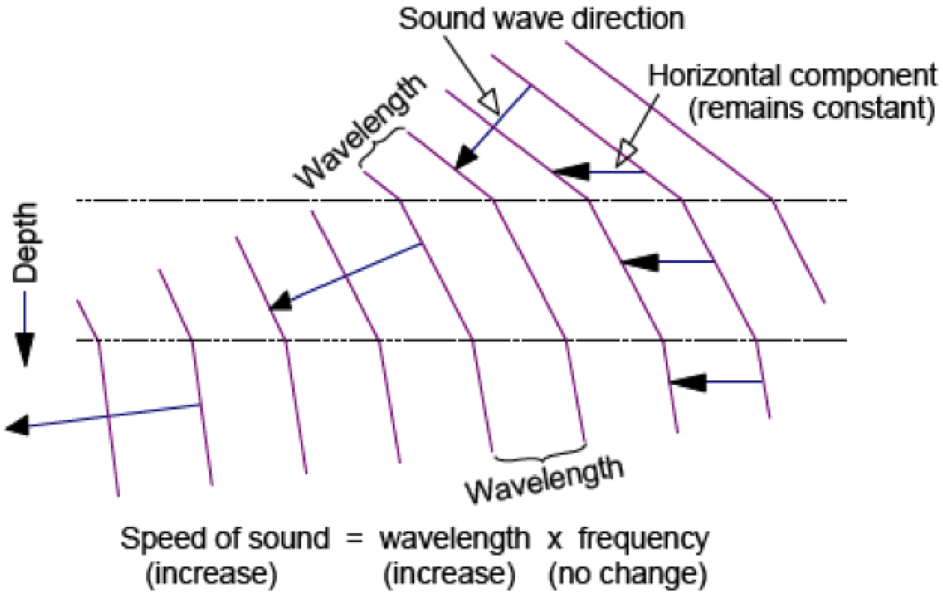



Figure 5: Sound speed refraction with depth. Even though the direction and sound speed change with depth, the horizontal sound velocity component remains constant. From 'Principles of operation. A practical primer'.

In contrast, variations in the vertical velocity component are proportional to variations in sound speed.

Whilst sound speed is not important with depth, the initial speed at the transducers might be so, for it changes the initial beam angle and then it can mistake the distance along beams (the cell depth). This change occurs in a similar ratio as the Doppler shift, which decreases for a higher sound speed (RDI, 1996). So, for an overrated sound speed, the depth cell size is underestimated, but so is the Doppler shift. Thus, a smaller cell would generate a smaller shift with a similar proportion, compensating the error. The significance of this effect would only be important when the used sound speed diverges substantially with the real.

According to Firing (1991), the sound speed calculated by the instrument is usually sufficiently good, but it needs to be checked and corrected if the divergence is beyond certain limits. Sound speed changes by about 0.1% for each psu change in salinity, so it is not necessary to keep changing the salinity in the configuration as long it is in reasonable ranges. Regarding temperature, sound speed changes by 0.3% per °C at 0°C, and by 0.13% per °C at 30°C. Recalculating sound speed for each 1°C change in sea surface temperature would be a reasonable procedure.

Therefore, sound speed only needs to be considered at the transducer depth. Within reasonable salinity values, only the temperature is important. It needs to be checked and compared to the measured remote temperature (tsg), if the difference is over 1°C, then corrections might be considered.

Throughout this cruise, salinity was set to 35 psu, while the temperature kept a close relation with tsg temperature. It was always with a difference below 1°C. Thus no calibrations of sound speed were made.

### 5.1.5 Post-Processing

The final processing of the data was done using the CODAS (Common Ocean Data Access System) suite of software provided by the University of Hawaii. This suite of python and Matlab programs allows manual inspection and removal of bad profiles and provides best estimates of the required rotation of the data, either from water profiling or bottom tracking. In this cruise a new matlab script enclosing all post processing steps was made, making the processing easier and faster. Further information of this script is found in Section 5.1.6. Datasets were processed every time a new sequence was started, almost daily. The processing followed these steps:

1. Data transferring into the ship's server.

   The data is compiled in the two pc lab's computers, but it needs to be transferred to the ship's file server system. In RRS James Cook, the directories on the ADCP PCs are shared. The Cookfs file server mounts these shares and then uses the Syncback software package to backup the data from the ADCP computers every fifteen minutes. This step was automatized by the ship's system.

2. Ensuring the datasets are complete.

   For starting the processing of a dataset, it is very important to work with the complete sequence, so the first step should be ensuring all logged data has been uploaded into the system. On JC064, these were uploaded every 15 minutes, the available dataset might still be incomplete after stopping the log. The best way to make sure it has finished to transfer the data is checking if next sequence data is already available. That means all the previous set is complete.

   These data were found in the Cook's file server, in the directory

   /cookfs/JC64/Ship_Systems/Acoustics/OS(inst)/raw_data/ ((inst) stands for OS type; 75 or 150 according to the instrument)

   In case after stopping the log it is not restarted again (e.g. when mooring in port, or for the last sequence) waiting more than 15 minutes before processing would be enough.

3. Transferring the data into oceanus.

   Once it has been checked, next step is copying the raw data into the cruise database. It was copied with the unix console into the directory:

   /noc/users/pstar/cruise/data/vmadcp/jc064_os(inst)/rawdata/ ((inst) stands for OS type; 75 or 150 according to the instrument)

   The command vmadcp_movescript was run in the console, in the folder jc064_os(inst) (hereafter known as main directory). This command spares all the rawdata in subdirectories for every dataset sequence.

4. Making an adcptree directory.

   In order to process the data, a tree directory needs to be made for every sequence. Without changing the previous directory, the command

   adcptree.py jc064(sss)nbenx - -datatype enx ((sss) stands for sequence number; 001 for the first one) was applied. It sets up a tree directory for the codas dataset and an extensive collection of configuration files, text files and m files.

5. Elaborating on the control files

   Throughout the processing, two control files are needed for every dataset, q_py.cnt and q_pyedit.cnt. The first file guides the data loading, routine editing and processing and it also estimates water and bottom track calibration (if available). The q_pyedit.cnt commands the manual editing application.

   These files can be made brand new, but it is easier to download them from the CODAS software guidelines and then edit them to suit the current cruise. In this cruise, they were first obtained and edited from the CODAS guidelines and saved into the main folder. Then, every time a dataset was processed, they were copied again into their new tree directory. Once after the matlab processing script was made and used (see Section 5.1.6), both files were automatically made every time it was run.

   There are also other control files such as q_pyrot.cnt or q_pytvrot.cnt, although they are for angle correction. They are further seen in calibration (Section 5.1.7).

6. Primary and manual processing

   Once the control files were completed or copied into the tree directory, the command quickadcp was run in the terminal, inside the directory. This python command, directed by a control file, processes and applies what the file orders. Quick_adcp was run with q_py.cnt as a control file, which leaded the first processing steps:

   quick_adcp.py –cntfile q_py.cnt

   It might take a few times, if it is a large dataset. After running quickadcp, the averaged ADCP data are loaded in the tree directory, as well as the bottom track and water track calibrations (when available), which are stored in the cal/ directory.

   The manual editing then began. This was done with gautoedit, a package within CODAS that allows the user to review closely the data collected by VmDas and flag any data that is deemed to be bad.

   Matlab was opened and then the command codaspaths was run to load the CODAS packages. It was necessary to change to the edit directory to run gautoedit. Detailed information and instructions can be found on the JC032 report (pages 130 to 133).

   Once the manual editing is finished, the changes are applied running quick_adcp in the tree directory again, but with the control file q_pyedit.cnt.

   quick_adcp.py –cntfile q_pyedit.cnt

   Finally, the files .asc containing the flagged data information were stored in a directory such as edit_files/jc064(sss)nbenx inside the main directory. Sometimes, datasets have to be redone from the start. Saving these files elsewhere makes it possible to apply the manual edits without running gautoedit again.

7. Final processing

   After the main processing is done, a few matlab scripts were run to read the data into Mstar. First, mcod_01.m was run. It loads the vmadcp data and stores it as a mstar file. Next mcod_02.m was also run. It calculates ship's speed and expands 1D arrays into 2D. Finally, once these two scripts were run, mcod_mapend.m appended all processed data into a final file.

### 5.1.6 Processing script vmadcp_proc.m

During the cruise, a matlab script enclosing all processing steps was made in order to make the steps easier, faster and automate them in only one single script. This vmadcp_proc.m script only asks for two inputs (instrument type and dataset sequence to process) and it carries out the whole processing chain itself. Before being used for the first time on a cruise, some settings need to be changed. First, the ship's file server directory where the raw data are being loaded, then the amplitude and angle phase corrections. If bottom track data is still not available for a good calibration of the angle offset, then it should be set as 0 and be changed once after it is found.

The script generates the needed directories as well as .cnt control files. It also classifies the raw data, runs quick_adcp.py and opens the gautoedit interface. After the manual editing is done, the script continues just by pressing (enter) or typing (go). Then it applies all manual edits, and saves them in another folder (so they can be applied again if the dataset is deleted and reprocessed again).

Finally it reads the data into Mstar to finish the processing and to append all the cruise's vmadcp processed data. A diagram with all the steps the script does is found in Figure 6.

### 5.1.7 Calibration

In order to obtain accurate horizontal velocities, it is vital to correct for heading errors. These can either occur as a result of transducer misalignment with respect to the hull, or from errors in navigation. The navigation on the James Cook is fed directly into VmDas from the Applanix POSMV, which incorporates a GPS heading source that is not sensitive to many of the heading errors that occur when gyrocompasses are used in isolation (e.g. Schuler Oscillations).

The best calibration estimates are obtained when the velocity data are referenced to the bottom. However, bottom track calibration estimates are only obtainable when the water depth is within 1.5 times the depth of the ADCP profiling range.

During the first leg of the cruise (JC063), on the way from Falmouth to Tenerife, good quality bottom track could be recorded on the wide continental shelf for OS75kHz.

However, due to an incorrect setup on the OS 150kHz, heading was not being recorded on the first two sequences, hence it was not possible to get satisfactory bottom track data for this instrument at the beginning of the cruise.

Water track calibration was considered as second choice. This cruise, however, was not characterized by a large amount of transitions from on to off station. Since it is fundamental to have these transitions for an accurate estimation, data from every sequence differed significantly with each other and consequently no reliable corrections were obtained.

Finally, proper heading data was imposed to the bottom track data of the first two sequences for 150kHz. A satisfactory correction was obtained and applied. In this section all calibrations and results are discussed in detail, as well as the application of their correction.

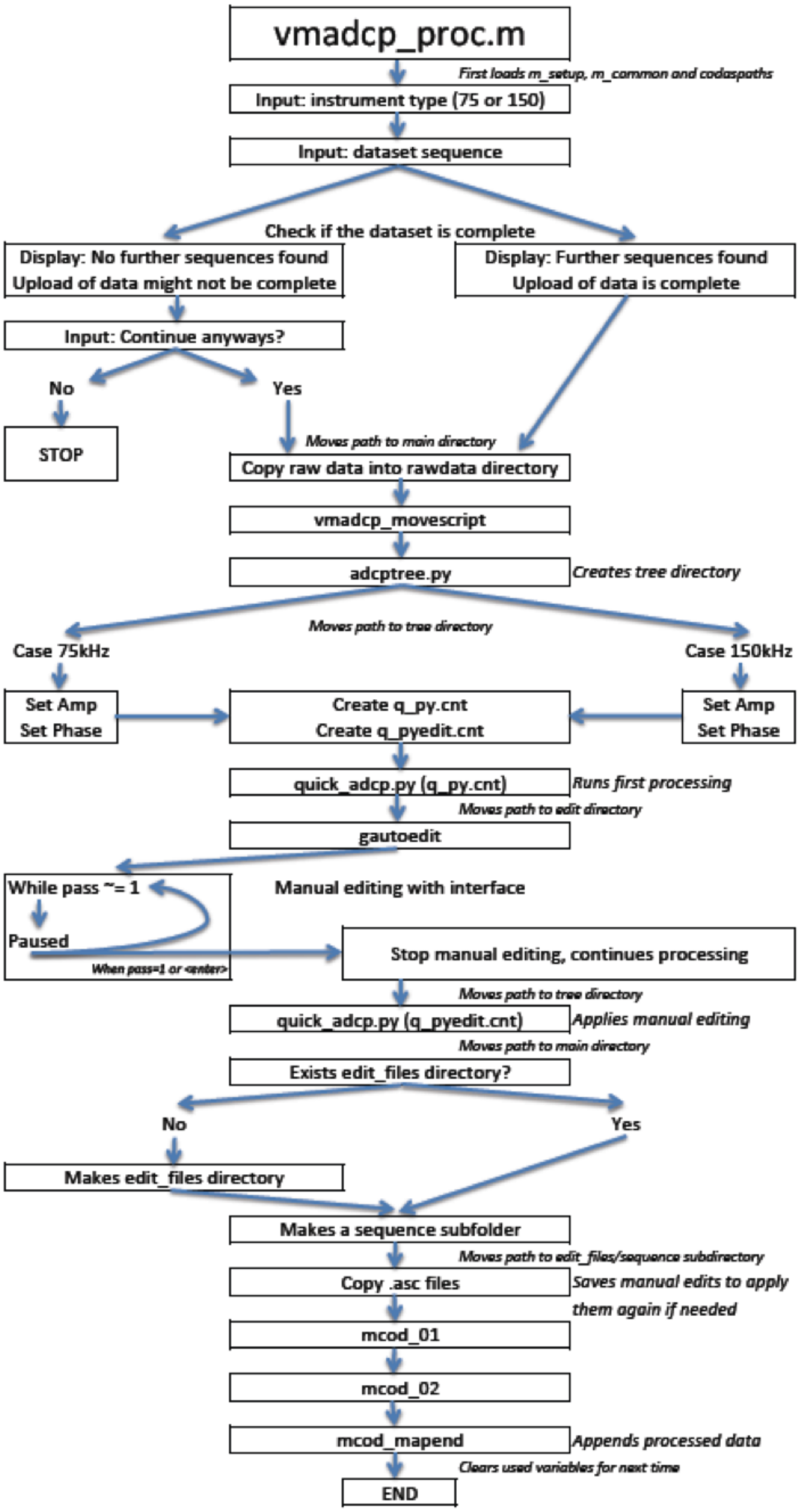



Figure 6: vmadcp_proc.m diagram

| Sequence | Data points | Parameter | Median | Mean | STD |
|---|---|---|---|---|---|
| 1 | 169 | Amplitude | 1.0038 | 1.0036 | 0.0015 |
| | | Phase | -8.7697 | -8.7683 | 0.1348 |
| 2 | 46 | Amplitude | 1.0047 | 1.0048 | 0.0018 |
| | | Phase | -8.7912 | -8.7774 | 0.1907 |
| JC064 final corrections | | Amplitude = 1.00 | | Phase = -8.78 | |

Table 3: Bottom track calibration results for os75kHz and final correction.

| Sequence | Parameter | Median | Mean | STD |
|---|---|---|---|---|
| 5 | Amplitude | 1.01 | 1.0148 | 0.0117 |
| | Phase | 0.1395 | -0.0278 | 0.839 |
| 6 | Amplitude | 1.0165 | 1.017 | 0.0065 |
| | Phase | 0.8535 | 0.5355 | 0.9094 |
| 9 | Amplitude | 0.997 | 0.9967 | 0.0035 |
| | Phase | 0.329 | 0.145 | 0.3521 |

Table 4: Some water track results for OS150kHz.

### 5.1.8 Bottom track calibration

When the bottom can be detected, CODAS software automatically estimates bottom track corrections of amplitude and angle phase when running quick_adcp.py and store them inside the tree directory, in cal/botmtrk/. The file btcaluv.out contains the estimated deviations for amplitude and angle phase, while the file btcaluv.ps includes some plots such as navigation, depth and angle phase deviation (see Figure 7). Both can be read from the unix console. Data are contained in btcaluv.out, while the plots are available in btcaluv.ps.

On this cruise, sequences 1 and 2 were used to obtain bottom track calibration (corresponding to the days steaming over the continental shelf). The results are presented in the Table 3.

As expected, the amplitude does not need corrections (it should be 1).

From other cruises, it was known that the phase deviation was close to 9 degrees, as we obtained. The final correction applied was -8.78°.

### 5.1.9 Water track calibration

Water track is a method that compares on and off station. The software's technique consists in comparing certain number of consecutive points straddling a transition from off station to on station. It takes the first two points (streaming points) and the last two points (stationary points) and compares them to ascertain the offset.

Water track calibration was considered as alternative to bottom track calibration for OS150kHz and as a possible source to compare OS75kHz bottom track. As mentioned before, neither of them was possible due to imprecise data. Table 4 shows the range of these results:

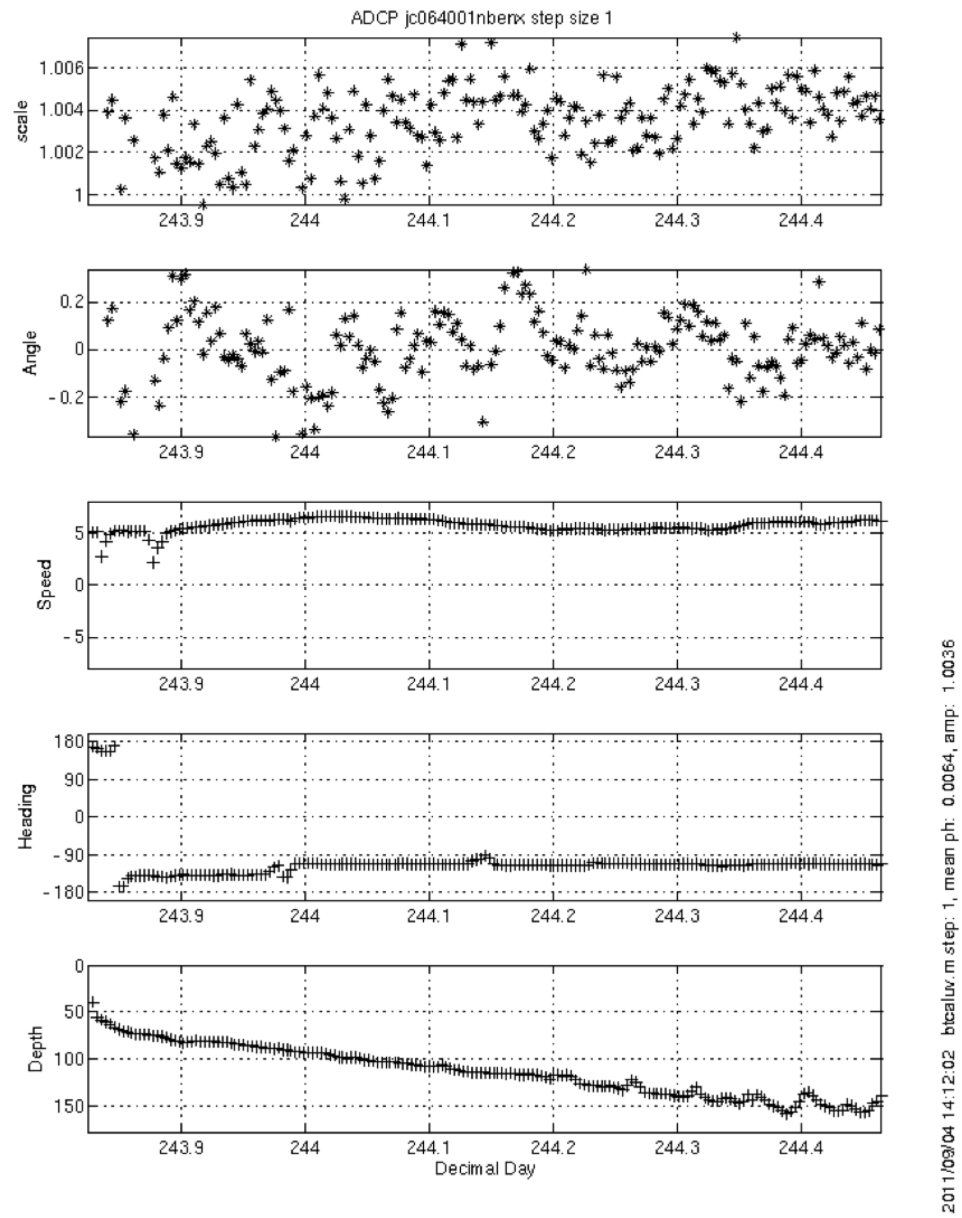



Figure 7: Plots from file btacluv.ps after correcting the angle phase

| Sequence | Data points | Parameter | Median | Mean | STD |
|---|---|---|---|---|---|
| 1 | 161 | Amplitude | 1.012 | 1.0128 | 0.0035 |
| | | Phase | -0.824 | -0.7253 | 0.8771 |
| JC064 final corrections | | Amplitude = 1.0 | | Phase = -0.8 | |

Table 5: Bottom track data for os150kHz after fixing the heading and final correction. Only one decimal was taken into account, since its precision was not adequate for more than one decimal

#### 5.1.10 Fixing heading for OS150kHz

To get the angle of rotation for OS150kHz, a new source of heading was imposed on the first two sequences, where bottom track had been recorded with an incorrect setup.

In order to apply it, a new matlab script, called make_adcp_heading.m, was made. It was made from the previous script make_g_minus_a.m but using seapath200 (attsea') as the unique source of heading. It was also modified to range from -180° to 180° instead of 0° to 360°, for it is necessary afterwards.

Once this command was run, a new file called jc064(sss)nnx.rot was made in the edit directory, inside the tree directory of sequence (sss). This file contains the new heading for every point of time used for bottom track. When a tree directory is made and quickadcp is run, a file called rotate.tmp is made in the directory cal/rotate/. This file needs to be edited (with command edit or vi) to add the path for the .rot file created previously. The line time_angle_file must be uncommented and the path and file name should be added instead of the (NOT USED) line. Then, typing the command run rotate rotate.tmp the new heading is incorporated.

Finally, in order to apply it onto the dataset, quickadcp is run with the control file q_pytvrot.cnt inside the tree directory. Again, this file can be copied from an older cruise (only the yearbase might have to be changed) or made brand new.

After running all these steps, new and reasonable bottom track data are acquired. In this cruise, only the first sequence had enough data points to get a precise bottom track correction (Table 5). This correction is not as accurate as it would be with its natural heading, but it is satisfactory. Some points seem to be offset, thus the median was chosen in place of the mean.

#### 5.1.11 Application of the angle rotation

Once the angle phase correction is calculated, it can be included in vmadcp_proc.m matlab script to add it in the q_py.cnt file and therefore apply the rotation when processing further sequences of data. Nevertheless, for all the previously processed datasets the rotation needs to be applied. For that purpose, the file q_pyrot.cnt is made. It can also be obtained from the CODAS guidelines, but in any case, it has to be edited to include the phase correction as well as the amplitude correction (if applicable). The instrument's type and year base also have to be changed if they are unfitting. Running quickadcp with that control file finally amends the angle deviation.

These adjustments are cumulative, hence applying it more than once would rotate it more than once developing a wrong calibration. Checking that new phase corrections suggested by bottom track are estimated near zero, will ensure the rotation as been properly applied. Finally, to make sure the rotation is accurate, the velocity sections

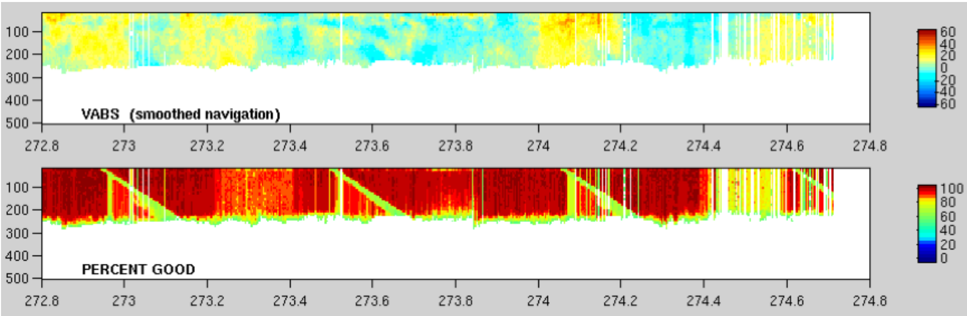



Figure 8: Periodic interferences, shown in sequence 30 of 150kHz instrument for 'v' velocities

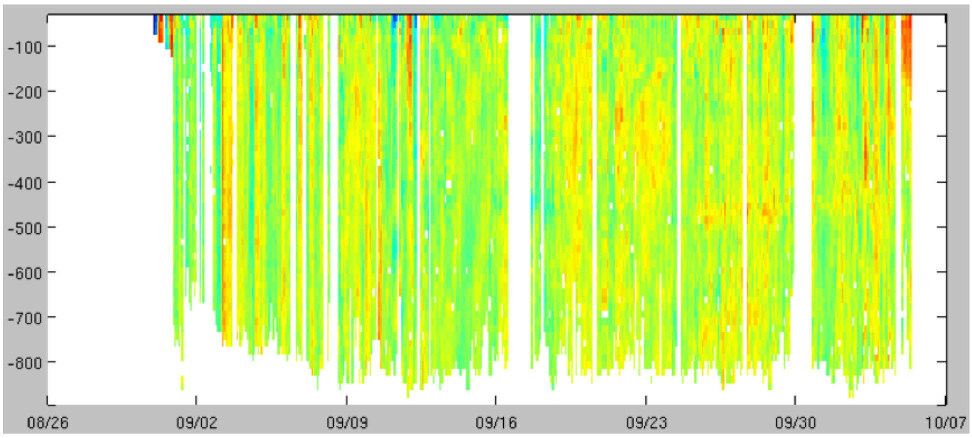



Figure 9: Uabs velocity during all cruise, for OS75kHz

should not show significant vertical stripiness when shifting from on station to off station.

### 5.1.12 Interference and data gaps

During the cruise, it was observed how data quality was affected periodically at a changing depth. Strips of inaccurate data appeared, moving up and down in time with depth (Figure 8).

At the beginning it was thought to be because of mooring and CTD operation. However, it was seen that they also occurred when no operations were being carried out. It was observed there is a periodicity in those interferences, thus it is thought some of them might be because of interferences with other acoustic instruments with a similar frequency, creating a phased interference.

### 5.1.13 Results

Despite recording data with the keel up throughout the cruise, the quality was remarkably good. Only on the days with roughest weather, the data logging was severely affected.

Some interesting features were found in this trip and are presented in this section, as well as some general results. Figure 9 shows the horizontal field of velocities. Zonal velocity is shown from the 75kHz instrument, displaying the high quality data acquired, excluding some gaps.

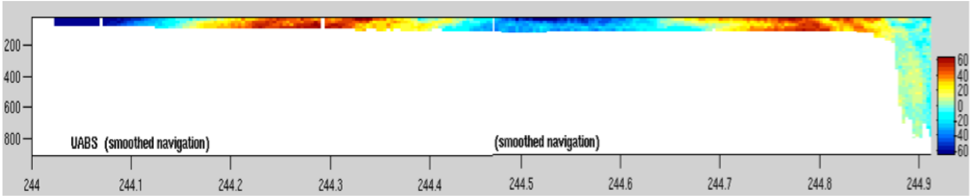



Figure 10: Tidal currents on the continental shelf. OS75kHz

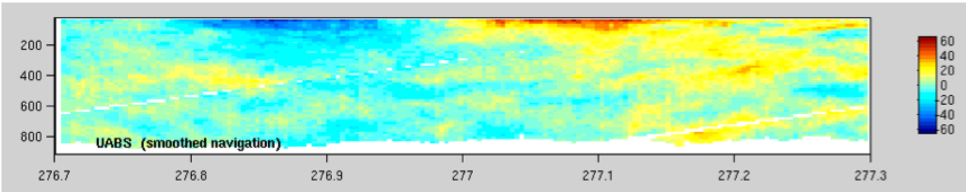



Figure 11: Counter clock eddy south off Gran Canaria Island.

On the first leg, over the continental shelf, strong tidal currents were recorded (Figure 10). It can be seen how the direction turns and how it is a semidiurnal tide, with a period of around half a day.

Another remarkable feature found was a counter clockwise eddy off Gran Canaria Island (Figure 10). This region is well known for the eddies formed south of Canary Islands due to the Canary current.

## 5.2 TSG

**Eleni Tzortzi**

Near surface oceanographic parameters were measured by sensors located in the non-toxic supply. These included fluorescence, light visibility (transmittance) of the surface waters, and a thermosalinograph (SB45 microTSG) measuring conductivity and housing temperature, based on which underway salinity was calculated in real time. In addition, a SBE38 Temperature Sensor, located in the inlet of the ship, was measuring remote temperature (i.e. sea surface temperature) at a depth of 5.5m below the sea surface. It should be mentioned that the daily housing temperature and conductivity were displaying two spikes about 12 hours apart, an example of which is shown in Figure 12 for the housing temperature. This was due to the daily change between the two pumps of the instrument. The water in this pipe warmed during the day which introduced a spike in temperature when pumped through the SBE45.

In order to calibrate the salinity derived from the SBE45 TSG data, salinity samples were collected from the non-toxic water supply outflow. Water samples from the TSG outflow pipe were collected in 200ml flat glass bottles every 4 hours. Before each collection, the hose connected to the outflow pipe was flushed with the sample water for several seconds (on occasions when the supply was not already running), and the sample bottles were rinsed twice with the sample water. Bottles were filled to halfway up the shoulder and the necks were wiped dry to prevent salt crystallisation at the bottle opening. The bottles were closed using airtight single-use plastic inserts and secured with the original bottle caps. The samples were stored in open crates and left in the controlled temperature

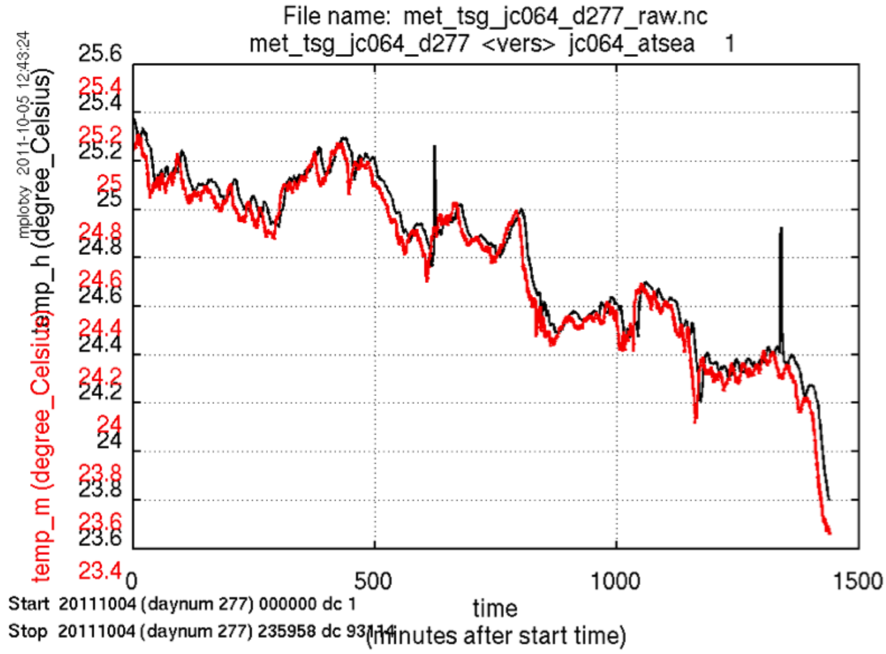



Figure 12: TSG housing temperature (temp_h, black line) and remote temperature (temp_m, red line) versus time for day 277 before manual editing. Note that the spikes in the housing temperature are due to the change between the two pumps taking place every 12 hours.

laboratory for a minimum of 24 hours before analysis. This allowed their temperature to adjust to the ambient temperature of the laboratory. A total of 104 TSG samples were taken over the duration of the cruise.

The conductivity ratio of each sample was measured using the salinometer, and the corresponding salinity value was calculated using the OSIL salinometer data logger software, and stored in a Microsoft Excel spreadsheet. The measured salinities of the samples were transferred to a text file, along with the date and time of collection. This file was converted to Mstar format, and the dates and times were converted into seconds since midnight on 1st January 2011.

In order to read the bottle samples, an extra column named 'SamNum' was added in the Excel spreadsheet of each crate denoting the Julian day and hour when the water sample was taken, in the form of dddhhmmss. The sample number was renamed as 'tsg00X_NN where X stands for the crate and NN for the sample number, respectively. This spreadsheet was saved as tsg_jc064_00X.csv, where the X accordingly denoted the crate number, while the .csv format would enable the Matlab processing and reading in the TSG bottle samples.

Accordingly, the TSG salinities were read in using the script mtsg_01.m, while the batch number and bath temperature were required as input information by the user in order for the new salinities to be calculated. This procedure was producing a file named tsg_jc064_00X.nc for each crate, where X stands for the crate number, while the final data from the different crates were appended and saved as 'tsg_jc064_all.nc'.

The bottle conductivity was computed based on the adjusted salinity and housing temperature, using the script mtsg_02.m, and the difference between the bottle and TSG conductivity was then calculated. Finally, the TSG data were merged onto the bottle

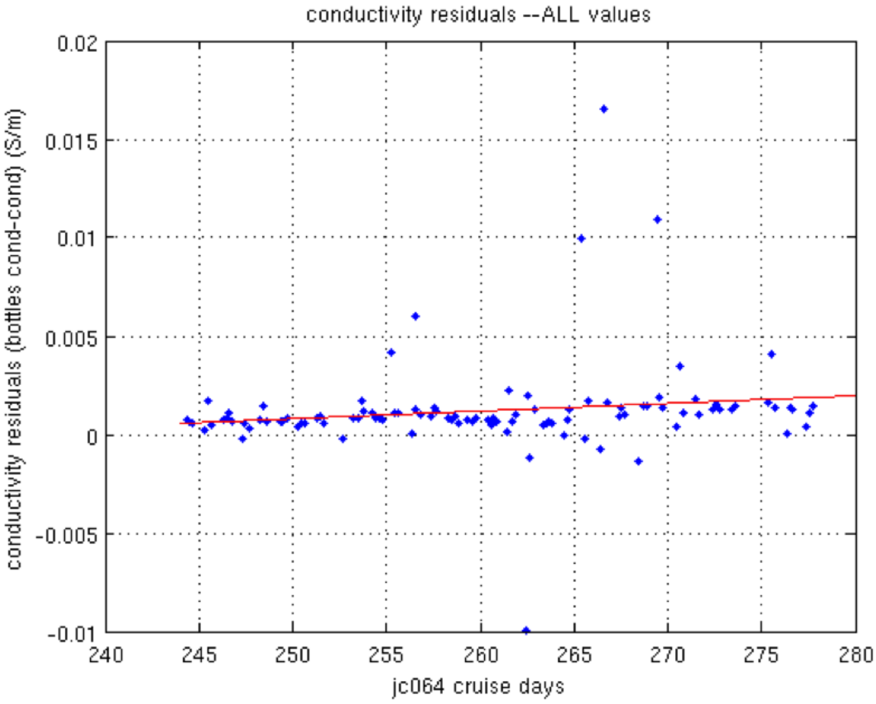



Figure 13: Bottle conductivity minus TSG conductivity for the whole cruise.

data and saved in a file named 'tsg_jc064_001_merge.nc.'

Figure 13 shows the difference between the bottle and TSG conductivity along the duration of the cruise. It can be seen that the conductivity residuals are characterized by a relatively significant positive trend due to the existence of some very high positive values away from the bulk of the data. Therefore, the ±95% quantile is estimated and is applied as the criterion to remove the outliers. The remaining conductivity residuals were then plotted again (Figure 14) and a new linear regression line fitted. This was used to calibrate the data.

## 5.3 Surfmet

**Eleni Tzortzi**

The surface meteorological conditions were measured throughout the cruise. A brief reference to the performance of the meteorological sensors is given in this section. The RRS James Cook was instrumented with a variety of meteorological sensors to measure air temperature and humidity, atmospheric pressure, short wave radiation, and wind speed and direction. These are logged as part of the SURFMET system.

The meteorological instruments are mounted on the ship's foremast in order to obtain the best exposure. The heights of the instruments above the foremast platform were: Gill WindSonic anemometer, 2.3 m; Vaisala air temperature and humidity 1.67 m and the irradiance sensors 1.38 m.

Files were transferred from the onboard logging system (TECHSAS) to the UNIX system on a daily basis, using the script mday_00_get_all.m. The raw SURFMET data files have names of the form met_jc064_dNNN_raw.nc, where NNN represents the day

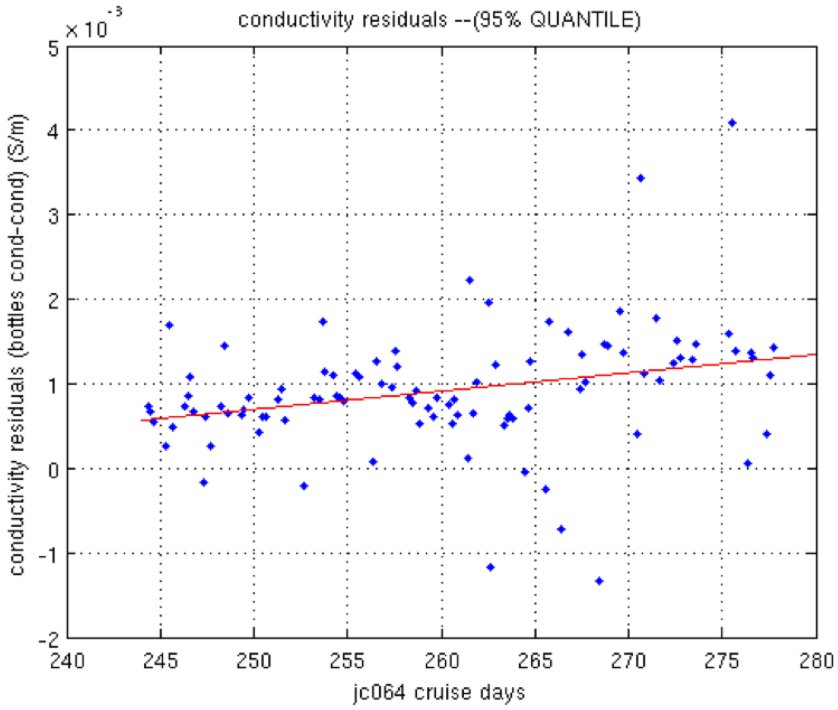



Figure 14: Bottle conductivity minus TSG conductivity for the whole cruise having applied the criterion of 95% quantile (0.004116163060023) in order to remove the outliers.

number. Wind speed units, initially labelled as knots by TECHSAS, were renamed to m/s using mmet_01.m and the data were plotted using mplotxy. Spikes were assigned an absent value using mplxyed.

True wind speed and direction were calculated using the scripts 'mbest_all' and 'mtruew_01'. 'mbest_all' is a wrapper for the 4 bestnav scripts; 'mbest_01' creates a 30-second 'nav' file from 1-Hz positions, while the speed, course and distance run are calculated using 'mbest_02'. A 30-second heading file is created from 1-Hz positions using 'mbest_03'. Here it should be noted that Seapath heading (i.e. 'attsea') is added instead of 'gyros' for James Cook cruises due to its better accuracy. Accordingly, bestnav navigation data were merged on to the SURMET data using 'mbest_04' which merges the vector-averaged heading onto the average speed and course. Finally, the true wind speed and direction were calculated using 'mtruew_01' which added the smoothed 'nav' to the wet wind to calculate the true wind data. To avoid problems associated with averaging wind direction over time, the relative wind speed, ship's heading and course made good were converted to eastward (u) and northward (v) components, using the script muvsd.m. The true wind direction was calculated and the data were averaged into 1-minute bins. The average directions were calculated by their respective u and v components and contained in the file (met_jc064_trueav.nc).

### 5.3.1 Air Temperature and Humidity

The Vaisala sensor was located on the starboard side of the foremast platform.

### 5.3.2 Wind Speed and Direction

The Gill Windsonic was located on the foremast platform. As mentioned also in the JC032 Report, only data from one anemometer was logged so no comparisons with other anemometers were made. A large spotlight has been placed on the front edge of the foremast platform potentially increasing the flow distortion in that region. This will bias the wind speed measurements made from foremast anemometers, especially when the anemometers are directly downwind of the spotlight.

### 5.3.3 List of significant events

Days 253 and 254: 'dps116', 'seapos', 'surflight', 'surfmet' and 'surftsg' data failed to be logged in Techsas NetCDF files. The NetCDF files were regenerated from the Level C by Jon Seddon for these days (Section 4.1). The approach taken was to process these days in subdirectories of a specially created directory: 'met_regen'. 'm_setup', 'mtnames' and 'mday_00' were edited to accept the regenerated variables. 'mday_00' was then run on the regenerated files for the missing days. The metadata of the regenerated files was edited using 'mheadr' to match the missing files. The regenerated files were then moved to the original location as replacements for the missing files. They then fell back in with the routine processing.

## 5.4 Navigation

**Eleni Tzortzi and Cristian López**

### 5.4.1 POSMV

The Applanix POSMV is the primary GPS system used for science on JC064. It is located on the bridge mast and its common reference point is in the gyro/gravimeter room in the centre of the ship. Three data streams are output by the RVS system at 1Hz. 'Posmvpos' contains the ships position whilst the 'posmvtss' contains heading information. The 'gyropmv' data stream contains the posmvtss heading information rounded to 1 decimal place and is not analysed in this report. The 'posmvpos' data were used in the VMADCP processing and for position in the bathymetry, in the SBE45 data files, as well as for the position of the moorings and CTDs.

### 5.4.2 Seapath System

The Seapath 200 system serves as another source for GPS position and ship's attitude. Similarly to 'posmvpos', the Seapath 200 antenna is located to the bridge mast and has its common reference point in the gyro/gravimeter room. Although it is a reliable system, it is not as good as the 'posmvpos' system. Two data RVS streams are available, the seapos and attsea for the ship's position and attitude, respectively.

### 5.4.3 DPS116

The dps116 is located in the bridge mast. Contrary to Seapath 200, it has one antenna i.e. dps116, for the ship's position. Data are logged in the Techsas NetCDF files.

### 5.4.4 Ashtech

The Ashtech instrument is located on the Bridge deck on the starboard side. Two data streams are output by the RVS system: 'adu5pat' and 'adupos', for the attitude and the position of the ship, respectively. The Ashtech system is not used for science as there are better quality systems for heading and position.

### 5.4.5 CNAV

The cnav instrument is located on the antenna, on the ship's mast. It only provides the ship's position and the data are characterized by good resolution, i.e. about 5 cm. This should provide the best GPS when bugs described in Section 4.1 are fixed.

### 5.4.6 Ship's Gyro

The ship's gyrocompass provides a reliable estimate of ship's heading (i.e. not dependent on transmissions external to the ship). However, the instrument is subject to a latitudinal dependent error, heading dependent error and has an inherent oscillation following a change in heading.

Ship's gyrocompass data was logged every second in the TECHSAS system via the RVS data stream as 'gyro_s'. Incremented files were created every day and the gyrocompass data were extracted and processed using the script mgyr_01.m, including the removal of data with headings outside the 0-360 degree range. The gyro data were used to remove any large outliers in the Ashtech system.

### 5.4.7 Routine processing

All data streams were processed in a similar manner. Data were transferred daily from the TECHSAS system using the script mday_00_get_all.m. Any data cycles that were non-monotonic in time were cleaned up using the script mgyr_01.m, while further cleaning up and smoothing of the ash data were followed using the scripts mash_01.m and mash_02.m, Spikes were assigned an absent value using mplxyed. Data were averaged into 1 minute bins.

Finally, using the script mjoin.m, the data were appended into final files named NNN_jc064_01.nc where NNN denotes the kind of data, i.e. 'met_light_jc064_01.nc', 'met_jc064_01.nc' or 'met_tsg_jc064_01.nc'.

Before averaging, the headings were split into east and north components to prevent errors arising from averaging a direction.

### 5.4.8 GPS Accuracy

A small study of the accuracy of the GPS systems was made. Position data while moored in Tenerife were plotted in order to see their distribution, deviation and differences from the other systems.

The data ranged from 10:00:00 to 13:20:00 GMT on 10th September 2011. Figures 15 and 16 show the difference in latitude and longitude with a reference point. Figure 15 subplots all GPS systems individually, taking the median of their latitude and longitude as the reference point (0,0). Figure 16 plots all the systems together, in order to see the

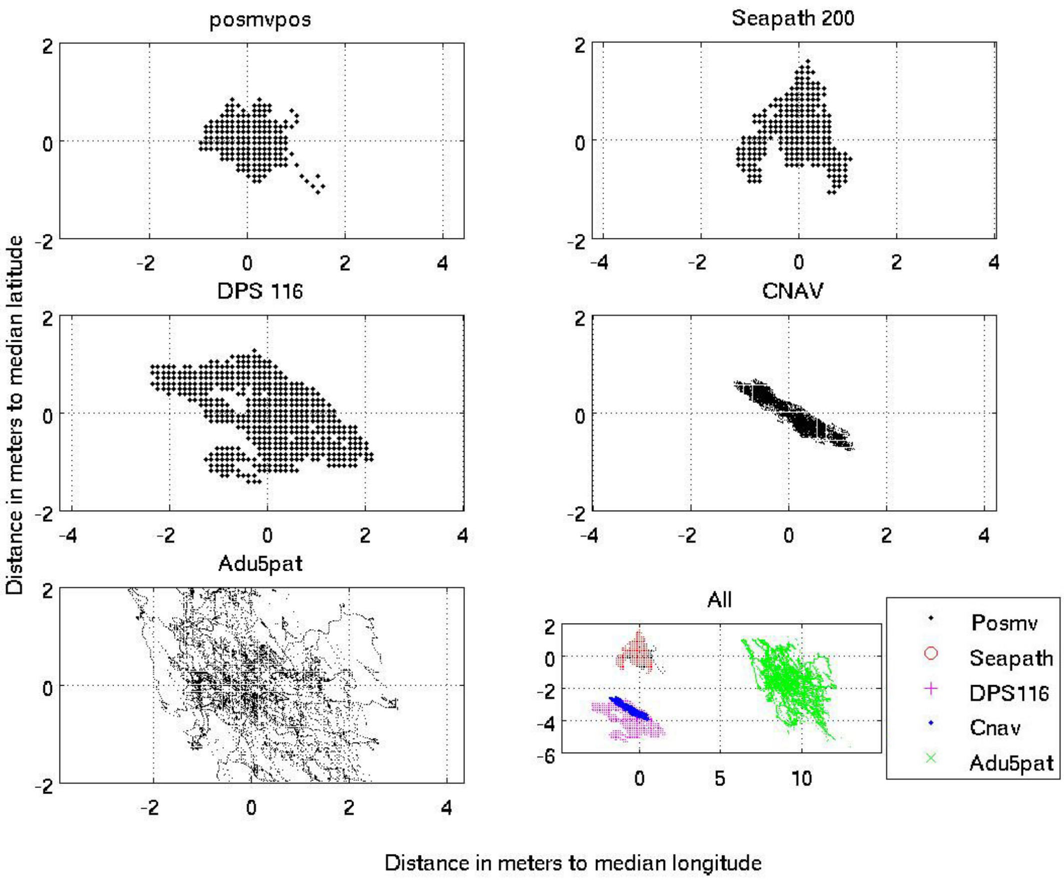



Figure 15: Scatter of the individual GPS systems on the James Cook while moored in Teneriffe.

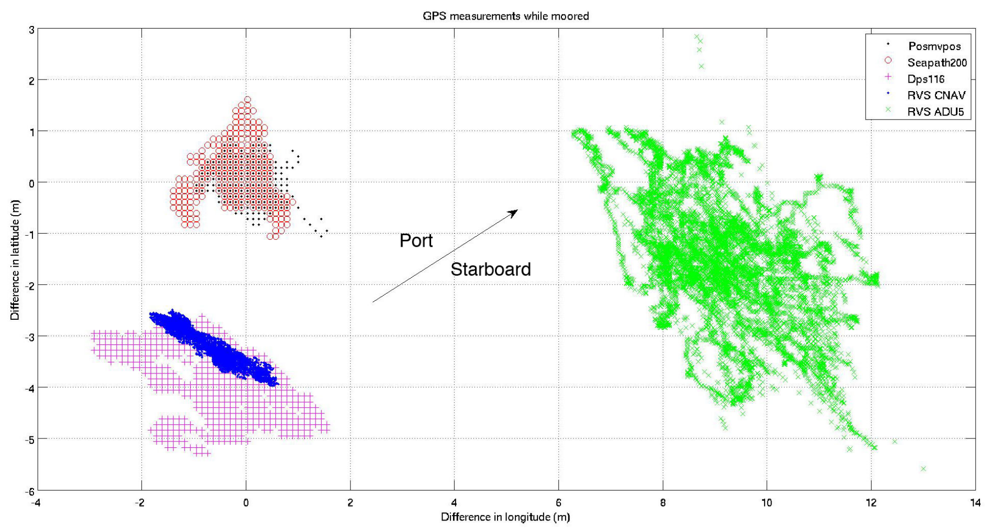



Figure 16: Comparison of different GPS systems on the James Cook. Ship's orientation is indicated using an arrow.

deviation from one another. This time the reference point was the median of Posmvpos, since this is the main GPS system.

It is seen that Posmvpos, Seapath200, DPS116 all log data in beams, with a similar resolution (Figure 15). CNAV shows a much more detailed resolution. Adu5pat shows good resolution, but it seems to have a more random location.

Concerning the accuracy and consistency, Adu5pat is certainly the least accurate, with deviations higher than 2 meters with a large spread. Posmvpos and Seapath both show quite concentrated points with excursions seldom over 1 meter. Conversely, the other systems have larger deviation toward the sides. This is due to the location of the GPS systems. While Posmvpos and Seapath translate the position to a common reference point in the ship's centre, the other systems do not. Hence, these two systems subtract the effect of rolling and pitching, whereas the ship's moving significantly influences the other ones.

A comparison between the five GPS systems is shown in Figure 16 for the period of mooring in Tenerife. An arrow indicates the ship's position during this time. DPS116, CNAV and Adu5pat show a deviation perpendicular to the ship due to the ship's rolling. Furthermore, the deviation to the median is larger towards starboard side, rather than port side. It is due loading operations in port. The cranes operated by starboard, mainly leaning the ship towards that side.

Finally, considering distance differences between one another in Figure 16. It is perceived a significant difference between some of them, larger than the their deviations. It can be explained taking into account the ship's orientation, by the location of every system on the ship. Seapath200 and Posmvpos data overlap, since they are translated to the gravimeter room. DPS116 and CNAV also overlap, though with a slight offset, as their antennas are located on top on the ship's mast, CNAV being slightly closer to bow. Regarding Adu5pat, it is located closer to bow, by starboard side, as shown by its data location.

The most accurate GPS system is Posmvpos. Even though CNAV has the finest resolution, it lacks the rolling correction. Seapath has good accuracy, close to Posmvpos, so it can be used when Posmvpos fails or for comparison and correction. Adu5pat is an obsolete instrument, not reliable for accurate measurements.

## 5.5 Bathymetry

**Eleni Tzortzi and Jon Seddon**

The EA600 and EM120 echo sounders both transmit at 12 kHz and so could interfere with communications to 12 kHz moorings transducers and so were shut off whenever the vessel was communicating with moorings. The ADCPs run at much higher frequencies and were left running.

### 5.5.1 Kongsberg EA600 Single Beam Echo Sounder

The EA600 echo sounder was run for the duration of the cruise. Data were logged as usual to Techsas and Level-C, but additionally raw data were saved in Kongsberg's proprietary binary format and also bitmap images. Hard copy printouts were generated on the Terminal Room laser printer, which were retained by the scientific party to assist with interpolating between gaps in the EA600 data.

The EA600 was used with a constant sound speed velocity of 1500 $ms^{-1}$. Data were post-processed to correct for sound speed by the scientific party. The Level-C data stream prodep was created with the raw EA600 data corrected using Carter table corrections.

Bathymetry data are measured at 1Hz by an EA600 echo sounder and are processed daily. The raw data were initially copied into a file named sim_jc064_dNNN_raw.nc (where NNN refers to the 3 digit Julian day number) using mday_00('sim',day). During the cruise, there were occasions where the EA600 instrument could not locate the bottom and either reported zeros and thus, gaps in the data (Figure 17) or inaccurate depths, which biases the mean towards a shallower value. Therefore, a preliminary clean up of the echo sounder data was made, setting an acceptable depth range between 5 and 10000 m depth, and smoothing the data by calculating the median over a period of 5 minutes using msim_01. The smoothed data, i.e. sim_jc064_dNNN_smooth.nc, were then plotted using msim_plot and the output was compared to a hard copy screen dump of the 4-hour depth trace from the EA600 to manually remove any remaining spurious depths.

After having manually removed any spikes, the bathymetry data were appended to sim_jc064_01.nc using the script mapend_sim. The depths were then corrected to be equivalent to sounding at 1500 m/s using mfix_depth. Finally, the position data from the posmvpos system and the distance run data calculated from the navigation files were merged onto the bathymetry data and the corrected depths were calculated based on carter tables which provide the climatological latitude/longitude dependence. The data were then averaged over 5 km bins using mmerge_sim_nav_jc064 and a file named sim_jc064_nav_merged.nc was created.

### 5.5.2 Kongsberg EM120 Swath System

The EM120 multibeam sonar was run throughout the cruise but the EA600 was not synchronised to the SSU as it was found on the JC063 passage that allowing the EA600 to ping as frequently as it liked produced the best results. When the EA600 was synchronised to the SSU it pinged infrequently and struggled to obtain a bottom track and output depths. Interference from the EM120 was seen on the EA600's screen but it did not appear to affect its ability to track the sea bed.

The EM120 (serial number 203) was run continuously throughout the cruise. Data for two specific sites were processed in Caris and data for the rest of the cruise were exported in an ascii xyz format. The following sound velocity profiles were installed at the date and time specified and were used thereafter.

The EM120 swath system was running throughout the cruise recording the centre beam depth directly beneath the hull via the TECHSAS system. It is known that the flow of water over the ship's hull produces bubbles that are detrimental to the swath depth measurements, and thus it is considered more reliable in calm seas or on station when the number of bubbles passing over the hull is reduced. During the cruise, the instrument was generally more constant in measuring the actual station depth than the single beam EA600 when the sea floor was steeply sloped, e.g. the EA600 depth measurements were occasionally 400m shallower than the actual bottom depth. This was primarily due to the unadjusted sound speed in the EA600.

The EM120 centre beam swath data were preliminarily cleaned up and smoothed using a 5 min median, and the acceptable depth range was set between 5 and 10000 m, using the script mswth_01. A file named em120_jc064_dNNN_smooth.nc was created. Accordingly,

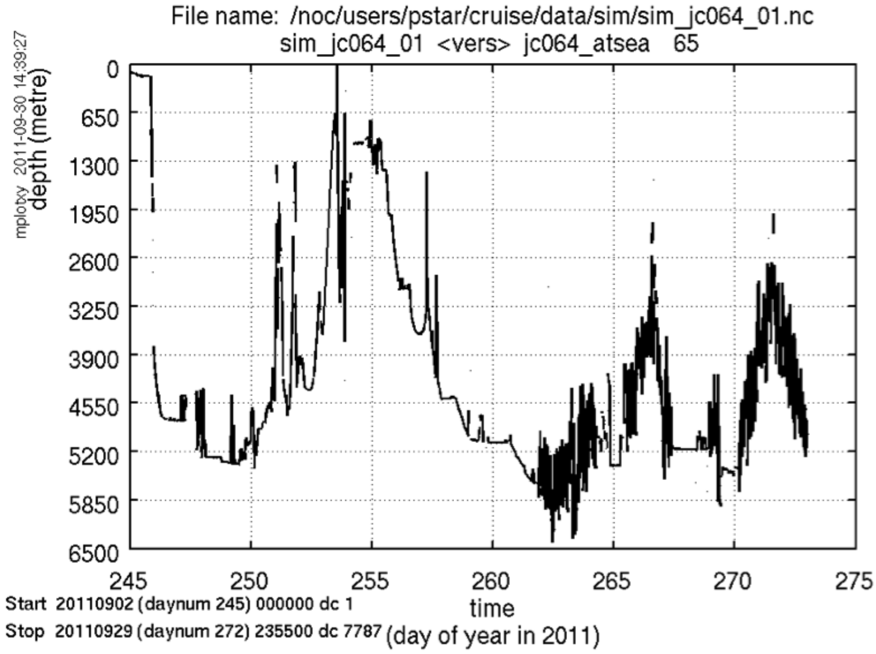



Figure 17: Five minute averaged bathymetry data up to day 272.

the swath data were merged using msim_02 to aid visual editing which was performed using msim_plot. A file named sim_jc064_01_merged.nc was created.

The EM120 was off between 18:23 and 18:30 on 29th September to experiment with gridded data export.

The EM120 PC crashed overnight and so no EM120 data was logged from 20:22 on 1st October until 09:09 on 2nd October.

The EM120 was suffering from an ongoing fault causing steps of around 6 m at either edge of the data. Kongsberg have been investigating this fault and have replaced the timing circuit boards in the previous year and the back plane circuit boards in July 2011. They examined data from JC062 during this cruise and are due to visit the vessel for further work at the end of JC064. An example is shown in Figure 17.

### 5.5.3 Bathymetric Surveys on JC064

**Jon Seddon**

All Caris data are saved in /JC64/Ship_Systems/Acoustics/EM-120/EM120_Caris_Processed of the cruise data structure, with the ASCII output in the export subdirectories.

### 5.5.4 Eastern Boundary Glider Site

Starting at 19:15 UT on 11th September 2011 a swath survey was carried out in the Eastern Boundary area where there is currently a glider operating. The brief for the survey was to survey the largest possible coverage of the operational area of the SeaGlider Bellatrix in the time available before moorings operations resumed at 06:30 the following morning. Maximising coverage was to be preferred to perfect data quality. The scientists supplied a historical sound velocity profile from mooring data rather than gathering a

| Line Number | Start Time, UT | Heading, °(T) | Start Lat. | Start Long. |
|---:|---:|---:|---:|---:|
| 7 | 1:50 | 90 | 27°51.42' N | 013°45.58' W |
| 18 | 19:15 | 30 | 27°52.41' N | 013°30.87' W |
| 19 | 20:37 | End of line (eol) | 28°00' N | 013°27' W |
| 20 | 21:07 | 180 | 28°00' N | 013°30' W |
| 21 | 22:41 | eol | 27°47' N | 013°30' W |
| 22 | 23:02 | 0 | 27°47' N | 013°33' W |
| 23 | 0:33 | eol | 28°00' N | 013°33' W |
| 24 | 0:55 | 180 | 28°00' N | 013°36' W |
| 25 | 2:35 | eol | 27°45' N | 013°36' W |
| 26 | 2:59 | 0 | 27°45' N | 013°39' W |
| 27 | 4:23 | eol | 27°57' N | 013°39' W |
| 28 | 4:47 | 180 | 27°57' N | 013°42' W |
| 29 | 5:12 | eol | 27°52.44' N | 013°42' W |

Table 6: Lines run during Eastern Boundary swath survey

current sound velocity profile using the CTD or sound velocity profiler. There was no time available either to check the calibration of the swath bathymetry system.

The water depth was around 1000 m and so the James Cook's EM120 system (serial number 203) was used. To maximise data coverage the beam width was set to ±70°, giving a swath width of 4000 to 5000 m. The survey speed was initially 6 knots but was rapidly increased to 8 knots and then 9 knots for the final line to make sure that the ship was back at the mooring site for the following mornings work. The sea conditions were calm and at 8 and 9 knots there appeared to be few gaps in the data. Additional data were incorporated from a line when the ship was transiting to the area earlier in the day.

A summary of the lines run appear in Table 6 and Figure 18(l).

No tidal correction was added to the data during its processing as it was suggested that tidal variations in this area are minimal, particularly when compared with the depth of the water.

Despite no calibration being performed before the survey, enough suitable data was identified to check the pitch and roll alignment of the EM120. For pitch a trench between lines 018 and 020 was used and the Caris calibration module showed no pitch error (Figure 18(r)).

For the roll calibration overlapping data between lines 024 and 026 were used. Using the Caris calibration module a roll error of +0.86°was identified. When this was applied to the vessel file it could be seen in the overlap between lines 018 and 020 that this estimate of the roll error was too great. The roll error was then manually adjusted and an error of +0.30°gave the best fit. The overestimation from the calibration module was because of the known problem with the EM120 that Kongsberg are investigating that causes a step in the data (Figure 19(l)).

This step was observed between lines 024 (peach) and 026 (blue) and the magnitude of the step in line 024 was 6 metres.

The data were manually cleaned using Caris' swath editor. Spikes in the data were marked as rejected. Figure 19(r) shows typical cleaning performed. The data were from line 020. Green data were captured by the starboard half of the transducer and red by the port side. Data marked as rejected are grey. Care had to be taken to not remove

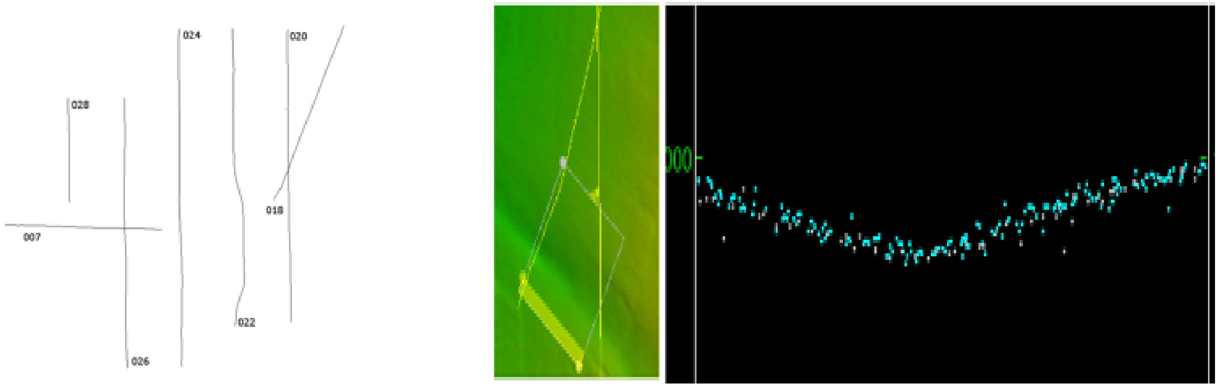



Figure 18: (l) Swath lines run during the eastern boundary swath survey described in Table 6. (r) Pitch error between lines 018 and 020.

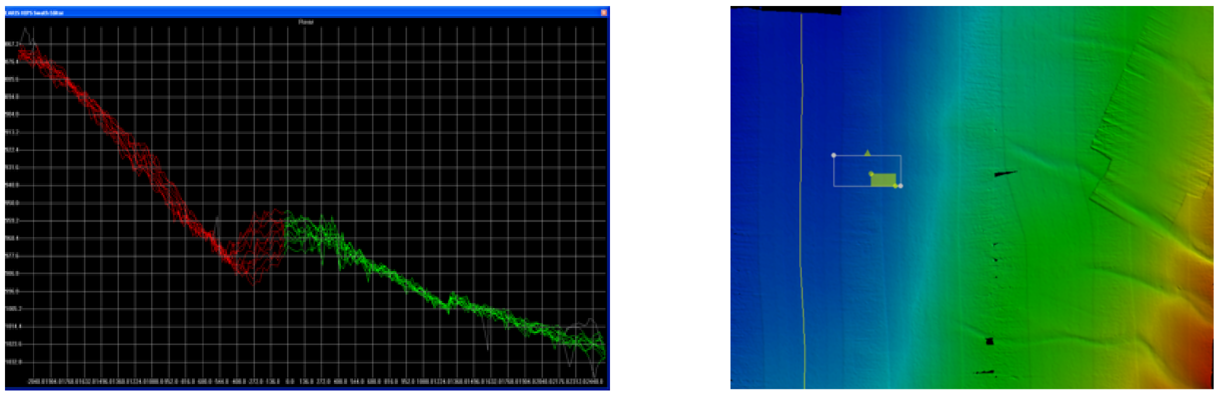


Figure 19: (l) Step in the data. (r) Spikes in the data.

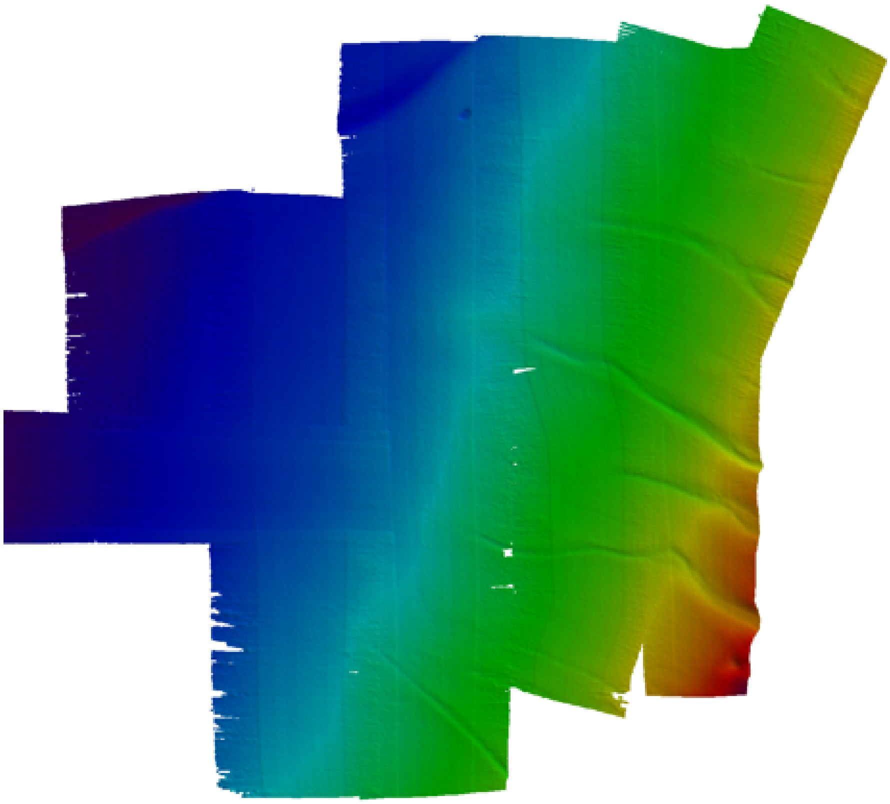


Figure 20: Final data from swath survey at the Eastern Boundary.

objects such as the deep hole in the north of the area that can look similar to noise in the swath editor.

The depths were produced from an Uncertainty BASE surface, which was found to give the results.

A geo-referenced TIFF image file was produced along with a gridded xy-depth text output, with depths at 25 m intervals. The positions in the gridded text output are in decimal degree latitude and longitude format.

#### 5.5.5 MAR0 Mooring Site

The EM120 data from the MAR0 mooring site was also processed in Caris. A dedicated survey of the MAR0 was not performed and data from the EM120 running continuously at the mooring site was used. As the vessel was either sat on station under DP control, or steaming slowly during mooring deployment and recovery there were a large number of overlapping data points. These were cleaned using swath and TPU order 2 filters, and some manual editing in the swath editor. A CUBE surface was used as its hypothesis generation was found to generate the most accurate surface from the overlapping data points. Because of the large number of data points the CUBE surface generation was able to eliminate the problems caused by the EM120's step fault apart from the eastern most area, which was only sampled by a single line. The data were again exported in a geo-referenced TIFF image and decimal degree comma separated ASCII.

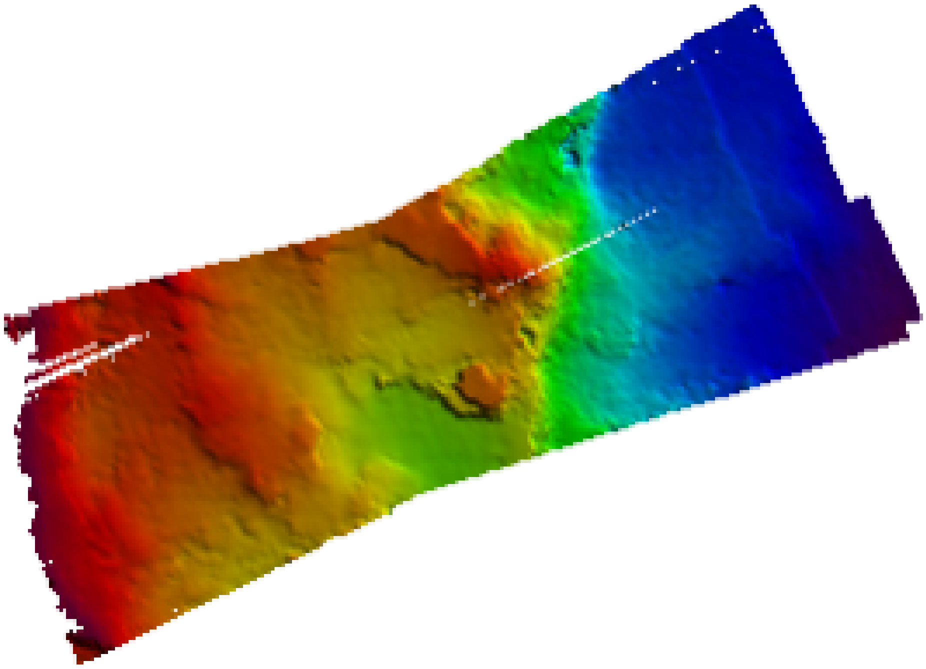


Figure 21: Final data from swath survey at the MAR0.

## 5.6 WAMOS Wave Radar

The WAMOS wave radar was operated from the start of the cruise until it began to have problems rotating its antenna at 00:00 on 22nd September. The antenna failed completely later that day. A crane and a man cage is required to access the antenna. A radar engineer has been arranged to visit the vessel in port at the end of JC064.

## 5.7 Waterfall System

One of the JC064 PIES landers that was recovered was fitted with a beacon that pinged every 4 seconds at a frequency of 12 kHz. An attempt was made to track this beacon using the ship's fitted waterfall display system.

The waterfall display is designed to operate with 10 kHz pingers and due to damage to the 12 kHz moorings transducer the only transducer that could be used was the single element of the 10 kHz EA500 echo sounder. However, by using the maximum possible gain on the waterfall system and tuning the gains on the display the beacon was tracked to the surface. Considerable noise was encountered when the azimuth thruster was operating. The weather conditions at the time were calm and so the bridge were happy to disable the azimuth thruster, allowing continuous tracking of the beacon.

The waterfall system acquires 3900 samples every four seconds and these are displayed along the x-axis with the start of the sampling period on the left hand side of the screen and the last sample at the right hand side. At the end of four seconds these samples are shifted down one row and the next 3900 samples are displayed across the top row. If a pinger is stationary in the water column then a vertical line will be drawn on the screen. If the pinger is rising to the surface then the trace will be go from the bottom-right to the top-left with a faster ascent rate producing a trace closer to the horizontal. A descending pinger will result in a trace from the bottom-left to the top-right. This assumes that the pinger's ping period is exactly 4 seconds.

On later recoveries of Ixsea releases, experiments were made using the pinger mode of the 12 kHz EA600 echo sounder. The EA600 has the facility to track a pinger by detecting the pinger and the bounce of its pulse off the sea floor, or the doppler of the beacon. The EA600's pinger mode requires the initial depth of the pinger to be known. However, the EA600 was unable to track the beacon. If this functionality is required on future cruises then time should be made available on a trials cruise to test the EA600's pinger mode with a 12 kHz pinger on a wire to allow the technicians to gain experience of using this mode of the EA600. The Ixsea's ping repetition rate was 5 seconds. They could be heard on the Waterfall display's speaker and seen on its analogue display, but could not be tracked because the Waterfall software has sampling periods of 4, 2, 1, 0.5 and 0.25 seconds and so could not synchronise with the Ixsea pinger.

## 5.8 Moorings Transducers

The new 12 kHz moorings transducer fitted to the starboard drop keel during the July 2011 refit had not been tested due to the cancellation of the trials cruise. Prior to the start of JC064 its capacitance was measured in the main lab as 29.3 nF. It was used unsuccessfully to communicate with the first mooring and the EA500's 10 kHz single element was successfully used for the rest of the cruise instead. After this first use the 12 kHz transducer's capacitance had increased to a value in the order of microfarads. The transducer and wiring will be tested during the next port call to establish what happened.

## 5.9 Development of RAPID-WIDGIT

**Patrick Farrell**

RAPID-WIDGIT is a MATLAB chart plotter used to provide planning support to the science program. Over the course of JC064, some minor improvements were made to the program.

- When the user clicked a point on the map, the program displayed the longitude and latitude of the point clicked. This has been extended so that it also displays the bathymetry of the point clicked. The algorithm cycles through all of the zoom bathymetry files first, and if none of these return a value, the large-scale background bathymetry dataset is used. The value is computed using the interp2 MATLAB routine (in src/plotetopo2fn_dham.m).

- Previously, the axes were labelled in DD.dddd°format (e.g., 26.5°). This has been changed so that it displays DD°MM.mmmm' format instead (e.g., 26° 30.0'). This logic is encapsulated in the new plot_etopo2_set_axis_ticks function, which is now called wherever the axes are updated (plot_etopo2_zoomin, plot_etopo2_zoomout, plot_etopo2_plot_map, plot_etopo2_mask_tiles).

- When the user scrolls the mousewheel, the bathymetry plot now zooms in or out. This does not work when the mouse mode is set to 'pan', but works for all others.

- At one point during the cruise there was concern over the proximity of tropical storm Philippe. The program (/noc/users/pstar/atlantic_storms/parse_at.py) in Python fetches the NOAA RSS feed for the storms currently present in the North Atlantic, parses the NOAA report for its location and velocity, and records this data in a plain text file (/noc/users/pstar/atlantic_storms/atlantic_storms.txt). A button was added to RAPID-WIDGIT to invoke this program and to plot the storm locations on the chart.

| No. | Date | Time | Lat | Lon | Pmax (db) | Dmax (m) | Corr. Depth (m) | Depth corr. |
|---|---|---|---|---|---|---|---|---|
| 1 | 9/5/11 | 9:15:37 | 42.326 | -14.584 | 5309.9 | 5203.8 | 5225.9 | 52.1 |
| 2 | 9/5/11 | 14:31:38 | 42.327 | -14.584 | 5308.1 | 5201.8 | 5253.8 | 52 |
| 3 | 9/14/11 | 22:42:58 | 24.922 | -21.318 | 4573.4 | 4495.7 | 4552.6 | 26.9 |
| 4 | 9/15/11 | 3:14:05 | 24.922 | -21.318 | 4575 | 4497.3 | 4524.2 | 26.9 |
| 5 | 9/16/11 | 4:35:32 | 23.733 | -24.105 | 5158.6 | 5064.8 | 5107.7 | 42.9 |
| 6 | 9/16/11 | 21:51:53 | 23.701 | -24.226 | 5202 | 5106.9 | 5151.1 | 44.2 |
| 7 | 9/17/11 | 3:24:00 | 23.701 | -24.226 | 5201.5 | 5106.4 | 5150.5 | 44.1 |
| 8 | 9/21/11 | 22:16:28 | 23.842 | -41.067 | 5302.4 | 5204.3 | 5251.4 | 47.1 |
| 9 | 9/22/11 | 3:32:22 | 23.842 | -41.067 | 5303 | 5204.8 | 5251.9 | 47.1 |
| 10 | 9/25/11 | 4:18:25 | 24.179 | -49.718 | 5301.9 | 5203.7 | 5254.8 | 51.1 |
| 11 | 9/26/11 | 14:10:04 | 24.114 | -52.017 | 3038.3 | 2997.3 | 3005.2 | 7.9 |
| 12 | 9/26/11 | 18:40:25 | 25.106 | -52.012 | 5636.3 | 5527.5 | 5590.3 | 62.8 |
| 13 | 9/27/11 | 1:20:04 | 25.113 | -52.014 | 5300 | 5201.5 | 5252.5 | 51 |

Table 7: Deployment information for CTD stations. Time and position are given when the CTD is at the bottom of the cast.

# 6 Lowered CTD Programme

The ships CTD and rosette were used for performing calibration dips, for which the standard RAPID procedure was used: every other Niskin bottle was removed so that 12 MicroCATs could be mounted with the Niskin bottle hardware for in situ calibration. One cast (station 12) used 24 Niskin bottles, as additional samples of Antarctic Bottom Water were desired.

A total of 13 CTD casts were made for MicroCAT calibration or pressure release testing. The stations are summarised in Table 7.

On CTD 9, the primary conductivity sensor suffered from biological fouling on part of the downcast, causing a large spike in the T-S plot. The problem resolved itself after a short period, so no further action was taken.

For CTD 10, the plan was to begin the cast at approximately 21:00 (GMT), and to follow that with an additional overnight CTD cast. However, technical difficulties were encountered with the winch, and the CTD could not be hauled overboard until 02:00 (GMT). Therefore, only one cast was performed that night. The same issue with the winch occurred at the beginning of CTD 11, but the problem was quickly resolved as the deck crew recognised the fault.

# 7 CTD Operations

**Jeff Benson**

The initial sensor configuration was as follows:

- Sea-Bird 9plus underwater unit, s/n: 09P-0943

- Frequency 0 - Sea-Bird 3 Premium temperature sensor, s/n: 03P- 2674
- Frequency 1 - Sea-Bird 4 conductivity sensor, s/n: 04C-2231
- Frequency 2 - Digiquartz temperature compensated pressure sensor, s/n: 110557
- Frequency 3 - Sea-Bird 3 Premium temperature sensor, s/n: 03P - 4872
- Frequency 4 - Sea-Bird 4 conductivity sensor, s/n: 04C-3258
- V0 - Sea-Bird 43 dissolved oxygen sensor, s/n: 43-0363
- V2 - Benthos PSA-916T 7Hz altimeter, s/n: 41302
- V3 - Free
- V4 - Free
- V5 - Free
- V6 - Free
- V7 - Free

Ancillary instruments & components:

- Sea-Bird 11plus deck unit, s/n: 11P-24680-0587
- Sea-Bird 24-position Carousel, s/n: 32-19817-0243
- 12 x Ocean Test Equipment 10L water samplers, s/n: 1A, 3A, 5A, 7A, 9A, 11A, 13A, 15A, 17A, 19A, 21A, 23A

13 CTD casts were made and they were primarily carried out for SBE 37 MicroCAT calibration and release tests. Log sheets were scanned and included with the data from this cruise.

The pressure sensor was located 30cm below the bottom and approximately 75cm below the centre of the 10L water sampling bottles.

The carousel was fitted with 12 water samplers in alternate positions, excepting cast 012, which included the remaining even numbered samplers (2A through 24A).

The configuration file used was JC064_NMEA.xmlcon, and JC064_NMEA_oxy.xmlcon (see Appendix A).

# 8 CTD Data Processing

**Patrick Farrell and Gerard McCarthy**

CTD cast data were post-processed according to guidelines established with BODC (ref. Moncoiffe 7th July 2010). Additional post-processing was undertaken for RAPID; these files were created separately from standard BODC processed files, and are designated by rapid appended in the file names.

| Raw CTD files | |
|---|---|
| CTD_JC064_XXX.CON | Configuration file |
| CTD_JC064_XXX.bl | Bottle file |
| CTD_JC064_XXX.hdr | Header file |
| CTD_JC064_XXX.hex | Data, in ASCII format but data is in hex |
| Processed CTD files | |
| CTD_JC064_XXX.btl | Bottle summary file |
| CTD_JC064_XXX.cnv | Data, in plain text arranged in columns |
| CTD_JC064_XXX_ctm.cnv | Data, corrected for the conductivity cells thermal mass |
| CTD_JC064_XXX.ros | Rosette file |

Table 8: Example CTD files (where XXX is replaced with the cast number, e.g. 001) that are copied from the PC that runs the CTD and deck unit rosette to cookfs.

Crucial to this setup was to ensure that the begin archiving immediately option was selected. When not selected it causes a timing discrepancy of up to ten minutes. This causes problems when compared with microCATs on caldips.

Variables and units were selected as:

- Time
- Depth
- Pressure (dbar)
- Temperature, 1&2, °C
- Conductivity, 1&2, mS/cm
- Scan
- Altimeter

The CTD casts were processed with the MEXEC routines written by Brian King. These routines are higher-level processing programs that depend on the MSTAR library. MSTAR is a replacement to PSTAR, runs in MATLAB and uses NetCDF as its native format. The base directory for CTD processing on oceanus is /noc/users/-pstar/cruise/data/ctd.

The raw data files e.g. CTD_JC064_XXX.bl and CTD_JC064_XXX.hex, where XXX is the CTD cast number – are converted with Seabird processing software (SBE Data Processing, v7.20g) to CTD_JC064_XXX.cnv, CTD_JC064_XXX.ros, and CTD_JC064_XXX_ctm.cnv. The data in CTD_JC064_XXX_ctm.cnv are corrected for cell thermal mass effects using an adaptive filter with alpha = 0.03 and tau = 7.0. All the files from the Seabird processing are shown in Table 8.

In MATLAB, the MEXEC routines are initialised with m_setup. The following routines are run in the order given (all written and described by Brian King, except for mplotud):

1. msam_01
2. mctd_01

3. mctd_02
4. mctd_03
5. mdcs_01
6. mdcs_02

At this point, the bottom pressure identified is compared against the recorded depth of the CTD cast with sw_dpth.

1. mdcs_03, which requires user input for identifying the start of the downcast and the end of the upcast.
2. mctd_04
3. mplotxy_ctdck, which plots the data from a given CTD cast against previous CTD casts. This required significant debugging to get it working again.
4. mplotud (newly written), which plots the T-S profile of the primary and secondary sensors, for both the downcast and upcast. This allows the primary and secondary sensors to be compared, and the downcast and upcast to be compared.
5. mdcs_04, which requires the daily processing to have been performed for the day of the CTD cast.
6. mfir_01
7. mfir_02
8. mfir_03
9. mfir_04
10. mwin_01
11. mwin_03
12. mwin_04
13. mdcs_05

This is all the processing that can be done without the bottle salinity data. Once the bottle salinity data is available, the following scripts are run:

1. msal_01
2. msal_02

All output files from these routines are saved in the base CTD directory. On inspection, it was found that msal_01 (which applies the offsets given in table 4 to the bottle sample data for each cast) had hardcoded the bath temperature of the salinometer to be 24°. Furthermore, this parameter was not displayed anywhere in its output, which could lead to errors in the calibration if the bath temperature was not 24° (on JC064, it was 21°). The msal_01 script was modified so that it requests the bath temperature from the operator.

| Date | Crate No. | CTD No./TSG No. | Start offset | Mid offset | End offset | Comments |
|---|---|---|---|---|---|---|
| 9/7/11 | 7 | CTD1/CTD2 | 0 | 2.60E-05 | 4.80E-05 | P153 |
| 9/9/11 | 3 | TSG1 | 0 | 2.40E-05 | 2.10E-05 | P151 |
| 9/19/11 | 6 | TSG2 | -1.50E-05 | 3.50E-05 | 6.60E-05 | P153 |
| 9/19/11 | 8 | CTD3/CTD4 | 6.60E-05 | 4.90E-05 | 7.40E-05 | P153 |
| 9/19/11 | 7 | CTD5/CTD6 | 7.40E-05 | 6.90E-05 | 8.90E-05 | P153 |
| 9/25/11 | 3 | TSG3 | -3.00E-05 | 1.20E-05 | 4.00E-06 | P153 |
| 9/25/11 | 25 | CTD7/CTD8 | 4.00E-06 | 4.10E-05 | 3.20E-05 | P153 |
| 9/30/11 | 7 | CTD9/CTD10 | 3.20E-05 | 4.60E-05 | 7.10E-05 | P153 |
| 9/30/11 | 8 | CTD11/CTD12 | 7.10E-05 | 8.20E-05 | 8.10E-05 | P153 |
| 9/30/11 | 25 | CTD12/CTD13 | 8.10E-05 | 1.08E-04 | 9.70E-05 | P153 |

Table 9: Salinometer offset data. Offset is measured conductivity of standard seawater - known conductivity of standard seawater.

# 9 Salinometry

**Jeff Benson and Patrick Farrell**

A Guildline Autosal 8400B salinometer, s/n: 68426, was used for salinity measurements. A total of 218 salinity samples were taken during the cruise for CTD analysis. The salinometer was sited in the Constant Temperature Laboratory, with the bath temperature set at 21°C, the ambient temperature being $20 - 22$°C. A bespoke program written in Labview called Autosal was used as the data recording program for salinity values.

Before the salinometer may be used to calibrate the CTD casts, the salinometer itself must be calibrated by measuring the conductivity of standard seawater and comparing the value obtained against the known true value. For all measurements, the salinometer bath was maintained at 21°.

Due to confusion over the supply of standard seawater, the salinometer was standardised three times over the course of JC063/JC064:

1. On 2011-09-07, the salinometer was standardised against standard seawater batch P153 (2K15=1.99958, salinity=34.992). The salinometer was then used to measure the conductivity of the seawater samples taken on CTD casts 1 and 2.

2. On 2011-09-09, the salinometer was standardised against standard seawater batch P151 (2K15=1.99994, salinity=34.999). The salinometer was then used to measure the conductivity of the seawater samples taken while underway on JC063.

3. On 2011-09-10, the salinometer was standardised again against standard seawater batch P153 (2K15=1.99958, salinity=34.992). The salinometer was then used for the remainder of the measurements performed on the cruise without any re-standardisation.

On 2011-09-28, it was observed that the constant temperature laboratory was not, in fact, at a constant temperature. Over the night of the 27th/28th, the temperature in the room had dropped to 12.5°. The apparent cause of this anomaly was maintenance performed by the ETO without the knowledge of the Deck/E, who is responsible for the maintenance of the laboratory. The minimum temperature at which the salinometer can

| CTD No. | Start offset | Mid offset | End offset | Offset applied |
|---|---|---|---|---|
| 1 | 0 | N/A | 2.60E-05 | 1.30E-05 |
| 2 | 2.60E-05 | N/A | 4.80E-05 | 3.70E-05 |
| 3 | 6.60E-05 | N/A | 4.90E-05 | 5.75E-05 |
| 4 | 4.90E-05 | N/A | 7.40E-05 | 6.15E-05 |
| 5 | 7.40E-05 | N/A | 6.90E-05 | 7.15E-05 |
| 6 | 6.90E-05 | N/A | 8.90E-05 | 7.90E-05 |
| 7 | 4.00E-06 | N/A | 4.10E-05 | 2.25E-05 |
| 8 | 4.10E-05 | N/A | 3.20E-05 | 3.65E-05 |
| 9 | 3.20E-05 | N/A | 4.60E-05 | 3.90E-05 |
| 10 | 4.60E-05 | N/A | 7.10E-05 | 5.85E-05 |
| 11 | 7.10E-05 | N/A | 8.20E-05 | 7.65E-05 |
| 12 | 8.20E-05 | 8.10E-05 | 1.08E-04 | 9.03E-05 |
| 13 | 1.01E-04 | N/A | 9.70E-05 | 9.89E-05 |

Table 10: Salinometer offset for each CTD cast. The offset applied is (measured conductivity of standard seawater) - (known conductivity of standard seawater). Only CTD12 has a middle value, as only CTD12 used 24 Niskin bottles. Salinity adjustment is measured in PSU.

be used is 15°. In the attempt to restore the temperature of the room to 20°, the heater was left on too long and the room temperature rose to 22°. As the temperature must remain stable for at least 24 hours before the salinometer is used, this caused a delay of several days to the science program.

The processing of the salinity data proceeds as follows. Conductivity data from the salinometer are entered into Excel files (e.g., BOTTLE_SALTS/JC064 CTD crate 7 19 September 2011.xls). These Excel files are exported to comma-separated value (CSV) format (e.g., BOTTLE_SALTS/sal_JC064_001.csv). The first column of the data must be ctdXXX, where XXX is the station number (e.g. 001 or 002). This allows for the data for several CTD casts to be stored in the same Excel/CSV file, as the salinometer is usually run for two or three casts in one sitting. The last column is entered by hand: it contains the CTD cast, followed by the bottle number (e.g. 105 for the bottle in position No. 5 on cast 1). These data are derived from the CTD logsheet. The Excel/CSV file also contains the measurement of the conductivity of the standard seawater, which is used to measure the instrument drift.

## 9.1 Calibration of CTD casts against the salinometer

The CTD conductivity measurements are calibrated against the water samples measured by the salinometer. The conductivity measurements typically drift the fastest of the three quantities measured by a CTD (compared to temperature and pressure, Seabird CTD Calibration Manual), and conductivity usually reads low compared to bottle samples by a constant multiplicative factor.

Before the calibrations are calculated, the bottle samples have to be inspected carefully and data points removed that are statistically different from the other bottle samples. This is done by considering the residual difference ΔC between the bottle conductivities CBOT and CTD conductivities CCTD. Data points are removed if the residual exceeds certain limits (> 0.005 or < −0.002 mS/cm) or if it is larger than three standard deviations from each station average. Out of 168 bottle samples, 30 are removed by the first criterion and none by the second. The data points picked for analysis are shown in Figure 22.

The first correction is to correct for a multiplicative factor between the bottle conductivity and the CTD conductivity, which is called a slope correction. As no distinct groups of casts were identified, all 13 stations were treated as one block in the ctd_cal script. The CTD data were multiplied by a correction factor of 1.000027 for all stations. Applying this correction produces residuals that are better centred around zero (Figure 23).

After the ratio correction there still remains an increase of residual with depth (Figure 23). As employed in the CTD processing of cruise D344, a quadratic fit of residual difference against pressure was computed and applied to the CTD cast data. The quadratic polynomial computed by ctd_cal was

$$\Delta C = (1.6028\,\exp^{-11})p2 - (3.6391\,\exp^{-07})p + 0.0007507.$$

As on D344, the procedure for applying the calibration consisted of the following steps.

1. ctd_cal (which computes the slope correction and quadratic polynomial)
2. calibrate_ctd (which loops through all of the stations and calls apply_calibration)

Several bugs were discovered and fixed in each of these scripts (ctd_cal, calibrate_ctd, and apply_calibration).

- ctd_cal was hardcoded for D344, with many cruise-specific filenames. More importantly, there were many cruise-specific branches to specially treat casts 3, 16 and 26. These were removed.
- ctd_cal was unable to apply the slope correction to all of the casts together; in several places, it assumed that the casts were divided into at least two blocks. These assumptions were removed.
- ctd_cal assumed it was to be called from the cruise/data/ctd directory. This assumption was removed.
- ctd_cal was not safe when called multiple times. Running ctd_cal once in a matlab session and then running it again would lead to errors to do with locked NetCDF files. Additionally, the script checked whether its output already existed and behaved differently in that case. These issues were fixed: the script should now behave the same when called repeatedly.
- ctd_cal had the number of stations hardcoded in several places, including the paths of the files to inspect. This was replaced with a call to dir, which identifies the files without having to edit the script.
- The block of code which saved the calibration constants had been disabled by placing it inside an if 1 == 0 block. This was removed.
- The calibrate_ctd script was again hardcoded for D344. This was changed to use a cruise variable defined by the operator at the top of the script.

- calibrate_ctd called ctd_all_part2, which includes the insertion of the winch cable data. However, CTD casts 1 and 2 were formally part of JC063, and the winch data was not available (mwin_* could not be successfully run). Therefore, calibrate_ctd was modified so that it executes all of the steps of ctd_all_part2 except for the mwin_* steps.

- apply_calibration was again hardcoded for D344. This was replaced with a cruise variable defined at the top of the script.

- apply_calibration uses the unix cp command to copy files around. However, the invocation of cp lacked the f flag, which meant that if the script were run more than once, it required operator intervention to give consent to the overwriting of temporary internal intermediate files. This was fixed by adding the f flag to the invocation of cp.

- apply_calibration was not safe when called multiple times. If the execution of the script were aborted due to a bug, it would fail to execute due to the locks placed on files during the previous execution, or due to the existence of temporary files that the script would fail to overwrite. The script was modified so that it could be invoked multiple times safely.

- apply_calibration assumed that the conductivity was stored in a variable called cond in the CTD file. This was not true on JC064: instead, there are two variables, cond1 and cond2, for the primary and secondary sensor respectively. This required several changes to the script to enforce. Now, the script uses the mctd_sensor_choice function to decide which sensor to use, and uses that choice as the basis for the calibration.

- The use of mheadr to rename the computed calibrated conductivity (cond_corr) to the appropriate variable name for use in downstream processing (cond1 or cond2, as appropriate) did not work. I hypothesise that at some point between D344 and JC064, mheadr was modified so that if the user attempted to rename a variable to have the same name as an already existing variable, it failed. The invocation of mheadr was changed to work with the currently existing version.

Once these issues were fixed, the calibrate_ctd script executed successfully. The calibrated data can be seen in Figure 24.

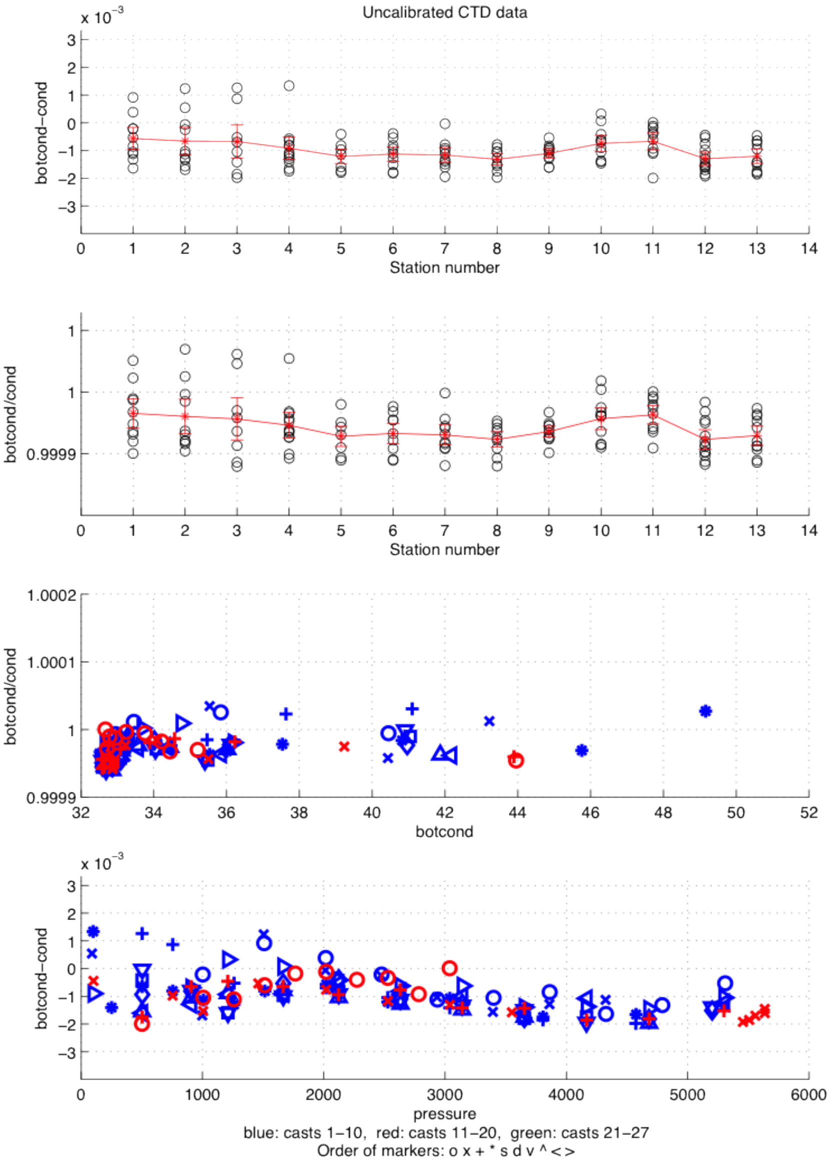



Figure 22: Uncalibrated CTD data. a) The conductivity difference for each station. b) The conductivity ratio for each station. c) The conductivity ratio plotted against conductivity. d) The conductivity ratio plotted against pressure.

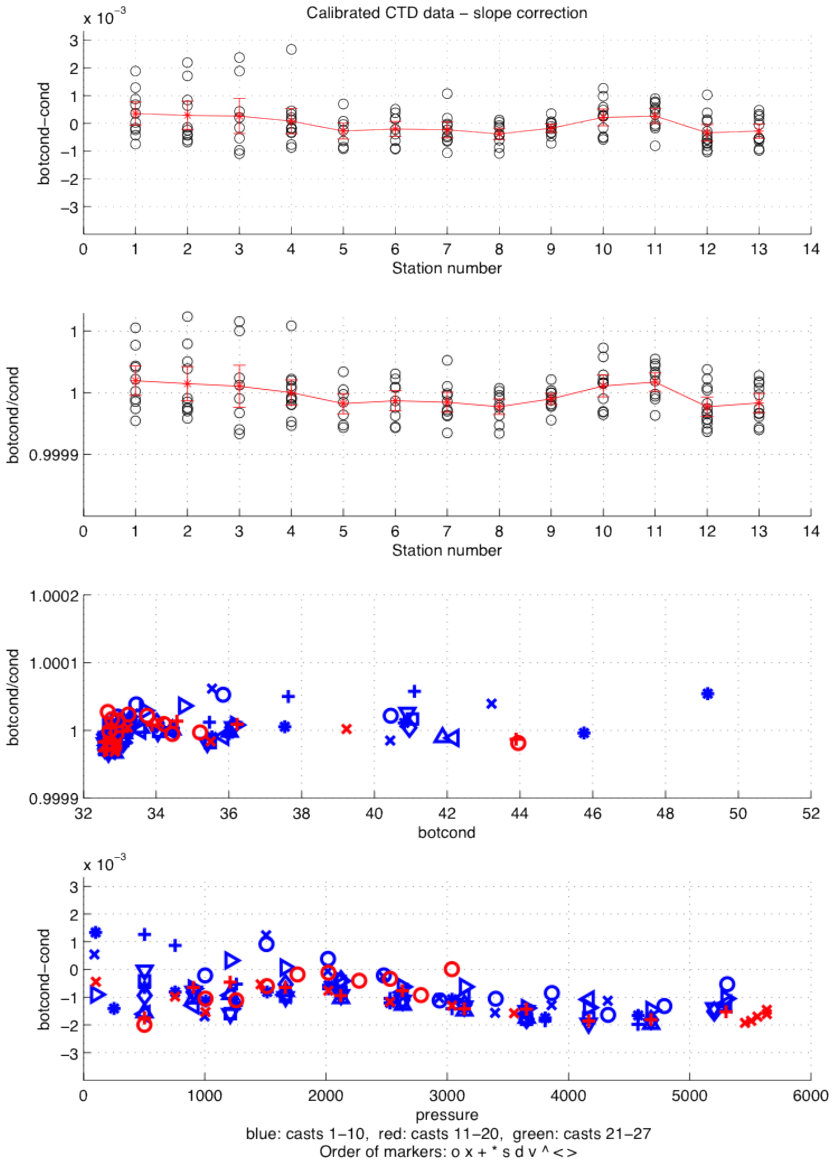



Figure 23: CTD data calibrated with the slope correction. Otherwise, a)-d) are as in Figure 22

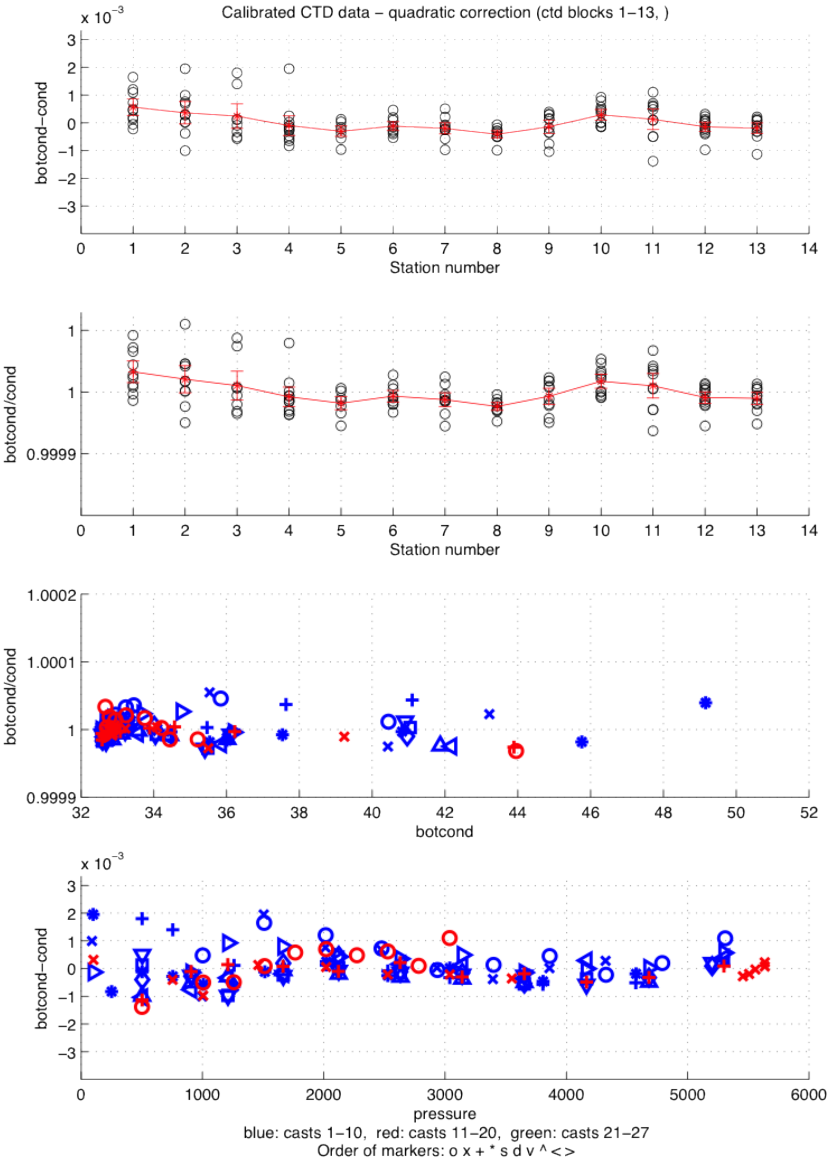



Figure 24: CTD data calibrated with slope correction and quadratic pressure fit. Otherwise, a)-d) are as in Figure 22

# 10 Mooring Operations

**Robert McLachlan**

Mooring recovery and deployments were carried out using the Double Barrel winch with two reelers; one placed forward of the winch and one to the STBD side utilising a diverter sheave. The AFT pedestal crane was used with a hanging block on for the mooring wires/ropes and hardware to pass through. During deployments both AFT pedestal cranes were used to deploy the anchor; one to take the load of the outboard mooring and one to lift the anchor in to the water. Both were then released using two Seacatch release hooks.

The smaller rope moorings were deployed by hand out of baskets with the anchor being deployed using the crane. A stopper anchored to the deck was used to transfer the loads of the mooring when needed and the carpenters stop was used on occasion when tangles impeded the use of the stopper.

## 10.1 Design changes

During the cruise the need arose on occasion to alter the design of the moorings.

1. Landers. The first Lander deployed, EBH4L3, did not sink so it was recovered. Investigation showed that the anchor was of the wrong dimensions and therefore not as heavy as it should have been. It also became apparent that even with the correct dimensions the anchor was still not heavy enough. It was decide to remove one glass sphere from each of the three packs. This design change was adopted for all of the Lander deployments on this expedition. For future Lander deployments the larger 600kg anchors will be used and the buoyancy returned to three packs of four.

2. MAR0. The original design had only glass spheres at the top with no place to locate a recovery beacon. It was decided that a Billings float would be incorporated in to the design along with a location beacon. It was also noted that there is now a double release Lander at the anchor; so more back up buoyancy was needed. The final design therefore consisted of removing one glass sphere from the top three pack of glass and inserting a Billings float and the bottom six pack of glass was increased to eight.

3. EBH1. The accent of the bottom pack of glass spheres on EBH1 was noted as being quite slow and was subsequently noticed being partially submerged when on the surface. It was decided to insert one glass sphere in to the bottom pack of three.

4. Releases. All of the moorings and Landers deployed on this expedition have two releases.

## 10.2 AutoSBE

**Patrick Farrell**

AutoSBE is a suite of six programs used for automating the programming of Sea-Bird MicroCATs.

Over the course of a cruise, the MicroCATs are programmed on the order of one hundred times: for deployment on a mooring, and for pre- and post-mooring calibration. Typically, many devices must be programmed uniformly so that their behaviour is homogenous. Up to now, these devices have been programmed manually, following printed instruction sheets. There are several difficulties with this approach:

- As RAPID is a longstanding project, there are several generations of MicroCATs used, with varying firmware versions, names for analogous commands, and methods for physically communicating with the device. This inhomogeneity makes it difficult to program the devices so that they behave in a uniform manner.

- The correct configuration of the MicroCATs is crucial to the success of the deployment, but programming them is laborious, tedious and error-prone. It is very easy to make a mistake and forget one command when you have typed the same commands twenty times.

Programming the MicroCATs is repetitive and laborious: therefore, it is a natural candidate for automation. However, the SeaTerm and SeaTermV2 software used to program the devices offer no mechanism for scripting them. Therefore, if SeaTerm/V2 are to be automated, an external program must drive them by sending the appropriate mouse clicks and keyboard events. This is precisely the strategy employed in AutoSBE.

AutoSBE is built upon the pywinauto library, a module for the Python programming language that uses the Win32 API to drive graphical Windows programs. As pywinauto is written in Python, AutoSBE is also written in Python. AutoSBE starts the SeaTerm/V2 executable under its management and then operates the program exactly as a trained human operator should: starting a capture file, connecting to the device, issuing the appropriate commands, and disconnecting from the device. The software was developed over the course of the cruise and put into operational deployment. It was found that the approach worked well and that it led to large efficiency gains for the technicians responsible for the MicroCATs.

### 10.2.1 Installation

Installation of the AutoSBE software is straightforward. The entire project is contained in one directory (called autosbe). To install it onto a computer, merely copy this directory onto the hard drive of the machine. AutoSBE will happily run from a USB memory stick. To delete the software, delete the directory.

The only dependency of AutoSBE is SeaTerm/V2. Note that AutoSBE relies on the installation of SeaTerm/V2 in the default directory suggested during the SeaTerm/V2 installation procedure.

### 10.2.2 Operation

There are essentially three kinds of MicroCAT used in the RAPID project:

- Devices with firmware $< 3.0$ that are connected via inductive modem

- Devices with firmware < 3.0 that are connected via RS232
- Devices with firmware >= 3.0 that are connected via RS232

All three have slightly different requirements for what software should be executed and how it should be managed. Furthermore, there are two cases for which the devices must be configured:

- Mooring deployment
- Pre-/Post-calibration deployment

As there are three kinds of device and two configurations, there are six executables in the AutoSBE directory:

- run_seatermV1_caldip.exe
- run_seatermV1_IM_caldip.exe
- run_seatermV2_caldip.exe
- run_seatermV1_moor.exe
- run_seatermV1_IM_moor.exe
- run_seatermV2_moor.exe

where caldip refers to a hard-coded configuration for calibration dips, and moor refers to a hard-coded configuration for mooring deployments. The moor and caldip versions are almost identical: they differ only in the commands hard-coded in the executables, and the filename of the configuration files they read.

The AutoSBE executables read a configuration file (caldip.cfg or moor.cfg for caldip and moor respectively) in the same directory as the executables. These configuration files contain additional commands for the software to execute on the MicroCAT. This feature is necessary because it would be impossible to hard-code MicroCAT start times/dates, or to hard-code the STARTLATER command.

These files contain commands in V1 format: AutoSBE translates between the V1 and V2 syntax when operating SeaTermV2.

These commands are hard-coded in the moor configuration:

- SAMPLENUM=0
- STORETIME=Y
- OUTPUTSAL=N
- NAVG=1
- INTERVAL=1800
- PUMPINSTALLED=Y
- OUTPUTSV=N

- SYNCMODE=N
- TXREALTIME=N

These commands are hard-coded in the caldip configuration:

- OUTPUTSAL=N
- NAVG=1
- INTERVAL=10
- PUMPINSTALLED=Y
- OUTPUTSV=N
- SYNCMODE=N
- TXREALTIME=N

Additionally, these commands are hard-coded for operating SeaTermV2:

- OutputExecutedTag=n
- Outputformat=3
- BAUDRATE=38400

The basic operation of the executables may be summarised as follows:

1. Start a capture file so that the commands issued to the device are logged. The capture file is initially created with a temporary filename (the timestamp). At the end of the program, it is renamed to SERIALNUMBER_DATE_TIME.cap. This temporary filename is used because, before connecting to the device, the serial number is unknown.

2. Connect to the device. Note that for inductive modem MicroCATs, the inductive modem must be switched on before the AutoSBE executable is ran. The software does not explicity configure SeaTerm for an inductive modem as the software recognises the microCAT as soon as the modem is switched on.

3. Display the initial status of the device (DS).

4. Set the clock of the device to the system time (the time displayed in the bottom-right corner in the system tray). As accurate timekeeping is important, it is crucial that the system clock of the computer running AutoSBE is updated beforehand (by NTP or manually).

5. Execute the hardcoded instructions, translating from V1 to V2 syntax if running SeaTermV2.

6. Execute the instructions in caldip.cfg or moor.cfg, translating from V1 to V2 syntax if running SeaTermV2.

7. Display the final status of the device (DS).

8. Disconnect from the device.

9. Stop the capture file and rename it as described above.

The inductive modem version was the most difficult to get working. It was found that the communication became garbled, with the MicroCAT returning gibberish. The problem was resolved when Christian Crowe hypothesised that it was caused by the speed at which AutoSBE was delivering keypresses: the program was typing far faster than a human could, and the time between keystrokes was insufficient for the MicroCAT to distinguish between them. This was remedied by configuring pywinauto to deliver keystrokes at a slower rate (0.2 s between keystrokes, instead of 0.05 s).

The program displays the email address (patrick.farrell06@imperial.ac.uk) and telephone number (0044 7726 646965) of the author upon each invocation, so that the author may be contacted if necessary.

### 10.2.3 Rebuilding from source

It may become necessary in the future to edit the source code of AutoSBE to deal with changes in the underlying SeaTerm software. For this reason, the source code to AutoSBE is distributed with it.

The source is contained in the src directory of autosbe. While running AutoSBE has no dependencies other than SeaTerm, there are several dependencies that must be installed if one wishes to recompile AutoSBE from the source code. Full instructions are given in the README.txt, but are reproduced here for completeness.

The developer must install: Python 2.x (http://python.org); last used version 2.7.2. Note that this must be the 32-bit version, even on 64-bit Windows. Do not download Python version 3.x. pywinauto (http://code.google.com/p/pywinauto); last used version 0.40. py2exe (http://www.py2exe.org); last used version 0.6.9.

All of the installation executables are available in the src directory, so that users at sea do not need to download them.

One small modification was necessary to the pywinauto sources in order to make compilation with py2exe possible. The developer must edit Lib\site-packages\pywinauto\tests___init__.py (relative to the directory of the Python installation, C:\Python27 by default) to remove the call to __init_tests() right at the bottom of the file.

Once this setup is done, AutoSBE may be recompiled by opening a command terminal (cmd.exe), navigating to the autosbe\src directory, and executing

python setup.py py2exe

This compiles the Python scripts (run_seaterm*.py) into executables, and bundles all of their dependencies (the Python interpreter, pywinauto, etc.). The output of py2exe may be found in the autosbe\src\dist directory. Once the developer is happy with the changes made to the Python scripts, these compiled executables can be copied from autosbe\src\dist into the autosbe directory to overwrite the old version.

# 11 Mooring Instrumentation and Data Processing

## 11.1 MicroCATs

**Stuart Cunningham**

A total of 78 Sea-Bird SMP-37/IMP-37 MicroCAT CTDs were recovered from 11 moorings. The two instrument types (SMP/IMP) differ in their communication modes for programming and data retrieval being serial and inductive respectively. These are pumped CTDs with a temperature specification (initial accuracy: stability: resolution) of 2mC: 0.02mC/month: 0.01mC; conductivity specification 0.003mS/c: 0.003mS/cm/month: -0.0001mS/cm and; Pressure specification of 0.1% full-scale:0.05% of full scale range per year:0.002% of full scale range. The CTD instruments are fitted with one of three types of pressure sensor: Druck; Paine and; Kistler. The pressure sensors differ in their characteristics and the order of quality is Kistler, Druck and Paine, where the Paine is close to the specification above but typically has worse stability than quoted. The full scale for pressure is also different for the three pressure sensors but is around 7000 dbar.

Each instrument on recovery is downloaded using Sea-Bird Seaterm software appropriate to the firmware version of the SMPs. The IMPs are downloaded in HEX using our own software that allows multiple downloading of IMP instruments and is considerably quicker than the Sea-Bird software: the HEX files are subsequently converted to ascii format.

Subsequent to data download the instruments are then prepared for calibration. Calibration consists of lowering the instruments with the shipboard CTD. A comparison is then made between the microCATS and the shipboard CTD, using data from five minute stops on the CTD upcast, made at 12 depths throughout the water column. This provides a post mooring deployment calibration of each MicroCAT CTD sensor. The same calibration procedure is adopted for instruments to be deployed. By this method we obtain in situ pre and post deployment calibrations that can correct for sensor drift during their (typically) year long deployment. The pre deployment calibration also serves as a function test of the instrument. During the cruise 156 microCATS were lowered on 13 CTD casts.

For mooring deployments the microCATS sample once every 30 minutes and for calibration cast once every 10 seconds (their highest sampling rate).

Raw ascii microCAT data are collected together on a linux workstation for subsequent processing. Processing

The RAPID-MOC/MOCHA project uses instruments from a number of different manufacturers and measurements utilised by three science teams within the project. At the outset we adopted a common data format, to which we ensure all instrument data conform. The format is ascii and is referred to as RODB and the processing software is MATLAB. The programmes utilised are (briefly):

- mc_call_2_jc064.m : Performs stage 1 processing, converting microCAT raw ascii data to the common RODB format.

- microcat_raw2use_003.m : Performs stage 2 processing, eliminating data at mooring launch and recovery; interpolates data gaps; saves file; creates diagnostic plots.

- mc_call_caldip_jc064.m : Plots all microCAT data from one CTD cast with the CTD data. Used during the cruise for a function check of the micoCATS, and a qualitative assessment of sensor performance and post cruise provides quantified calibration information.

## 11.2 Bottom Pressure Recorders

**Patrick Farrell**

RAPID uses the Sea-Bird SBE26 Seagauge and/or the Sea-Bird SBE53 BPR to measure bottom pressure. They are mounted to frames that hold the anchor and the acoustic releases. Some moorings have two devices, while others have only one. No modifications were made to any of the file structures, formats or processing of the BPR records on this cruise. The following is based on the BPR processing documentation in the D344 cruise report, and uses EBH4L1_1_200927 as an example.

### 11.2.1 Stage 0

Raw instrument data are downloaded from the BPR using Sea-Bird's software and saved as .hex files. These are converted to .tid files using the same software. After downloading, the files are transferred to the seagauge directory in raw/(cruise)/ under filenames based on the serial number of the instrument recovered.

### 11.2.2 Stage 1

Stage 1 processing takes the ASCII .tid file, reads the info.dat file containing information about the mooring location, start and end times, and outputs the bottom pressure data to RODB format. The units are converted from psi to dbar. If there has been a clock offset recorded, then this is applied at this point. The code is found in the stage1 executable directory:

- seagauge2rdb_003.m, which produces RODB output saved in the proc/(mooring)/seagauge/ with filnames e.g. ebh4l1_1_200927_00040.raw

A stage1_log file is created that records the options chosen by the processing operator. If the data has been wrapped, this may be fixed at this point; this did not prove necessary on JC064. A postscript graph is created of the raw data.

### 11.2.3 Stage 2

Stage 2 processing takes the .raw file and trims off the deployment and recovery sections and calculates some basic statistics. Additionally, the routine applies an exponential-linear drift removal to the data to remove the effect of sensor drift. The two programmes are found in the stage 2 executable directory:

- seagauge_processing_003.m
- purge_bp_003.m, which calculates the exponential-linear fit.

The output file is a .use file located in the moor/proc/seagauge directory, e.g. ebh4l1_1_200927_0040.use. Two postscript graphs are created of the processed data.

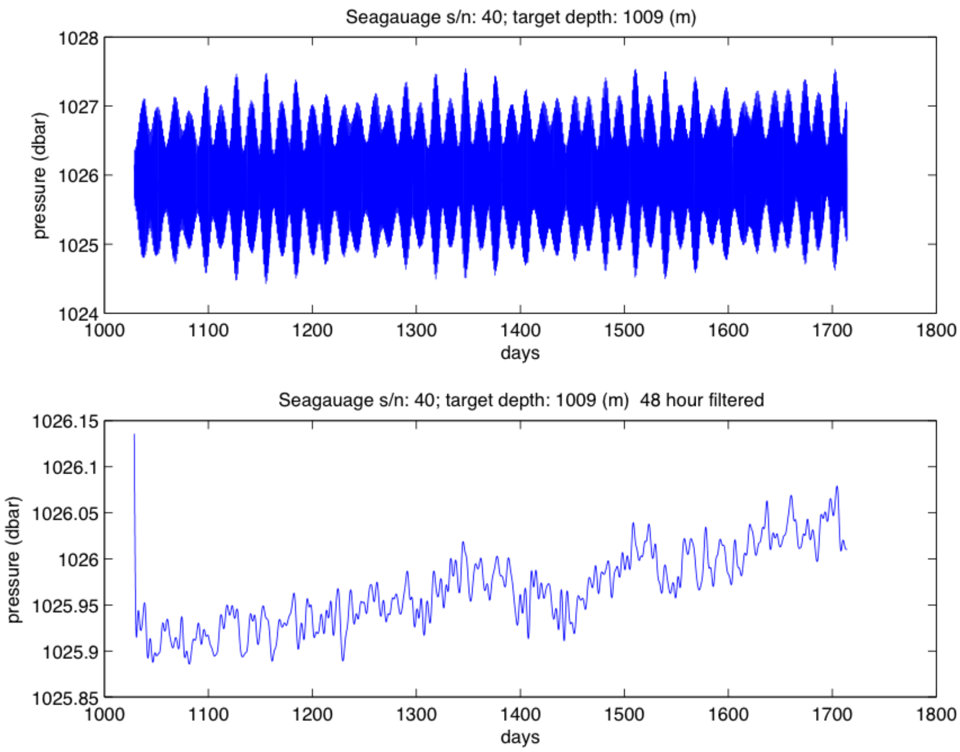



Figure 25: Output of Stage 1

#### 11.2.4 Stage 3

The data is two-day low-pass filtered, and interpolated onto a 12 hour grid. A fit for removing fortnightly and monthly tides is calculated. The script is found in the stage 3 executable directory:

- bpr_stage3_2011_09_12.m
- bottom_pressure_grid3.m, performs most of the heavy lifting.

#### 11.2.5 Problems

- One of the BPRs on EB1L6_6_200936 (s/n 0392) suffered from battery failure and recorded no data.
- One of the BPRs on MAR1L5_5_200941 (s/n 0420) suffered from flooding. Some data were recovered from the device, but on inspection proved to be not physically meaningful. We hypothesise that a small leak led the device to record incorrect measurements, before the leak grew and flooded the device.

### 11.3 PIES Processing

**Patrick Farrell**

One PIES (Pressure and Inverted Echo Sounder) device was recovered on JC064, EBP1_2_200832 (s/n 136). The processing of the PIES data to yield bottom pressure measurements followed the description by Zoltan Szuts in the cruise report of D334.

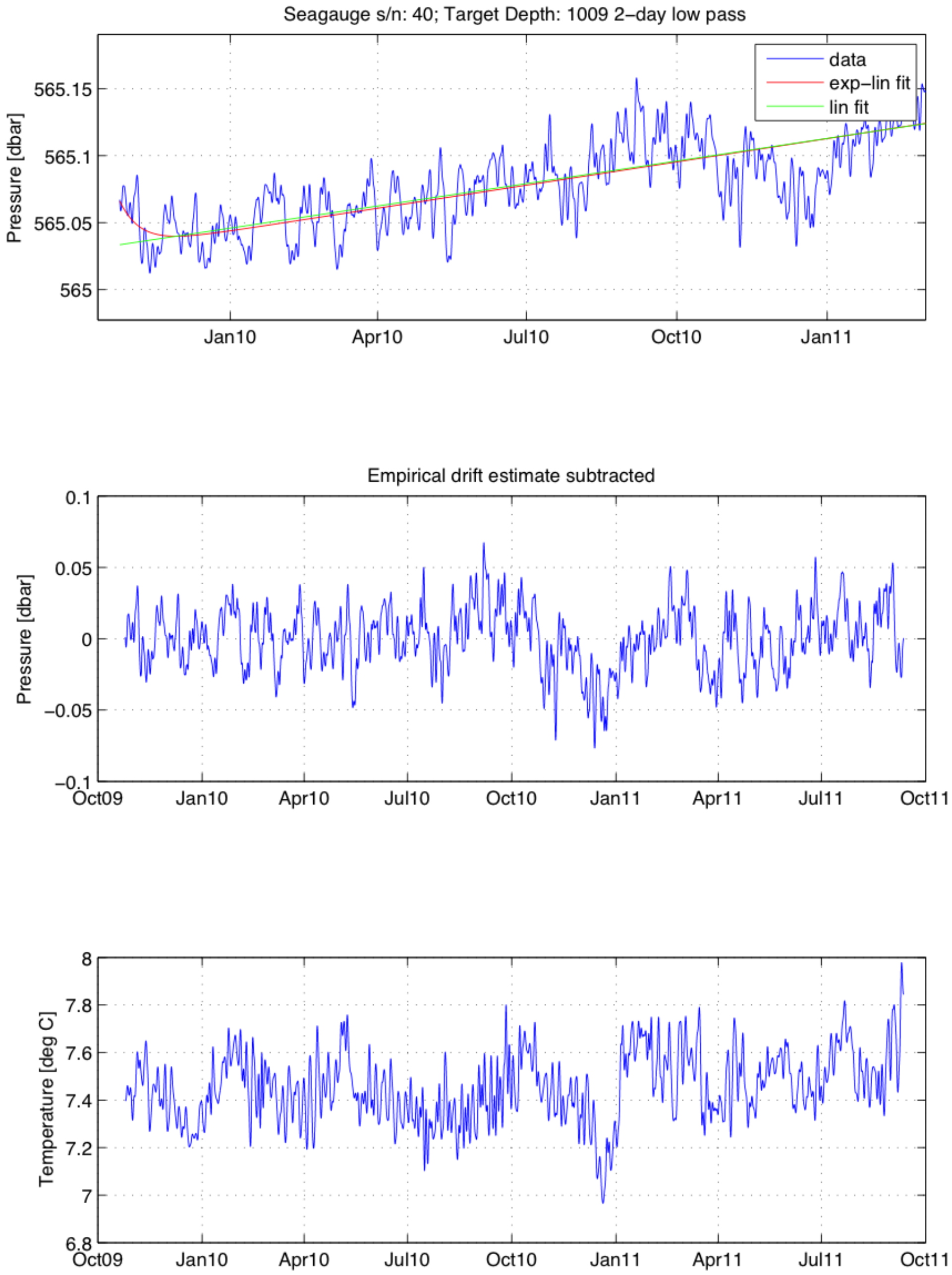



Figure 26: Output of Stage 2

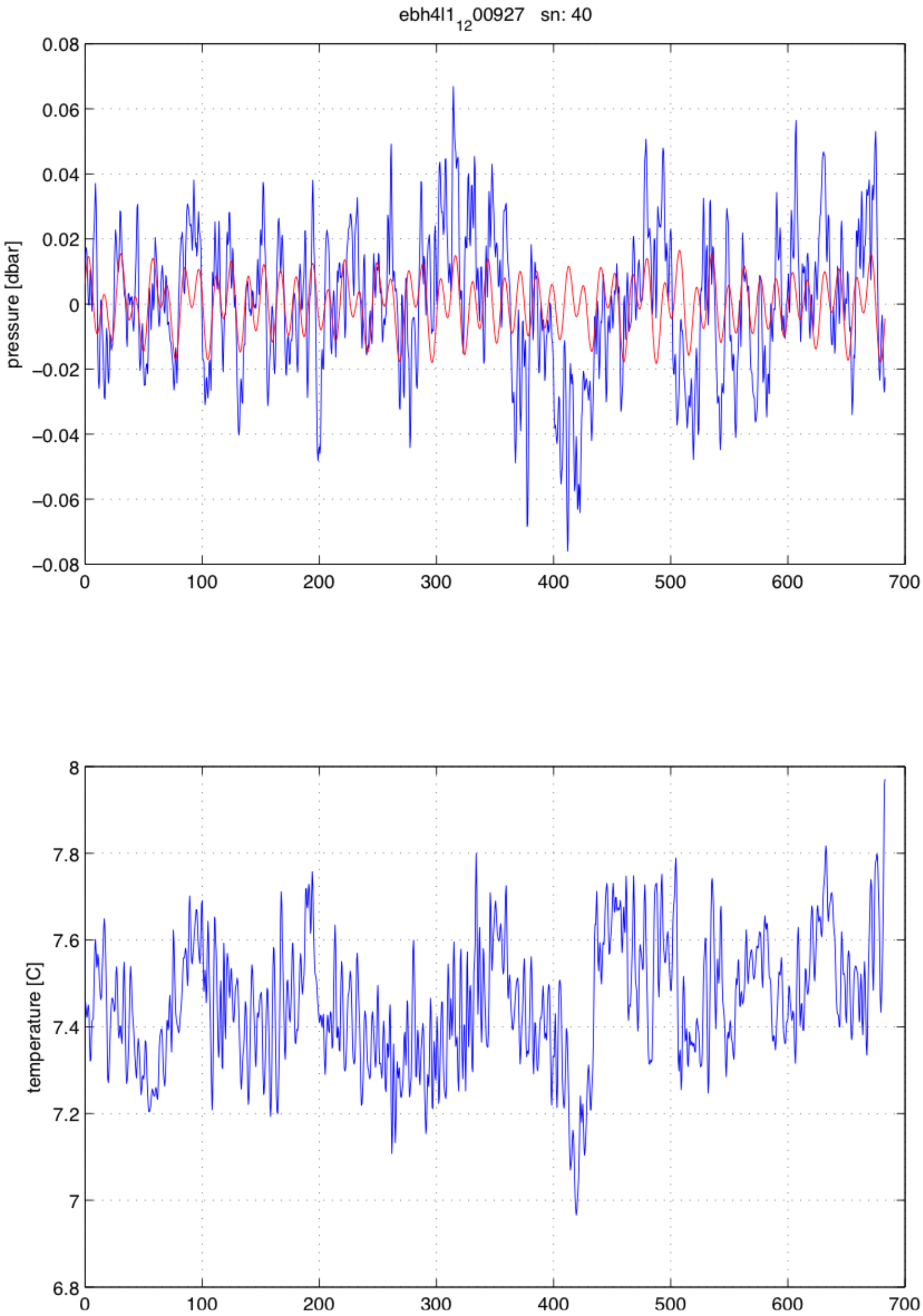


Figure 27: Output of Stage 3.

### 11.3.1 Stage 0

Stage 0 consists of transferring the raw data from the memory card of the PIES device to the raw cruise directory. The raw data consists of three .DAT files: T136_1.DAT (containing the temperature record), P136_1.DAT (containing the pressure record) and E136_1.DAT (containing engineering data).

### 11.3.2 Stage 1

Stage 1 processing consists of reading the raw ASCII files and converting it to RODB format. The script is found in stage 1 cruise executable directory:

- pies2rodb.m

### 11.3.3 Stage 2

Stage 2 processing consists of smoothing the travel time data by calculating hourly medians of each of the transmission channels, and processing the bottom pressure record to correct for exponential-linear drift. The script is found in the stage 2 cruise directory:

- bpr_processing/pies_processing_002.m

Due to the complexity of the further analysis of the travel time data (cruise report D344), this was not conducted.

## 11.4 Current Meters

**Gerard McCarthy**

Three different types of current meters were processed on this cruise: RCM11, S4 and Sontek Argonaut. Three Sontek instruments were recovered from EBH5 (950m), EB1 (1500m) and MAR1 (1500m). Six RCM11 instruments were recovered from many of the eastern boundary moorings, where they had been deployed near to the base of the moorings. Five S4 instruments were recovered primarily from MAR moorings, where again they had been deployed near the base of the moorings. These current meter deployments on the eastern boundary and mid-Atlantic, ridge in regions not renowned for strong currents, offer a useful database of reference currents for hydrographic currents including, for example, Argo velocity estimates.

### 11.4.1 Sontek Argonaut Processing

The Argonaut data were downloaded and then converted to an ASCII file format. This data file was stored in the mooring raw data folder under jc064/arg/. Stage 1 processing was undertaken with the argocat2rodb_004 script, which was modified for pathnames and cruise names specific to JC064.

As Argonaut files are non-conventional, a file linking the serial number of the Argonaut with the data file is created in the same directory as the data file. This file is called mooring_filenames.txt, where mooring refers to the full mooring name, for example ebh3_6_201109. Stage 2 processing was undertaken with the script argocat_raw2use_003, which again was edited for JC064. This converts the raw RODB data to useable RODB data, chopping off the period of the mooring during deployment and recovery. The parameters for chopping off were set during the microCAT processing and were not amended specifically for the current meters. This script also plots the two-day low pass filtered data.

### 11.4.2 RCM11 Processing

The RCM11 data were downloaded and then converted to an ASCII file format. This data file was stored in the mooring raw data folder under jc064/rcm/ as nnn.asc where nnn is the serial number of the instrument. Stage 1 processing was undertaken with the rcm2rodb_05 script, which was modified for pathnames and cruise names specific to JC064. This script read the raw ASCII to RODB format, producing figures of the currents and offers the opportunity to correct for wrapped conductivity. This was not performed on JC064. Stage 2 processing was undertaken with the script rcm11raw2use, which eliminates the launching and recovery periods and saves the data in .use format.

### 11.4.3 S4 Processing

Two S4 instruments, 35612577 and 35612574 failed to record any data. It is believed that they had not been set up to log correctly.

The S4 data were downloaded in ASCII file format. This data file was stored in mooring raw data folder under jc064/s4/ as nnnnnnnn_data.asc where nnnnnnnn is the serial number of the instrument. Stage 1 processing was undertaken with the s42rodb_v5_scr which calls the function s42rodb_v5. These were modified for pathnames and cruise names specific to JC064. This script read the raw ASCII to RODB format, producing figures of the currents, temperature, conductivity, pressure and instrument heading. Stage 2 processing was undertaken with the s4raw2use_v2_script_version, which calls the s4raw2use_v2 function. This produces two-day low pass filtered versions of the raw figures.

| Argo float No. | Date | Deployment Time | Lat | Lon |
|---|---|---|---|---|
| 4861 | 9/28/11 | 1038 | 26.1124 | -45.0678 |
| 4862 | 9/29/11 | 1100 | 26.4146 | -40.486 |
| 3908 | 9/30/11 | 955 | 26.5682 | -36.2506 |
| 3907 | 10/1/11 | 956 | 26.7134 | -31.9094 |
| 4860 | 10/2/11 | 1008 | 26.96 | -27.765 |
| 4863 | 10/3/11 | 1003 | 27.0151 | -23.312 |
| 4864 | 10/4/11 | 852 | 27.1525 | -19.2581 |

Table 11: Argo deployments

# 12 Apex Argo Float Deployments

**Patrick Farrell**

Argo is an array of around 3,000 profiling floats that provide observations from the global oceans with an average spacing of around three degrees in latitude and longitude (approximately 300 km). Since 2000 the Argo programme, which involves more than 30 countries, has deployed more than 6,000 floats into the ice-free deep oceans around the world. The floats measure ocean temperature, salinity (dissolved salt content) and pressure (depth) between the surface and 2,000 metres depth.

As part of the UK's commitment to the Argo programme, 8 Apex Argo floats were deployed on JC064. Before deployment, each float was connected to a computer using the supplied communication cables, and the recommended pre-deployment tests run. These checks include testing the satellite transmission, the high pressure pump, the battery voltage and internal vacuum, the pneumatic system, and the CTD sensor. Each float was activated via the terminal connection, rather than the magnetic reset. As expected, the 6 beeps 8 seconds apart were followed by inflation of the bladder and subsequent periodic satellite transmissions.

After deployment, confirmation emails were sent to the relevant project handlers at the BODC, Met Office and National Oceanography Centre. The Met Office confirmed that floats 4861, 4862, 3908, 4860 and 4863 were communicating successfully. However, while test messages were heard from 3907, no communication was received subsequently: the Met Office speculate that its 'deep profile first' programming was at fault and that it should report on 2011-10-11.

# 13 SeaGlider Bellatrix Recovery

**Gerard McCarthy**

Following a highly successful first deployment, the SeaGlider Bellatrix was recovered from the James Cook on the 5th October. The glider had been providing data for over three months and almost 600 dives from a region of the ocean between the Canary Islands and Morocco. These data are used as a virtual mooring to supplement the data of the RAPID project. It was the first time that NOC had undertaken a deployment of this type of glider.

Figure 28: Recovery of SeaGlider Bellatrix. Pictured are, from left to right, Phil Allison (Bosun's Mate), Gerard McCarthy (NOC Scientist) and Vanessa Laidlow (3rd Officer)

The captain and crew were professional and enthusiastic in the undertaking of this unexpected operation. In good weather, the ships boat was launched. 3rd Officer, Vanessa Laidlow, undertook the piloting. Bosuns Mate, Phil Allison and scientist, Gerard McCarthy undertook the recovery (Figure 28). Due to the unexpected nature of the operation, no specific equipment was available for the operation. The gliders aerial was damaged in the recovery  this would likely have been avoided had recovery equipment been available on the ship. In spite of this, the recovery was a success and the glider was functional on recovery.

The RAPID project has undertaken seven glider deployments in this area since 2008, totaling a full year's worth of data.

# Appendices

## A Details of Sea-Bird SBE 911plus CTD

Instrument configuration file: C:\Program Files\Sea-Bird\SeasaveV7\JC064\JC064_NMEA.xmlcon
Configuration report for SBE 911plus/917plus CTD

---

| | |
|---|---|
| Frequency channels suppressed: | 0 |
| Voltage words suppressed: | 0 |
| Computer interface: | RS-232C |
| Scans to average: | 1 |
| NMEA position data added: | Yes |
| NMEA depth data added: | No |
| NMEA time added: | No |
| NMEA device connected to: | deck unit |
| Surface PAR voltage added: | No |
| Scan time added: | No |

1. Frequency 0, Temperature

| | |
|---|---|
| Serial number : | 03P-2674 |
| Calibrated on : | 13 April 2011 |
| G : | 4.35675162e-003 |
| H : | 6.42193937e-004 |
| I : | 2.34494364e-005 |
| J : | 2.29940020e-006 |
| F0 : | 1000.000 |
| Slope : | 1.00000000 |
| Offset : | 0.0000 |

2. Frequency 1, Conductivity

| | |
|---|---|
| Serial number : | 04C-2231 |
| Calibrated on : | 12 April 2011 |
| G : | -1.07697431e+001 |
| H : | 1.69453083e+000 |
| I : | -2.49118239e-003 |
| J : | 2.97276980e-004 |
| CTcor : | 3.2500e-006 |
| CPcor : | -9.57000000e-008 |
| Slope : | 1.00000000 |
| Offset : | 0.00000 |

3. Frequency 2, Pressure, Digiquartz with TC

| | |
|---|---|
| Serial number : | 110557 |
| Calibrated on : | 26 April 2009 |
| C1 : | -6.010548e+004 |
| C2 : | -1.565601e+000 |
| C3 : | 1.823090e-002 |
| D1 : | 2.668300e-002 |
| D2 : | 0.000000e+000 |
| T1 : | 3.020528e+001 |
| T2 : | -6.718318e-004 |
| T3 : | 4.457980e-006 |
| T4 : | 1.203850e-009 |
| T5 : | 0.000000e+000 |
| Slope : | 0.99994000 |
| Offset : | -1.08250 |
| AD590M : | 1.280700e-002 |
| AD590B : | -9.299644e+000 |

4. Frequency 3, Temperature, 2

| | |
|---|---|
| Serial number : | 03P-4872 |
| Calibrated on : | 19 April 2011 |
| G : | 4.34380421e-003 |
| H : | 6.38106056e-004 |
| I : | 2.07199354e-005 |
| J : | 1.68084099e-006 |
| F0 : | 1000.000 |
| Slope : | 1.00000000 |
| Offset : | 0.0000 |

5. Frequency 4, Conductivity, 2

| | |
|---|---|
| Serial number : | 04C-3258 |
| Calibrated on : | 12 April 2011 |
| G : | -1.06523753e+001 |
| H : | 1.35929693e+000 |
| I : | 4.08972236e-004 |
| J : | 4.40882550e-005 |
| CTcor : | 3.2500e-006 |
| CPcor : | -9.57000000e-008 |
| Slope : | 1.00000000 |
| Offset : | 0.00000 |

6. A/D voltage 0, Oxygen, SBE 43

| | |
|---|---|
| Serial number : | 43-0363 |
| Calibrated on : | 26 January 2011 |
| Equation : | Sea-Bird |
| Soc : | 3.51500e-001 |
| Offset : | -6.48800e-001 |
| A : | -8.26610e-004 |
| B : | 1.10740e-004 |
| C : | -2.48860e-006 |
| E : | 3.60000e-002 |
| Tau20 : | 1.12000e+000 |
| D1 : | 1.92634e-004 |
| D2 : | -4.64803e-002 |
| H1 : | -3.30000e-002 |
| H2 : | 5.00000e+003 |
| H3 : | 1.45000e+003 |

7. A/D voltage 1, Free

8. A/D voltage 2, Altimeter

| | |
|---|---|
| Serial number : | 41302 |
| Calibrated on : | 20 April 2007 |
| Scale factor : | 15.000 |
| Offset : | 0.000 |

9. A/D voltage 3, Free

10. A/D voltage 4, Free

11. A/D voltage 5, Free

12. A/D voltage 6, Free

13. A/D voltage 7, Free

    Scan length : 37

# B Instrument Record Lengths

| Inst | s/n | Start | End | Mean press (dbar) |
|---|---|---|---|---|
| ebh4l1_1_200927 | 40 | 25/10/2009 | 11/09/2011 | 1026 |
| ebh4_8_201108 | 4719 | 12/01/2011 | 11/09/2011 | 337 |
| | 4717 | 12/01/2011 | 11/09/2011 | 404.3 |
| | 4720 | 12/01/2011 | 11/09/2011 | 505.6 |
| | 4721 | 12/01/2011 | 11/09/2011 | 612.3 |
| | 6824 | 12/01/2011 | 11/09/2011 | 705.5 |
| | 6825 | 12/01/2011 | 11/09/2011 | 811 |
| ebh5_6_201109 | 6826 | 12/01/2011 | 11/09/2011 | 108.3 |
| | 6827 | 12/01/2011 | 11/09/2011 | 174.6 |
| | 3282 | 12/01/2011 | 11/09/2011 | 251 |
| ebh3_7_201107 | 4708 | 11/01/2011 | 12/09/2011 | 893 |
| | 4709 | 11/01/2011 | 12/09/2011 | 1000.6 |
| | 5782 | 11/01/2011 | 12/09/2011 | 1112.8 |
| | 4711 | 11/01/2011 | 12/09/2011 | 1215.7 |
| | 4715 | 11/01/2011 | 12/09/2011 | 1427.6 |
| ebh2_7_201112 | 4473 | 11/01/2011 | 12/09/2011 | 1608.3 |
| | 5775 | 11/01/2011 | 12/09/2011 | 1818.8 |
| | 4475 | 11/01/2011 | 12/09/2011 | 2037.7 |
| ebh1_7_201106 | 5787 | 10/01/2011 | 13/09/2011 | 2509.3 |
| | 5786 | 10/01/2011 | 13/09/2011 | 3056.3 |
| ebh1l6_6_200933 | 395 | 26/10/2009 | 13/09/2011 | 3057.7 |
| ebhi_7_201104 | 5783 | 08/01/2011 | 15/09/2011 | 3484.4 |
| | 5784 | 08/01/2011 | 15/09/2011 | 4040.1 |
| | 5785 | 08/01/2011 | 15/09/2011 | 4578.7 |
| ebp1_2_200832 | 136 | 15/11/2008 | 16/09/2011 | 5200.101 |
| eb1l6_6_200936 | 419 | 29/10/2009 | 17/09/2011 | 5200.5 |
| eb1_9_201103 | 5240 | 07/01/2011 | 16/09/2011 | 24.5 |
| | 5241 | 07/01/2011 | 16/09/2011 | 76.3 |
| | 5762 | 07/01/2011 | 16/09/2011 | 146.3 |
| | 5763 | 07/01/2011 | 16/09/2011 | 227.8 |
| | 5766 | 07/01/2011 | 16/09/2011 | 302.7 |
| | 5767 | 07/01/2011 | 16/09/2011 | 378.1 |
| | 5768 | 07/01/2011 | 16/09/2011 | 582.7 |
| | 5770 | 07/01/2011 | 16/09/2011 | 778.1 |
| | 5771 | 07/01/2011 | 16/09/2011 | 982.1 |
| | 5773 | 07/01/2011 | 16/09/2011 | 1186.3 |
| | 5774 | 07/01/2011 | 16/09/2011 | 1590 |
| | 4474 | 07/01/2011 | 16/09/2011 | 2000.2 |
| | 5776 | 07/01/2011 | 16/09/2011 | 2511.1 |
| | 5778 | 07/01/2011 | 16/09/2011 | 3029.3 |
| | 5779 | 07/01/2011 | 16/09/2011 | 3559.7 |
| | 5780 | 07/01/2011 | 16/09/2011 | 4080.2 |

| | | | | |
|---|---|---|---|---|
| | 5781 | 07/01/2011 | 16/09/2011 | 4598.5 |
| | 4710 | 07/01/2011 | 16/09/2011 | 5090.5 |
| mar3l5_5_201031 | 13 | 03/11/2009 | 23/09/2011 | 5149.9 |
| | 38 | 03/11/2009 | 23/09/2011 | 5149 |
| mar3_7_201032 | 6125 | 31/12/2010 | 21/09/2011 | 2498.7 |
| | 3933 | 31/12/2010 | 21/09/2011 | 3047.2 |
| | 6333 | 31/12/2010 | 21/09/2011 | 3558.5 |
| | 6332 | 31/12/2010 | 21/09/2011 | 4048 |
| | 4472 | 31/12/2010 | 21/09/2011 | 4602 |
| | 7363 | 31/12/2010 | 21/09/2011 | 5119.5 |
| mar1_7_201028 | 6331 | 27/12/2010 | 24/09/2011 | 59.1 |
| | 3902 | 27/12/2010 | 24/09/2011 | 109.6 |
| | 4068 | 27/12/2010 | 24/09/2011 | 198.5 |
| | 6121 | 27/12/2010 | 24/09/2011 | 269.6 |
| | 6129 | 27/12/2010 | 24/09/2011 | 343.4 |
| | 4722 | 27/12/2010 | 24/09/2011 | 427.2 |
| | 4071 | 27/12/2010 | 24/09/2011 | 631.1 |
| | 6122 | 27/12/2010 | 24/09/2011 | 806 |
| | 4072 | 27/12/2010 | 24/09/2011 | 1024 |
| | 6828 | 27/12/2010 | 24/09/2011 | 1231.7 |
| | 7468 | 27/12/2010 | 24/09/2011 | 1832.7 |
| | 6123 | 27/12/2010 | 24/09/2011 | 2043.2 |
| | 6124 | 27/12/2010 | 24/09/2011 | 3076.6 |
| | 4180 | 27/12/2010 | 24/09/2011 | 3560.8 |
| | 6327 | 27/12/2010 | 24/09/2011 | 4081 |
| | 4305 | 27/12/2010 | 24/09/2011 | 4630.6 |
| | 6126 | 27/12/2010 | 24/09/2011 | 5129.9 |
| mar1l5_5_200941 | 393 | 06/11/2009 | 27/06/2011 | 5333.1 |
| | 420 | 06/11/2009 | 27/06/2011 | 5215.6 |
| mar2_7_201030 | 4070 | 28/12/2010 | 24/09/2011 | 1082.2 |
| | 4468 | 28/12/2010 | 24/09/2011 | 1388.8 |
| | 3934 | 28/12/2010 | 24/09/2011 | 1583.8 |
| | 6137 | 28/12/2010 | 24/09/2011 | 1803.1 |
| | 6320 | 28/12/2010 | 24/09/2011 | 2269.2 |
| | 6322 | 28/12/2010 | 24/09/2011 | 2777.4 |
| | 4470 | 28/12/2010 | 24/09/2011 | 3303.8 |
| | 6323 | 28/12/2010 | 24/09/2011 | 3808.4 |
| | 6325 | 28/12/2010 | 24/09/2011 | 4331.1 |
| | 6326 | 28/12/2010 | 24/09/2011 | 4853.1 |
| | 4471 | 28/12/2010 | 24/09/2011 | 5281.8 |
| mar0_4_201029 | 4306 | 27/12/2010 | 26/09/2011 | 5254.6 |
| | 6127 | 27/12/2010 | 26/09/2011 | 5378.6 |
| | 4307 | 27/12/2010 | 26/09/2011 | 5542.6 |
| | 6128 | 27/12/2010 | 26/09/2011 | 5654.9 |

# C Lost or Damaged Instruments and Hardware

| Serial number | Instrument | Problem |
|---|---|---|
| 919 | AR861 | Dropped during deployment, internal damage. |
| 911 | AR861 | Dropped during deployment, internal damage. |
| 821 | AR861 | Corrosion. |
| 258 | AR861 | Not working at depth. |
| 223 | RT661 | Not working at depth. |
| 35612577 | S4 current meter | no data, possibly not set up correctly. |
| 642 | RCM11 NMEP | no data, suspect electronics. |
| 6826 | SBE37 | conductivity reads low by 0.01 |
| 5246 | SBE37 | pressure sensor reads 30db low |
| 5766 | SBE37 | data record time base has jumps |
| 6118 | SBE37 | bad pump |
| 6116 | SBE37 | pressure sensor reads 30db low |
| 3913 | SBE37 | bad pump |
| 6819 | SBE37 | pressure overreads by 300 db |
| 5784 | SBE37 | pressure overreads by 30 db |
| 6331 | SBE37 | battery died on up cast needs cal lab |
| 4178 | SBE37 | did not record data |
| 4466 | SBE37 | battery shorted |
| 6803 | SBE37 | flooded |
| 3918 | SBE37 | flooded |
| 3890 | SBE37 | bad conductivity reads high 0.06 |
| 3229 | SBE37 | bad pump |
| 5246 | SBE37 | Bad pressure |
| 0392 | BPR | no data |
| 0420 | BPR | flooded |
|  | glass spheres | 3 implosions |
|  | Billings floats | 1 implosion |

# D Mooring deployment table and Acoustic Releases

| Mooring | Sequential mooring number | UKORS Mooring number | Lat (°N) | Lon (°W) | U/C depth (m) | Corr depth (m) | Date | Time (GMT) | Rel. 1 | Rel. 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| EBH4 | 9 | 2011/29 | 27°51.01' | 13°32.45' | 1058 | 1062 | 11/09/2011 | 13:05:55 | 264 | 906 |
| EBH5 | 7 | 2011/31 | 27°49.65' | 13°33.22' | 1057 | 1061 | 11/09/2011 | 15:23:00 | 249 | 256 |
| EBH3 | 8 | 2011/38 | 27°48.30' | 13°44.81' | 1419 | 1421 | 12/09/2011 | 13:31:39 | 908 | 925 |
| EBH2 | 8 | 2011/27 | 27°36.88' | 14°12.65' | from swath | 2022 | 12/09/2011 | 18:41:14 | 1242 | 927 |
| EBH1* | | 1st deployment | 27°16.73' | 15°24.65' | 2985 | 2988 | 13/09/2011 | 09:04:31 | 1200 | 827 |
| EBH1L8* | | 1st deployment | 27°16.48' | 15°24.61' | 2954 | 2957 | 13/09/2011 | 12:31:00 | 282 | 354 |
| EBHi | 8 | 2011/32 | 24°55.98' | 21°16.39' | from swath | 4505 | 15/09/2011 | 10:34:47 | 819 | 923 |
| EB1 | 10 | 2011/22 | 23°45.46' | 24°9.31' | 5049 | 5096 | 17/09/2011 | 12:58:30 | 1203 | 1197 |
| EB1L8 | 8 | 2011/23 | 23°47.47' | 24°6.80' | from swath | 5088 | 17/09/2011 | 16:33:26 | 930 | 253 |
| MAR3 | 8 | 2011/37 | 23°48.42' | 41°5.90' | 5019 | 5061 | 21/09/2011 | 14:43:35 | 917 | 322 |
| MAR3L7 | 7 | 2011/38 | 23°51.90' | 41°5.64' | 5013 | 5054 | 22/09/2011 | 09:25:00 | 1198 | 262 |
| NOGST | | | 23°46.26' | 41°5.93' | 4226 | 4247 | 22/09/2011 | 12:04:44 | 822 | |
| MAR1 | 8 | 2011/34 | 24°10.08' | 49°44.81' | 5165 | 5215 | 25/09/2011 | 15:54:09 | 920 | 316 |
| MAR2 | 8 | 2011/36 | 24°11.10' | 49°45.39' | 5166 | 5216 | 25/09/2011 | 19:37:01 | 1194 | 928 |
| MAR1L7 | 7 | 2011/35 | 24°11.57' | 49°44.71' | 5172 | 5222 | 25/09/2011 | 20:57:10 | 1202 | 921 |
| MAR0 | 5 | 2011/33 | 25°6.28' | 52°0.61' | from swath | 5529 | 26/09/2011 | 23:24:10 | 826 | 1199 |
| EBH1 | | 2011/24 | 27°8.61' | 15°22.66' | 2994 | 2997 | 06/10/2011 | 16:58:29 | 1200 | 827 |
| EBH1L8 | 8 | 2011/26 | 27°8.12' | 15°21.85' | 3002 | 3005 | 06/10/2011 | 18:36:54 | 282 | 354 |
| EBH1L7 | 7 | 2011/25 | 27°8.34' | 15°22.23' | 2997 | 3000 | 06/10/2011 | 18:12:16 | 824 | 281 |
| EBH4L3 | 3 | 2011/30 | 27°51.86' | 13°30.85' | 994 | 998 | 05/10/2011 | 19:10:07 | 922 | 926 |

* Moorings were recovered and redeployed in order to move further away from submarine cables.

# E Mooring Recovery Table

| Mooring Name | Sequential Mooring number | UKORS Mooring Number | Deployment Cruise | Lat (°N) | Lon (°W) | Deployment Date | Recovery Date |
|---|---|---|---|---|---|---|---|
| EBH4L1 (EBL5) | 1 | 2009/27 | D344 | 27°52.09' | 13°30.87' | 10/25/09 | 9/11/11 |
| EBH4 | 8 | 2011/08 | D359 | 27°50.99' | 13°32.46' | 1/12/11 | 9/11/11 |
| EBH5 | 6 | 2011/09 | D359 | 27°50.56' | 13°32.66' | 1/12/11 | 9/11/11 |
| EBH3 | 7 | 2011/07 | D359 | 27°48.47' | 13°44.80' | 1/11/11 | 9/12/11 |
| EBH2 | 7 | 2011/12 | D359 | 27°36.88' | 14°12.66' | 1/11/11 | 9/12/11 |
| EBH1 | 7 | 2011/06 | D359 | 27°16.89' | 15°24.98' | 1/10/11 | 9/13/11 |
| EBH1L6 (EBL4) | 6 | 2009/33 | D344 | 27°17.17' | 15°25.76' | 10/26/09 | 9/13/11 |
| EBHi | 7 | 2011/04 | D359 | 24°56.39' | 21°16.13' | 1/8/11 | 9/15/11 |
| EBP1 | 2 | 2008/32 | D334 | 23°49.38' | 24°05.99' | 11/15/08 | 9/16/11 |
| EB1L6 (EBL3) | 6 | 2009/36 | D344 | 23°48.77' | 24°06.41' | 10/29/09 | 9/16/11 |
| EB1 | 9 | 2011/03 | D359 | 23°45.54' | 24°09.36' | 1/7/11 | 9/16/11 |
| MAR3L5 (MARL2) | 5 | 2009/38 | D344 | 23°51.95' | 41°05.56' | 11/3/09 | 8/21/11 |
| Mar-03 | 7 | 2010/32 | D359 | 23°51.41' | 41°05.85' | 12/31/10 | 9/21/11 |
| NOGST | | 2011/01 | D359 | 23°46.29' | 41°05.90' | 1/1/11 | 9/21/11 |
| MAR1 | 7 | 2010/28 | D359 | 24°10.11' | 49°43.17' | 12/26/10 | 9/25/11 |
| MAR1L5 (MARL1) | 5 | 2009/41 | D344 | 24°12.02' | 49°44.26' | 11/6/09 | 9/25/11 |
| MAR2 | 7 | 2010/30 | D359 | 24°11.69' | 49°44.99' | 12/28/10 | 9/25/11 |
| MAR0 | 4 | 2010/29 | D359 | 25°06.45' | 52°00.65' | 12/27/10 | 9/26/11 |
| EBH1 | | 2011/XX | JC064 | 27°16.73' | 15°24.65' | 9/13/11 | 10/6/11 |
| EBH1L8 | | 2011/XX | JC064 | 27°16.48' | 15°24.61' | 9/13/11 | 10/6/11 |
| EBH1L7 | 5 | 2011/05 | D359 | 27°16.61' | 15°24.94' | 1/10/11 | 10/6/11 |

# F Acoustic Release Summary

| Serial No | Type | Previous location | Current location | NOTES | Serviced | New batts | Bench tested | Wire tested | Depth tested |
|---|---|---|---|---|---|---|---|---|---|
| 249 | AR861 | NOC | EBH5 | | YES | YES | YES | YES | 5150 |
| 256 | AR861 | NOC | EBH5 | | YES | YES | YES | YES | 5150 |
| 264 | AR861 | NOC | EBH4 | | YES | YES | YES | YES | 5150 |
| 906 | AR861 | NOC | EBH4 | | YES | YES | YES | YES | 5150 |
| 925 | AR861 | NOC | EBH3 | | YES | YES | YES | YES | 5150 |
| 908 | AR861 | NOC | EBH3 | | YES | YES | YES | YES | 5150 |
| 1242 | AR861 | NOC | EBH2 | | YES | YES | YES | YES | 5150 |
| 927 | AR861 | NOC | EBH2 | | YES | YES | YES | YES | 5150 |
| 827 | AR861 | NOC | EBH1 | FAILED | YES | YES | YES | YES | 5150 |
| 1200 | AR861 | NOC | EBH1 | | YES | YES | YES | YES | 5150 |
| 282 | AR861 | NOC | EBH1L8 | | YES | YES | YES | YES | 5150 |
| 354 | AR861 | NOC | EBH1L8 | | YES | YES | YES | YES | 5150 |
| 258 | AR861 | NOC | COOK | FAILED | YES | YES | YES | FAILED | 5150 |
| 223 | RT661 | NOC | COOK | FAILED | YES | YES | YES | FAILED | 5150 |
| 911 | AR861 | NOC | COOK | DAMAGED | YES | YES | YES | | |
| 919 | AR861 | NOC | COOK | DAMAGED | YES | YES | YES | | |
| 253 | AR861 | EBH3 | EB1L8 | | YES | YES | YES | YES | 5200 |
| 322 | AR861 | EBH1L6 | Mar-03 | | YES | YES | YES | YES | 5200 |
| 819 | AR861 | EBH2 | EBH i | | YES | YES | YES | YES | 4500 |
| 821 | AR861 | EBH5 | COOK | CORROSION | | | | | |
| 917 | AR861 | EBH4L1 | Mar-03 | | YES | YES | YES | YES | 5200 |
| 923 | AR861 | EBH4 | EBH i | | YES | YES | YES | YES | 4500 |
| 930 | AR861 | EBH1 | EB1L8 | | YES | YES | YES | YES | 5200 |
| 1197 | AR861 | EBH4 | EB1 | | YES | YES | YES | YES | 5200 |
| 1203 | AR861 | EBH5 | EB1 | | YES | YES | YES | YES | 5200 |
| 1198 | AR861 | EBH i | MAR3L7 | | YES | YES | YES | YES | 5200 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 262 | AR861 | EB1L6 | MAR3L7 | | YES | YES | YES | YES | 5200 |
| 316 | AR861 | EB1L6 | Mar-01 | | YES | YES | YES | YES | 5200 |
| 318 | AR861 | Mar-00 | COOK | RETURN | | | | | |
| 1201 | AR861 | Mar-00 | COOK | RETURN | | | | | |
| 1194 | AR861 | Mar-01 | Mar-02 | | YES | YES | YES | YES | 5200 |
| 1199 | AR861 | Mar-01 | Mar-00 | | YES | YES | YES | YES | 5500 |
| 920 | AR861 | Mar-02 | Mar-01 | | YES | YES | YES | YES | 5200 |
| 1202 | AR861 | Mar-03 | MAR1L7 | | YES | YES | YES | YES | 5200 |
| 922 | AR861 | Mar-03 | EBH4L3 | | YES | YES | YES | YES | 5500 |
| 370 | AR861 | MAR1L5 | COOK | RETURN | | | | | |
| 216 | RT661 | MAR1L5 | COOK | RETURN | | | | | |
| 928 | AR861 | MAR3L5 | Mar-02 | | YES | YES | YES | YES | 5200 |
| 826 | AR861 | MAR3L5 | Mar-00 | | YES | YES | YES | YES | 5500 |
| 921 | AR861 | EB1 | MAR1L7 | | YES | YES | YES | YES | 5200 |
| 822 | AR861 | EB1 | NOG | | YES | YES | YES | YES | 5200 |
| 926 | AR861 | NOG | EBH4L3 | | YES | YES | YES | YES | 5500 |
| 824 | AR861 | EBH1L7 | EBHIL7 | MOVED | | | | | |
| 281 | AR861 | EBHIL7 | EBH1L7 | MOVED | | | | | |

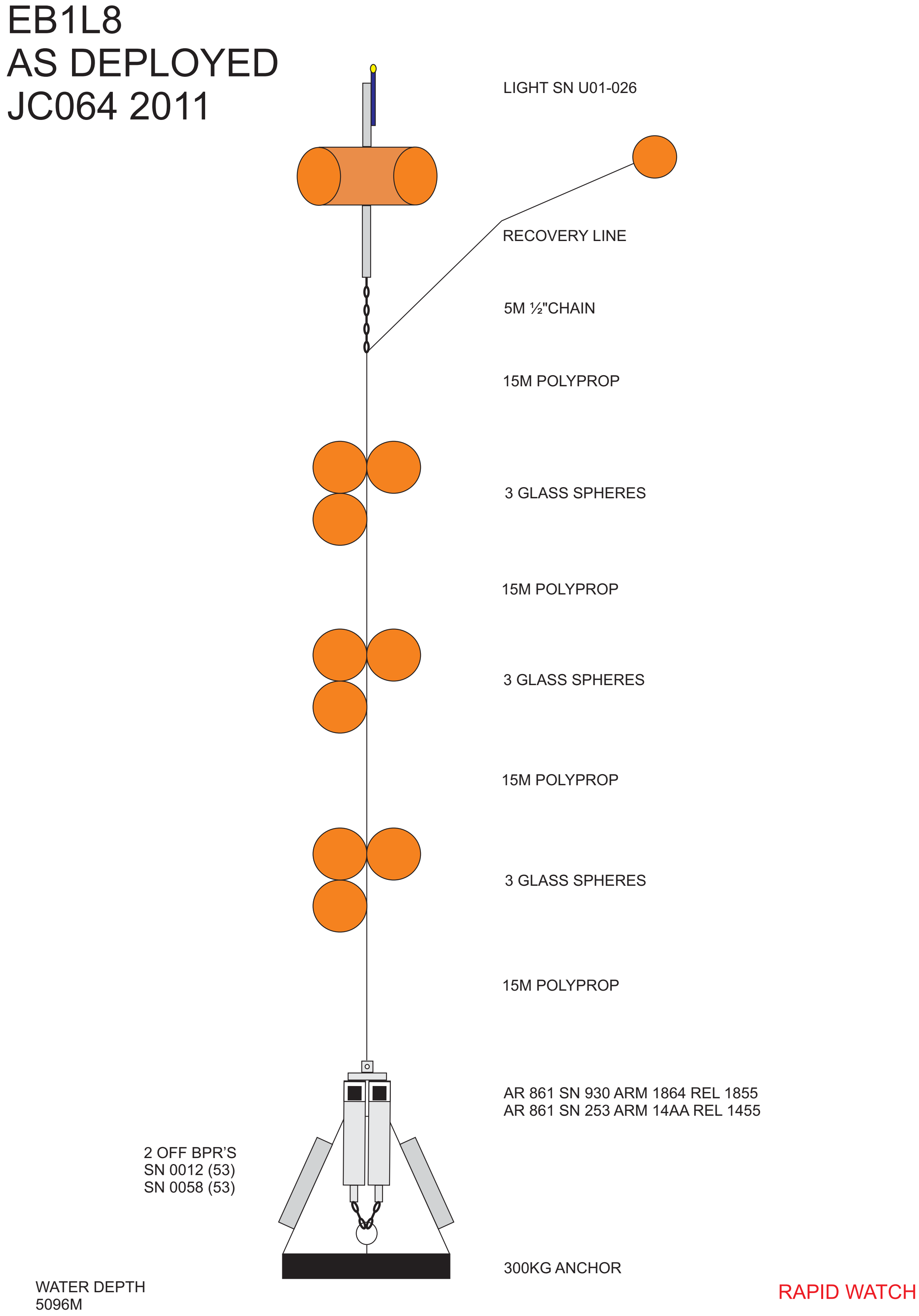
# G RAPID mooring and hydrographic cruises

| 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-04 | Initial Deployment of UK and US Western Boundary Moorings | RRS Discovery Cruise D277 and D278. Southampton Oceanography Centre Cruise Report, No 53, 2005 |
| P319 | RV Poseidon | Dec-04 | 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-05 | 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-05 | 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-05 | 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 05 | Emergency recovery of drifting WB1 mooring | No report published |
| RB0602 | RV Ronald H. Brown | Mar-06 | 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 |

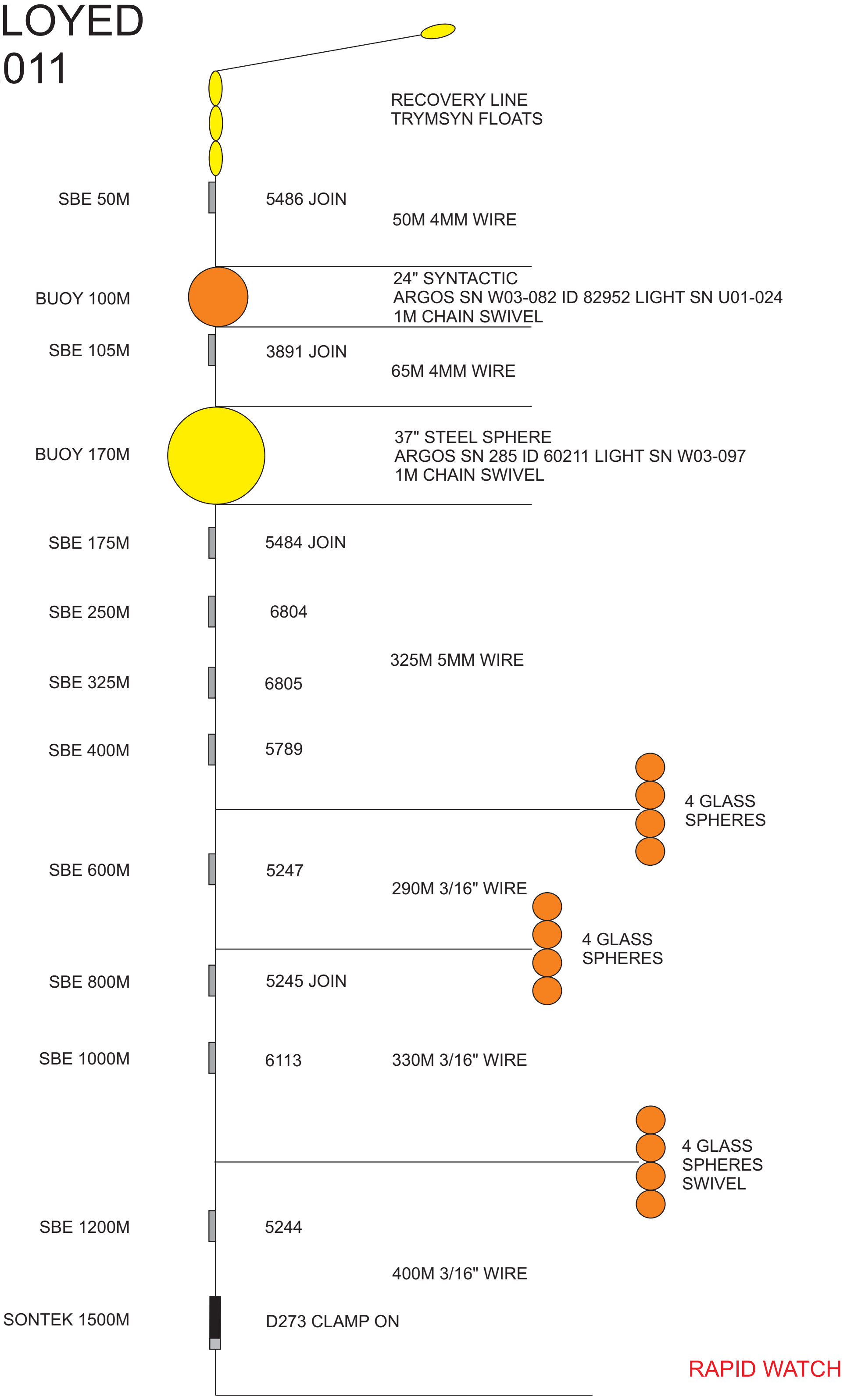
| | | | | |
|---|---|---|---|---|
| D304 | RRS Discovery | May - Jun 2006 | Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings | RV Ronald H. Brown Cruise RB0602 and RRS Discovery Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007 |
| P343 | RV Poseidon | Oct 06 | 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 | Dec 06 | 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 Oceanograpy Centre,Southampton Cruise Report, No 34 |
| SJ0803 | RV Seward Johnson | Apr-08 | 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 D344, 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 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 Cruise, D334, National Oceanography Centre, Southampton Cruise Report No. 51, 2010 |
| D345 | RRS Discovery | Nov - Dec 2009 | Recovery and redeployment of US Western Boundary moorings, and WBTS hydrography section | No cruise report to be published |
| OC459-1 | RV Oceanus | Apr-10 | Service and redeployment of the Western Boundary moorings | RV Oceanus Cruise OC459-1, National Oceanography Centre, Cruise Report, No. 1, 2011 |
| D359 | RRS Discovery | Dec 2010 - Jan 2011 | Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings | National Oceanography Centre, Cruise Report No. 09, 2012 |
| KN200-4 | RV Knorr | April 2011 - May 2011 | Recovery and redeployment of US Western Boundary moorings, and WBTS hydrography section | National Oceanography Centre, Cruise Report No. 07, 2012 |
| JC064 | RRS James Cook | September 2011 - October 2011 | Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings | This report |
| RB1201 | RV Ronald H Brown | Feb-12 | Recovery and redeployment of US Western Boundary moorings, and WBTS hydrography section | Cruise report pending |

# H Deployed Mooring Diagrams

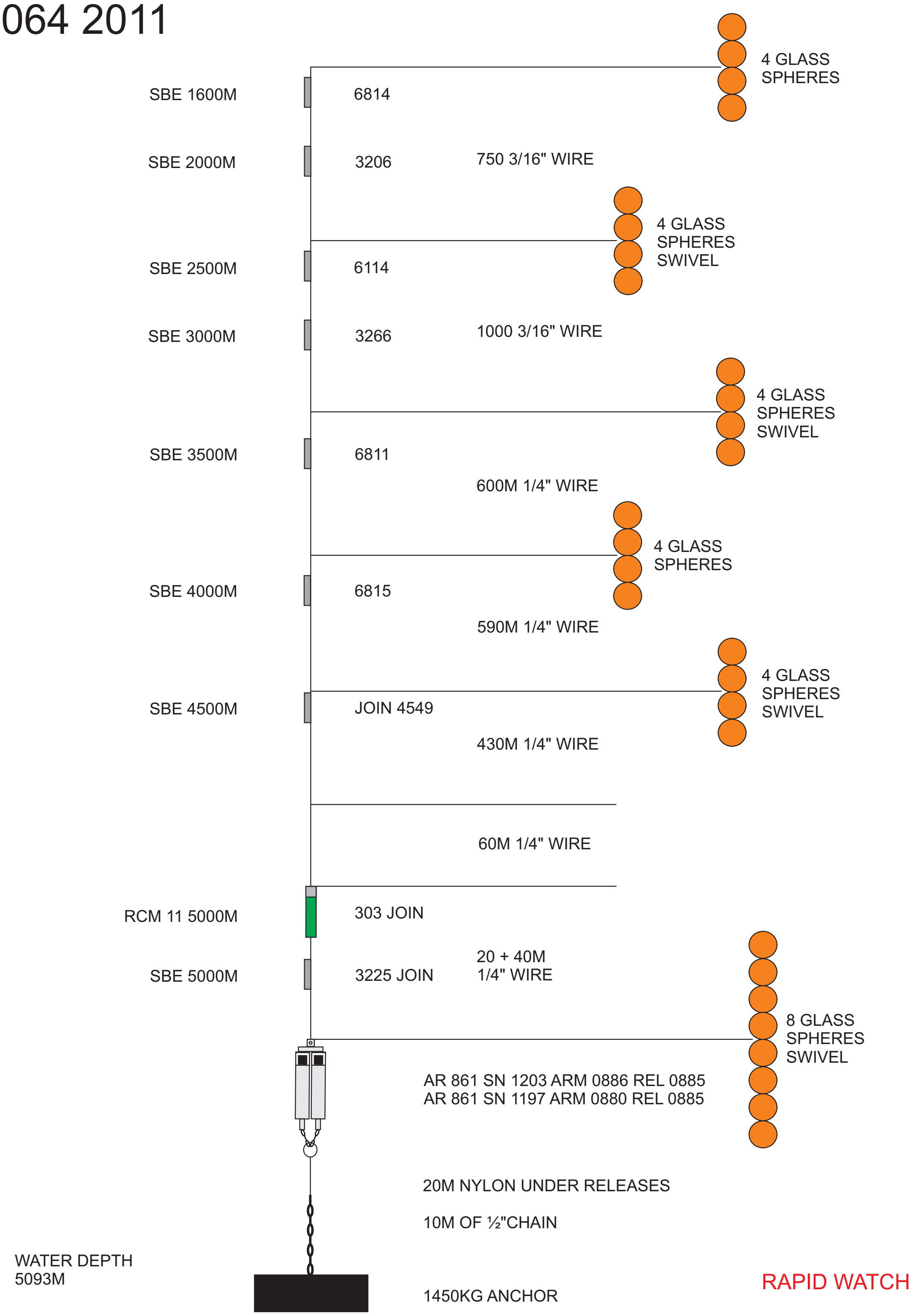


# EB 1
# AS DEPLOYED
# JC064 2011

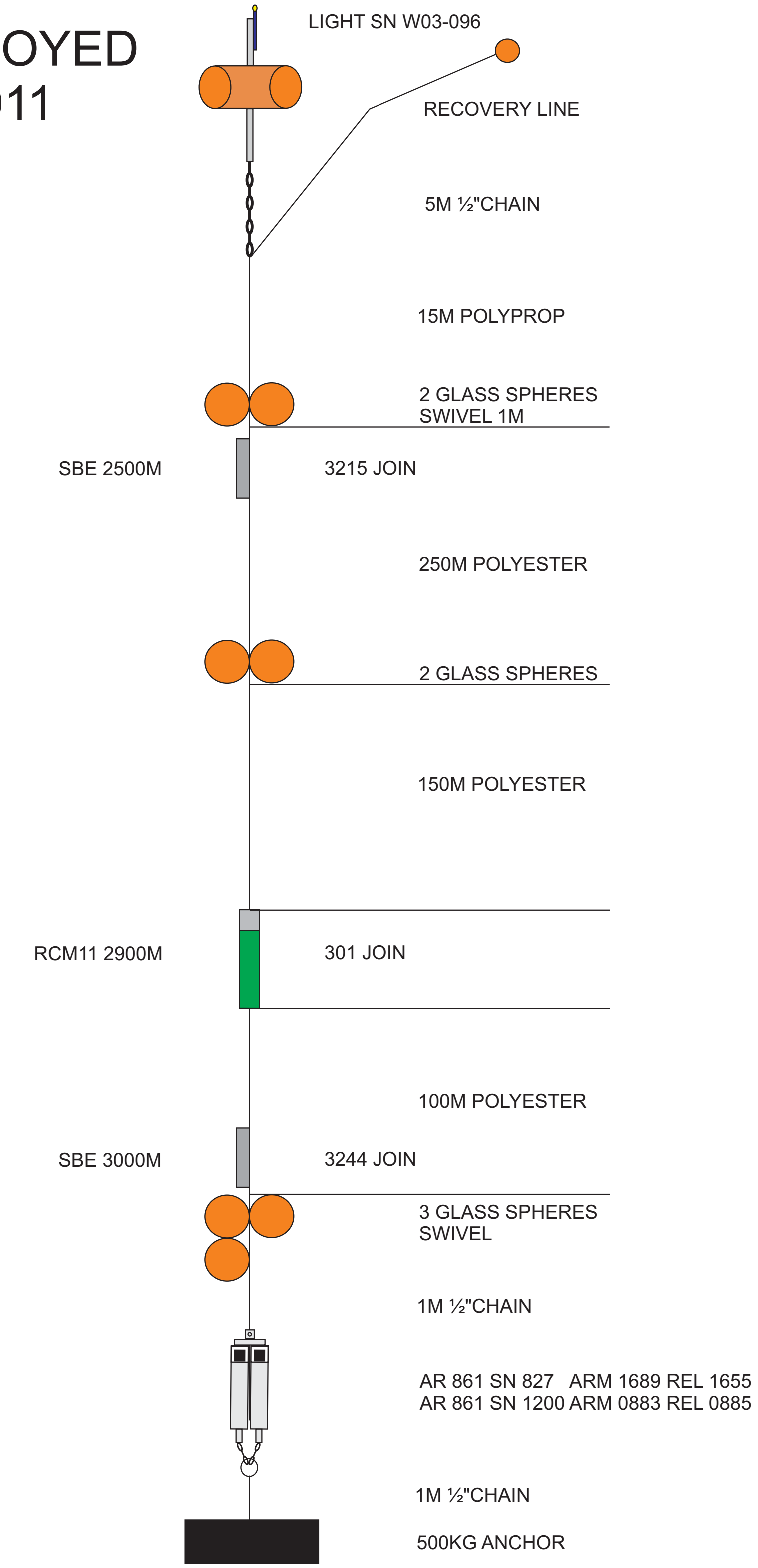


# EB 1
# AS DEPLOYED
# JC064 2011





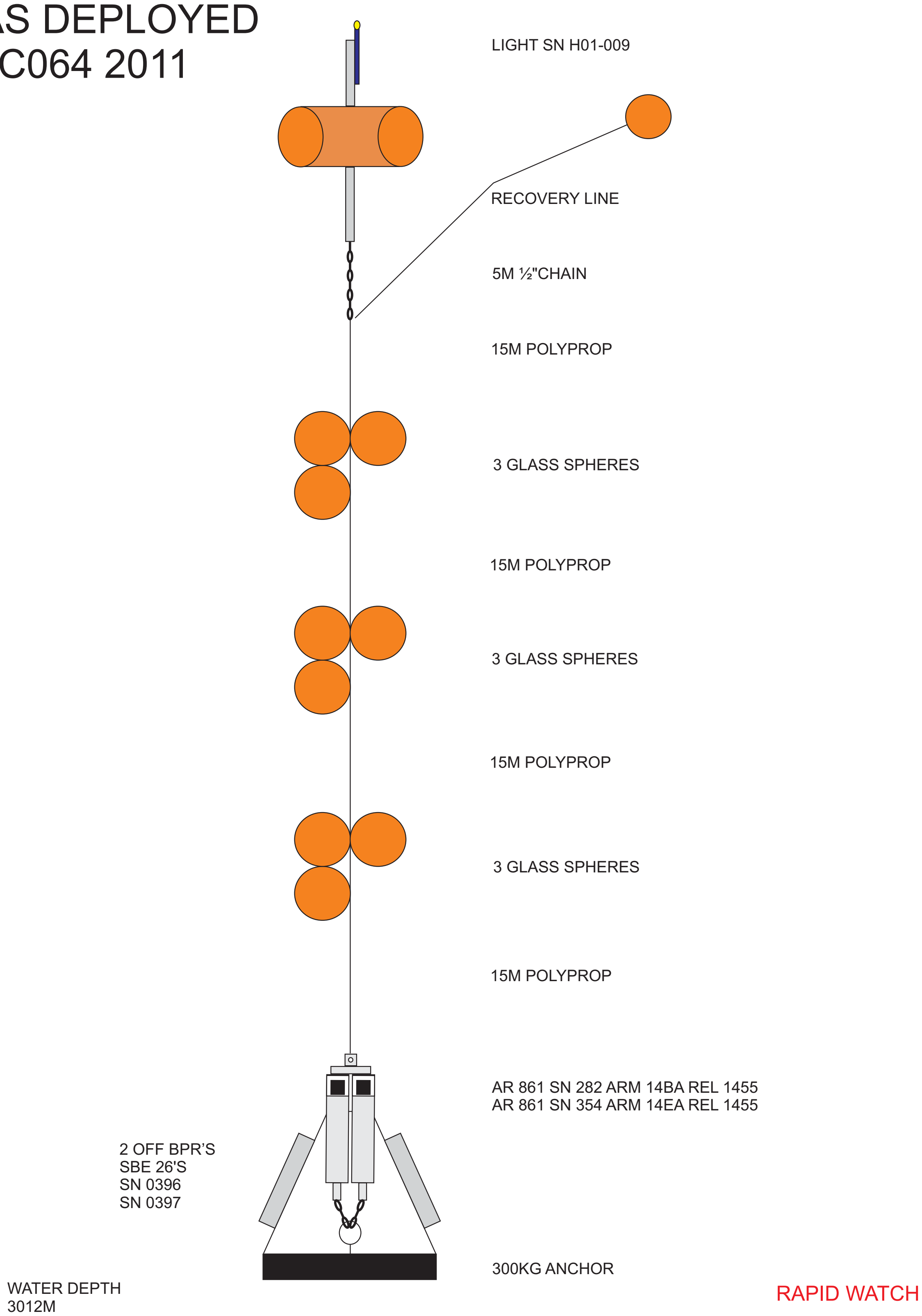
# EBH1
# AS DEPLOYED
# JC064 2011



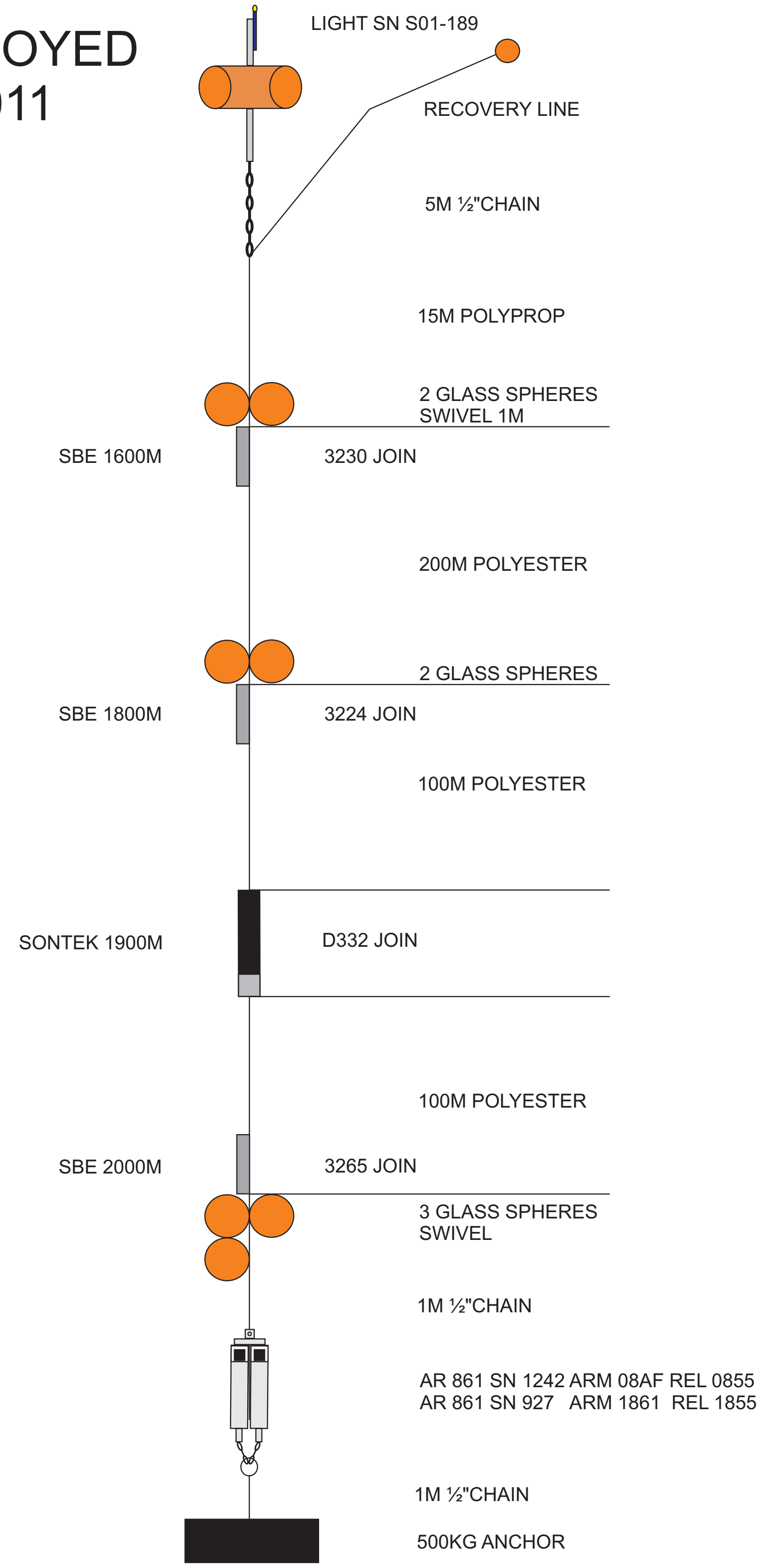

WATER DEPTH
3012M CORR

RAPID WATCH

# EBH1L8
# AS DEPLOYED
# JC064 2011



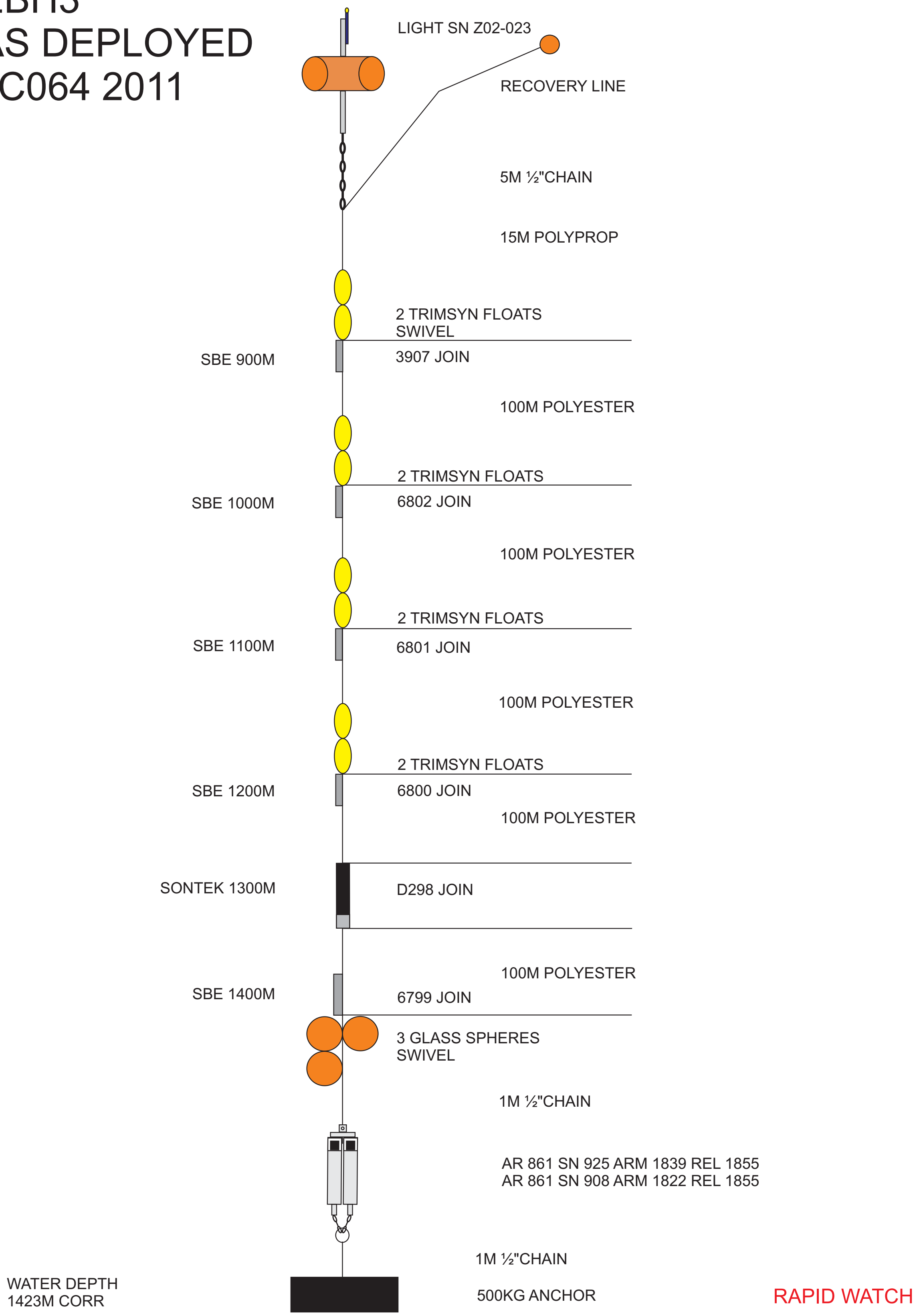
# EBH2
# AS DEPLOYED
# JC064 2011



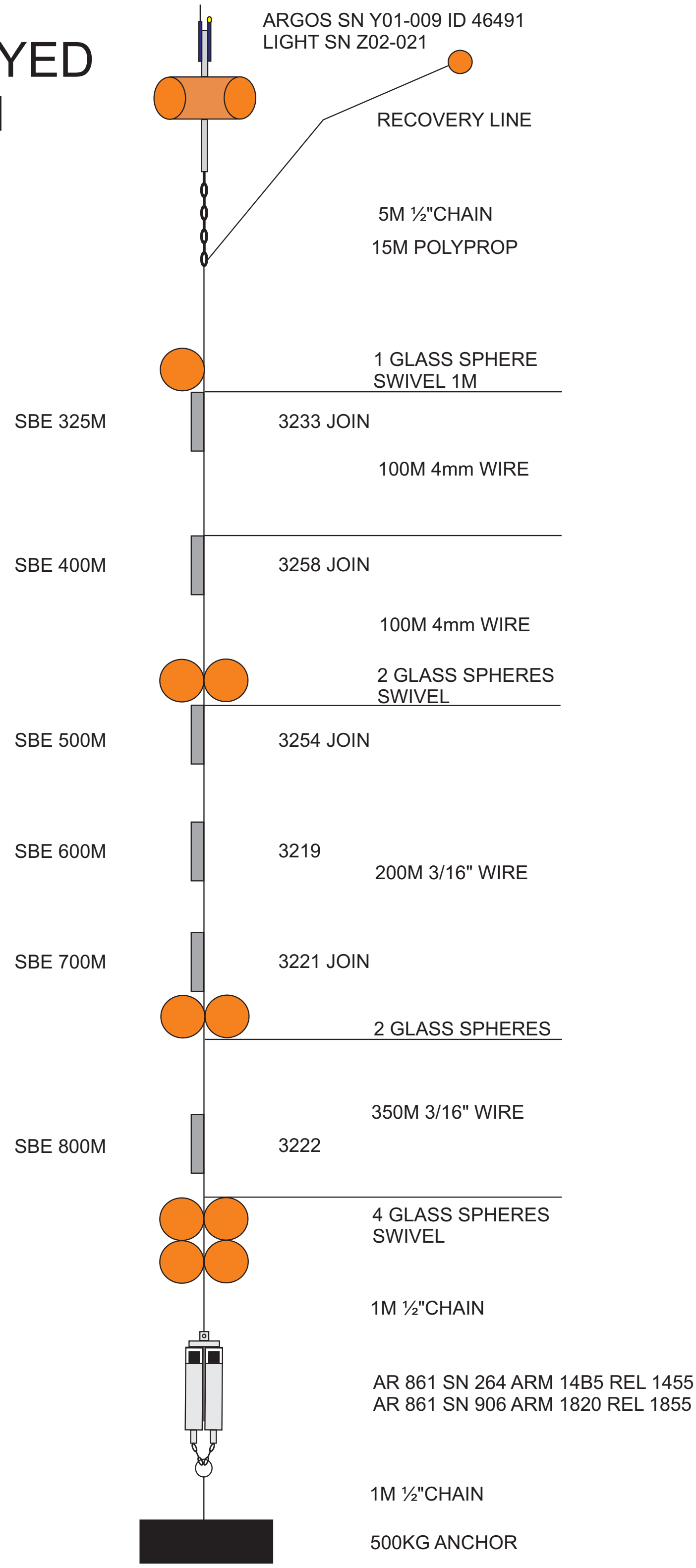

WATER DEPTH
2023M CORR

RAPID WATCH

# EBH3
# AS DEPLOYED
# JC064 2011



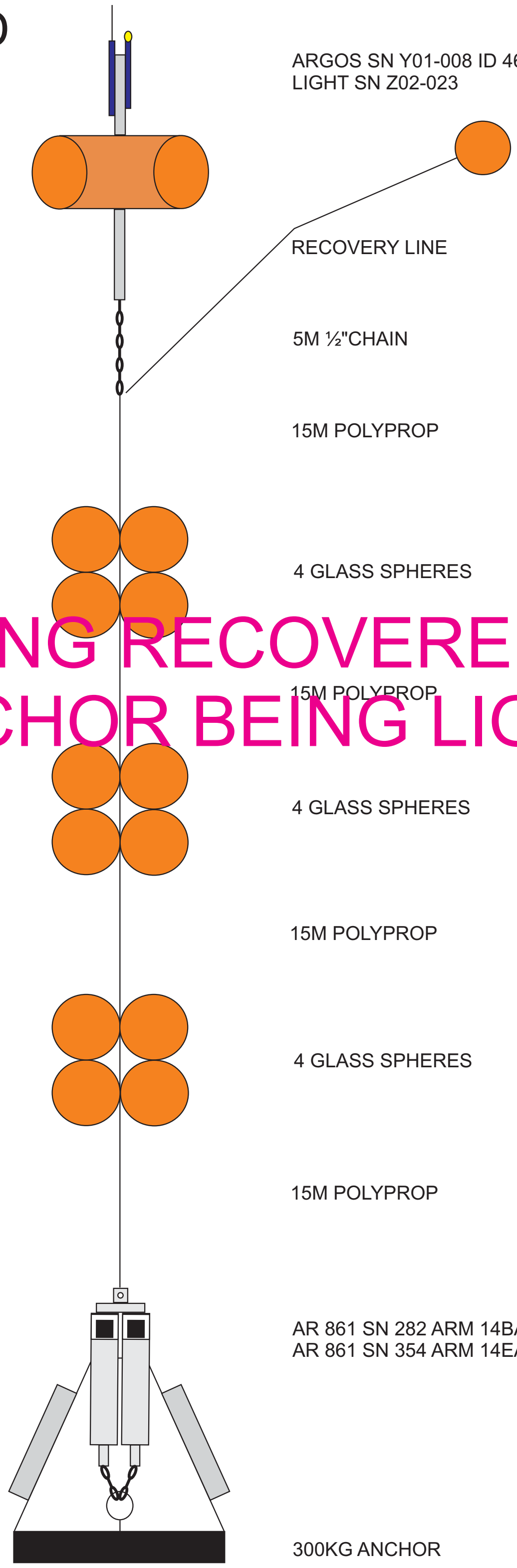
# EBH4
# AS DEPLOYED
# JC064 2011




WATER DEPTH
1050M CORR

RAPID WATCH

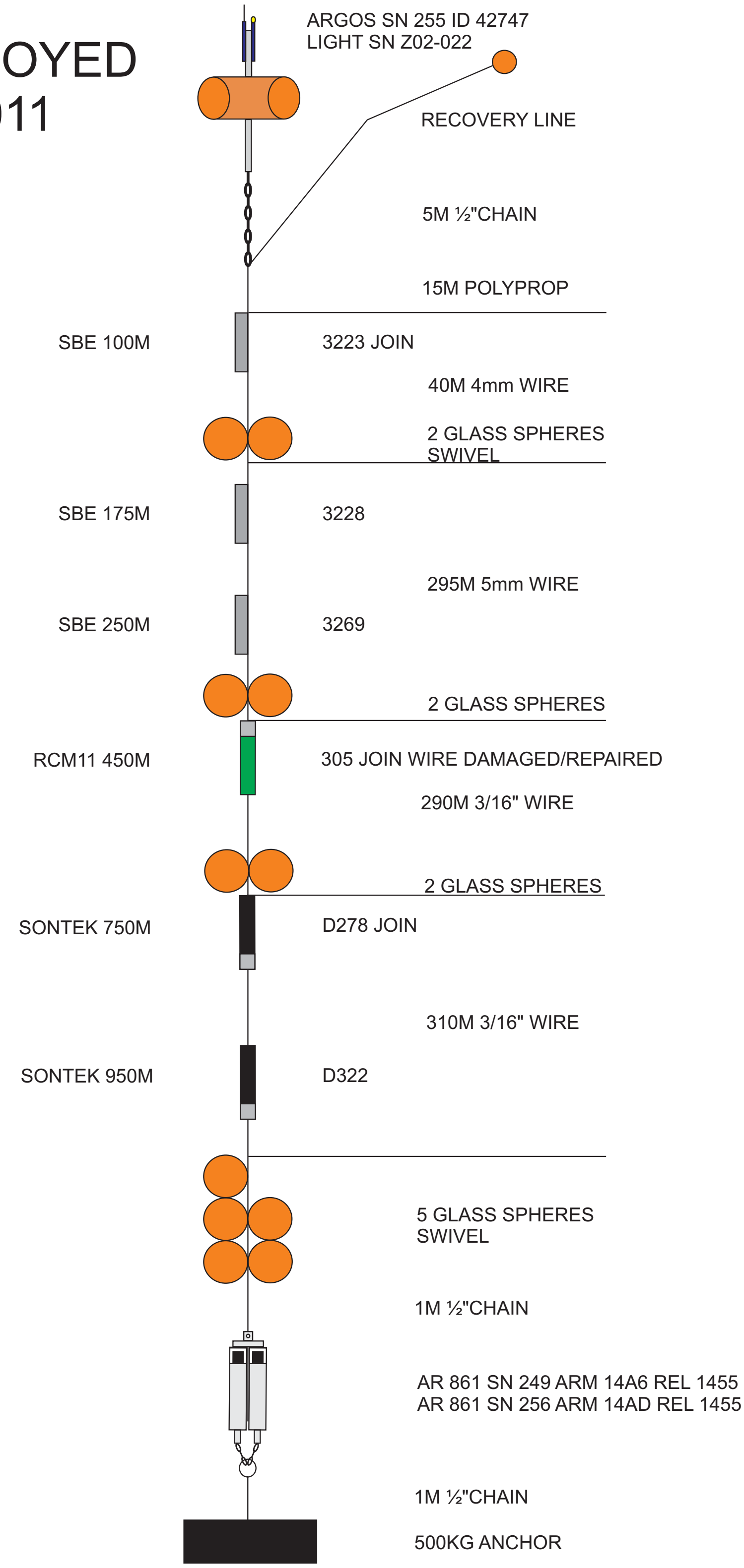
EBH4L3
AS DEPLOYED
JC064 2011




MOORING RECOVERED DUE TO ANCHOR BEING LIGHT.

RAPID WATCH

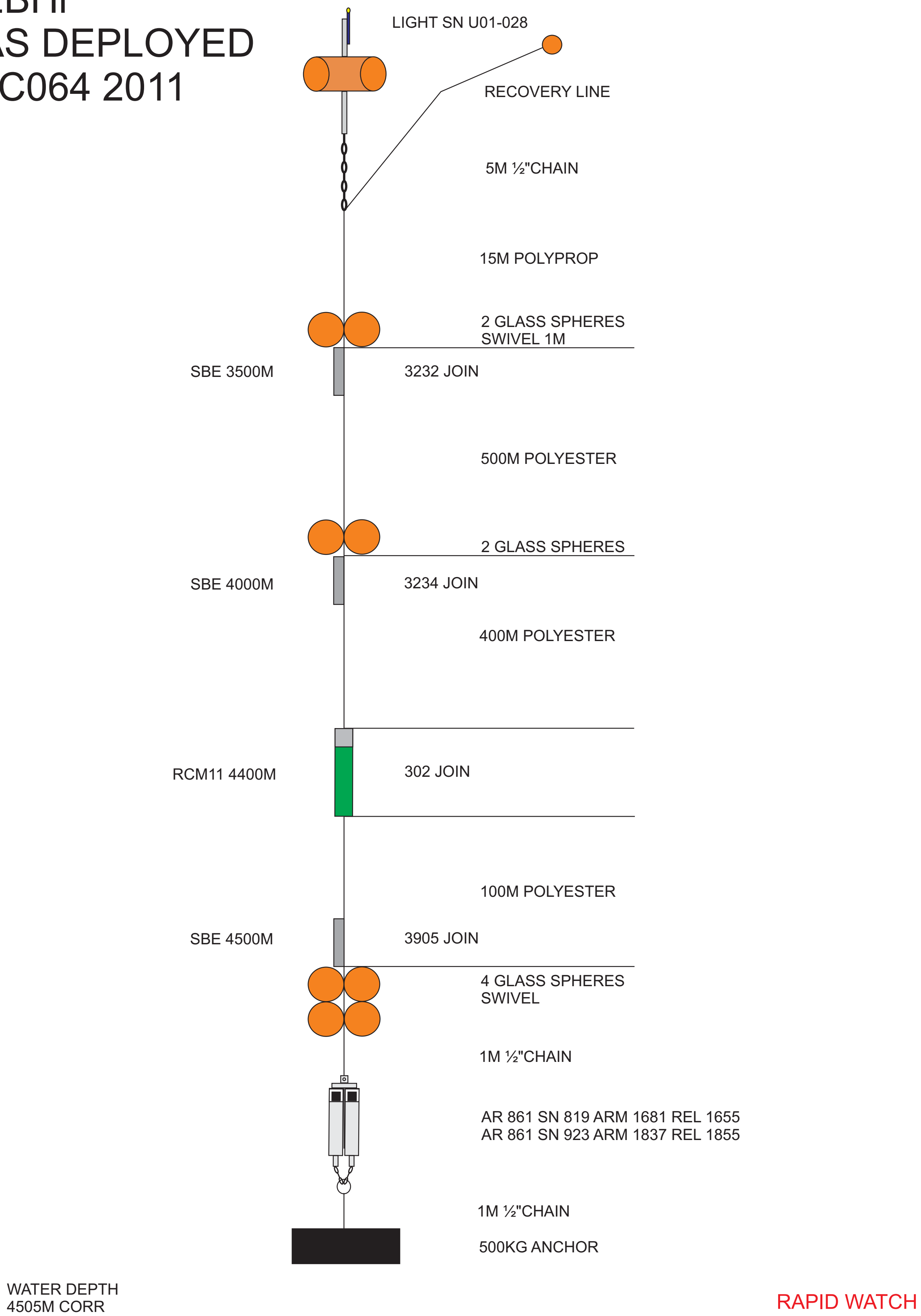
# EBH5
# AS DEPLOYED
# JC064 2011



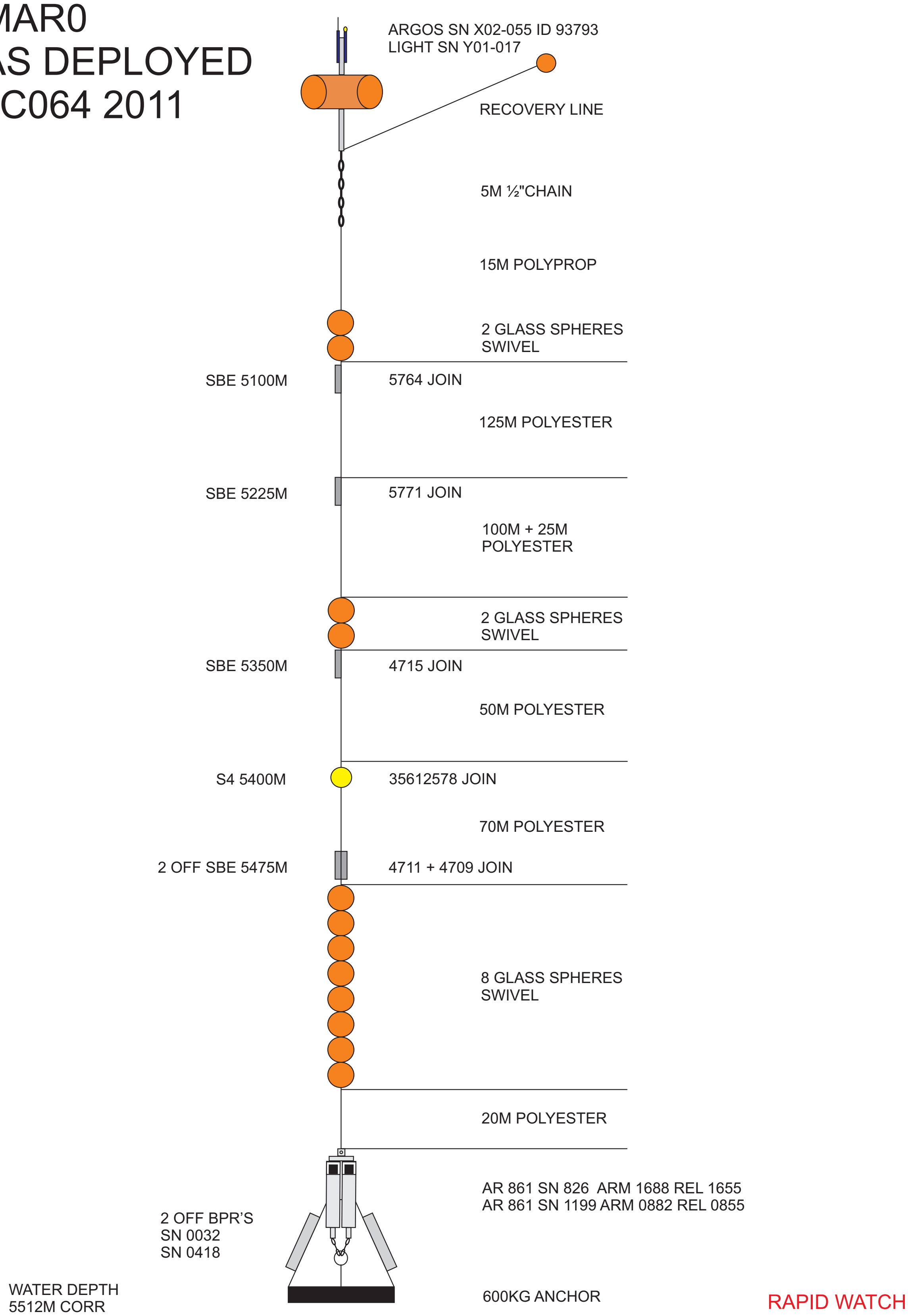

WATER DEPTH
1060M CORR

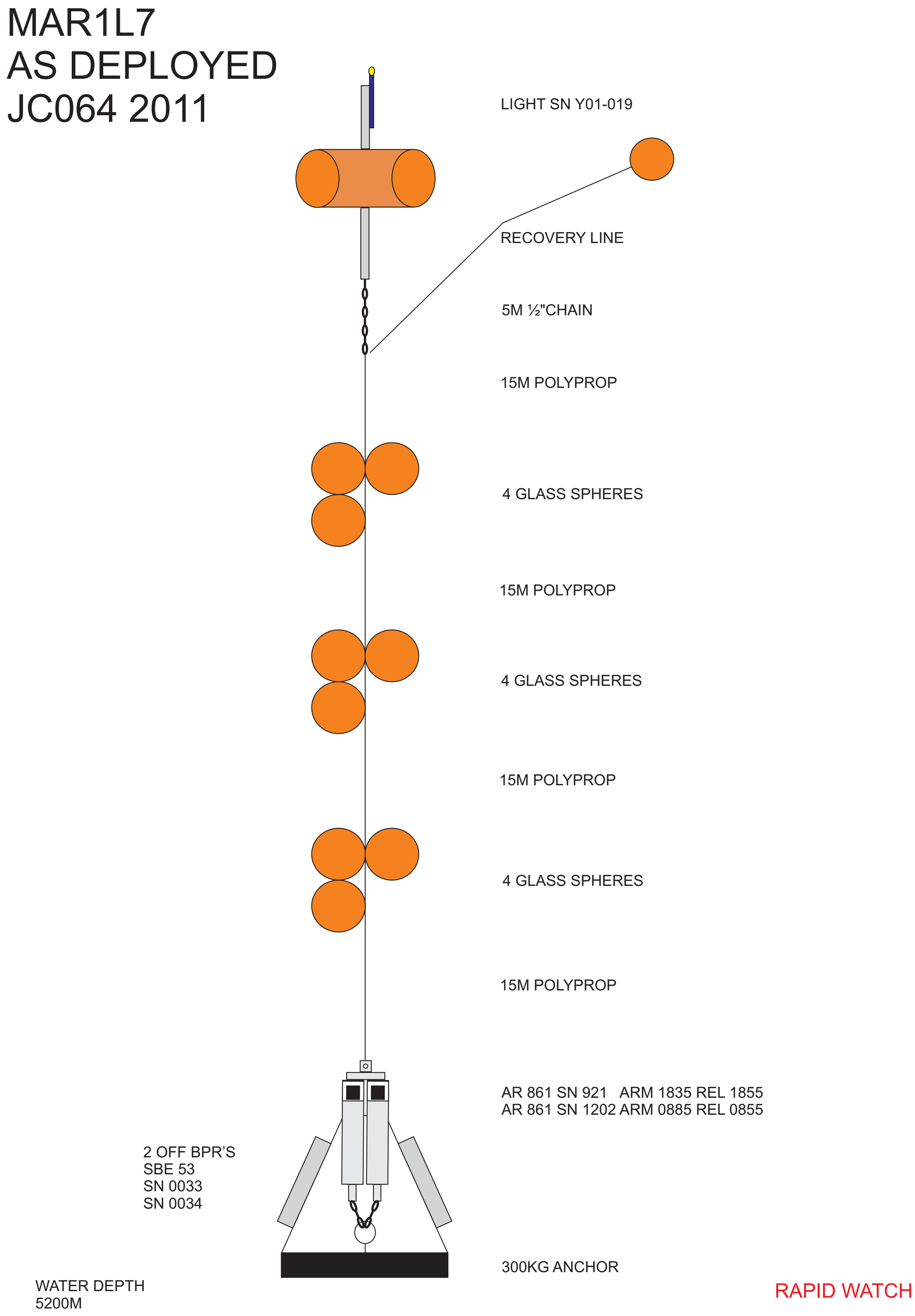
RAPID WATCH

# EBHi
# AS DEPLOYED
# JC064 2011

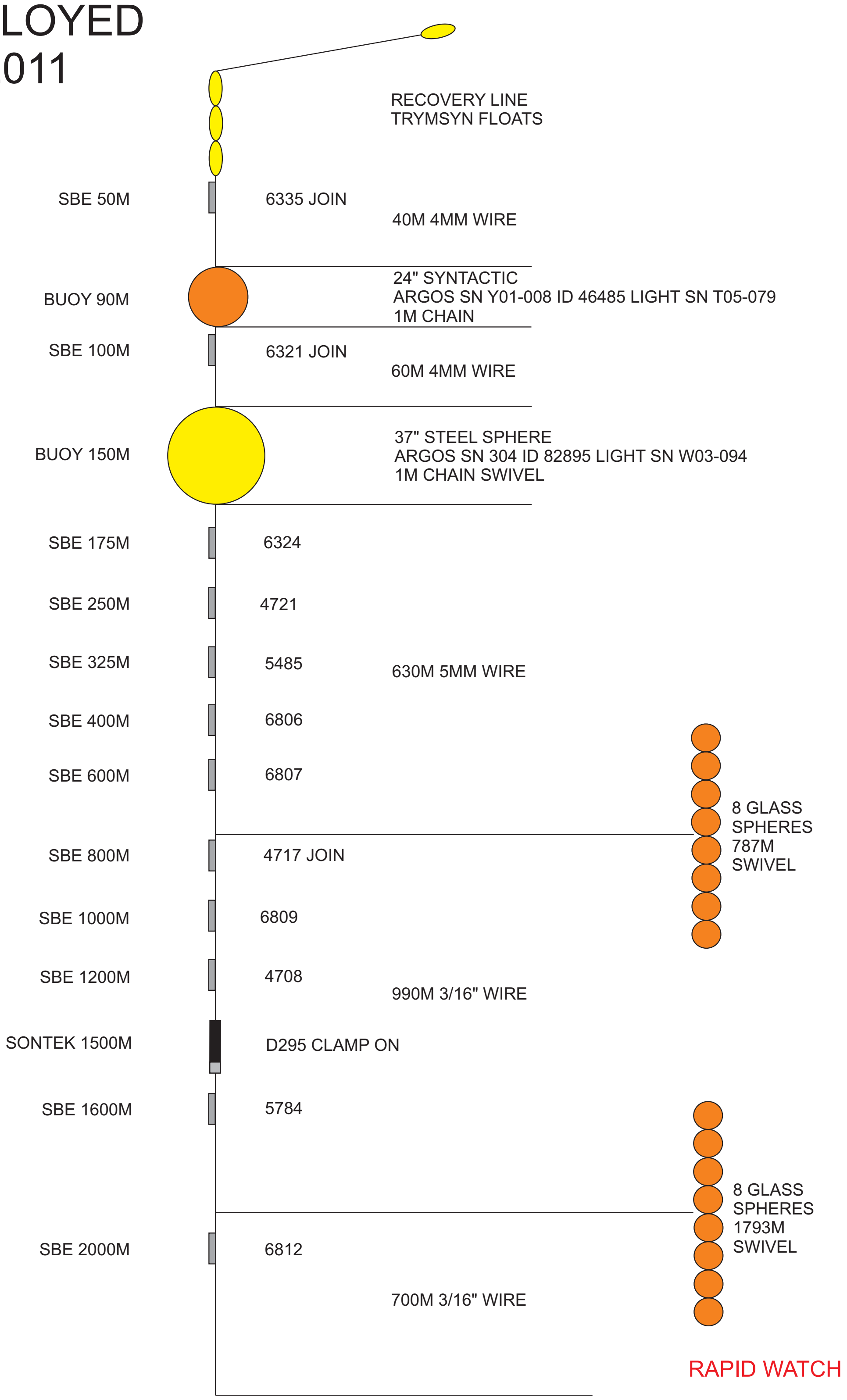


# MAR0
# AS DEPLOYED
# JC064 2011



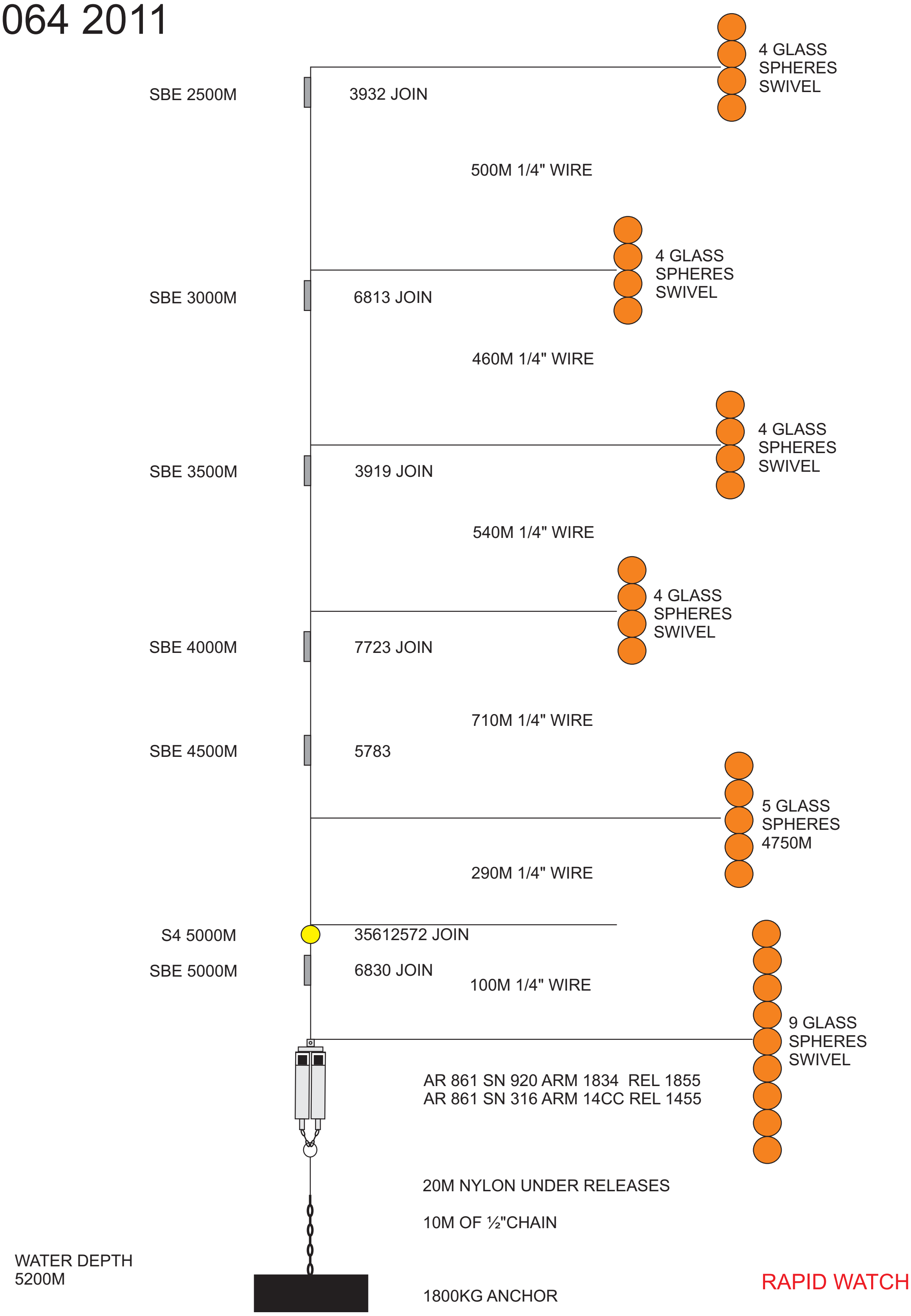

MAR1L7
AS DEPLOYED
JC064 2011
LIGHT SN Y01-019
RECOVERY LINE
5M ½"CHAIN
15M POLYPROP
4 GLASS SPHERES
15M POLYPROP
4 GLASS SPHERES
15M POLYPROP
4 GLASS SPHERES
15M POLYPROP
AR 861 SN 921 ARM 1835 REL 1855
AR 861 SN 1202 ARM 0885 REL 0855
2 OFF BPR'S
SBE 53
SN 0033
SN 0034
300KG ANCHOR
WATER DEPTH
5200M
RAPID WATCH

# MAR 1
# AS DEPLOYED
# JC064 2011

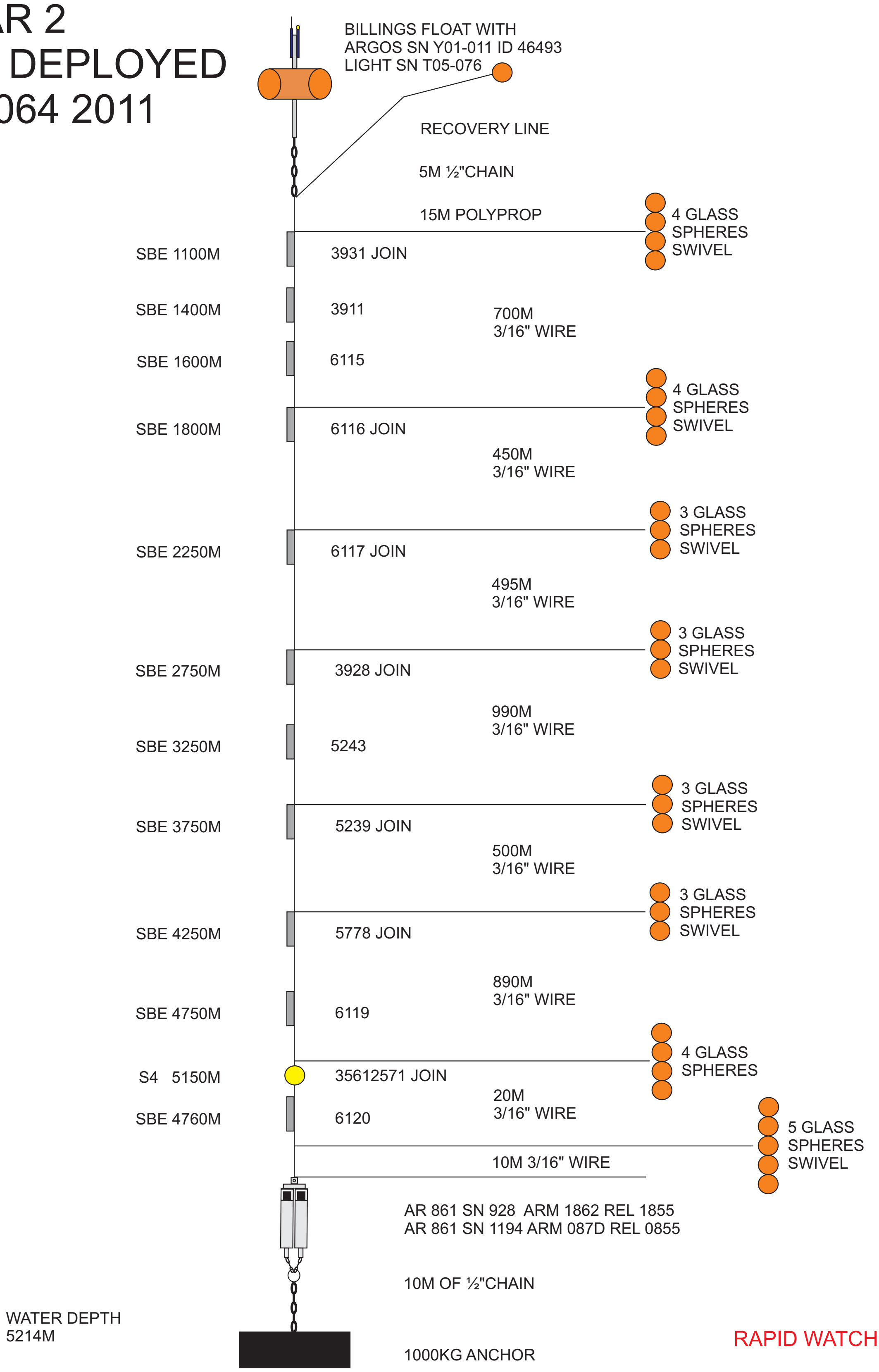


# MAR 1
# AS DEPLOYED
# JC064 2011

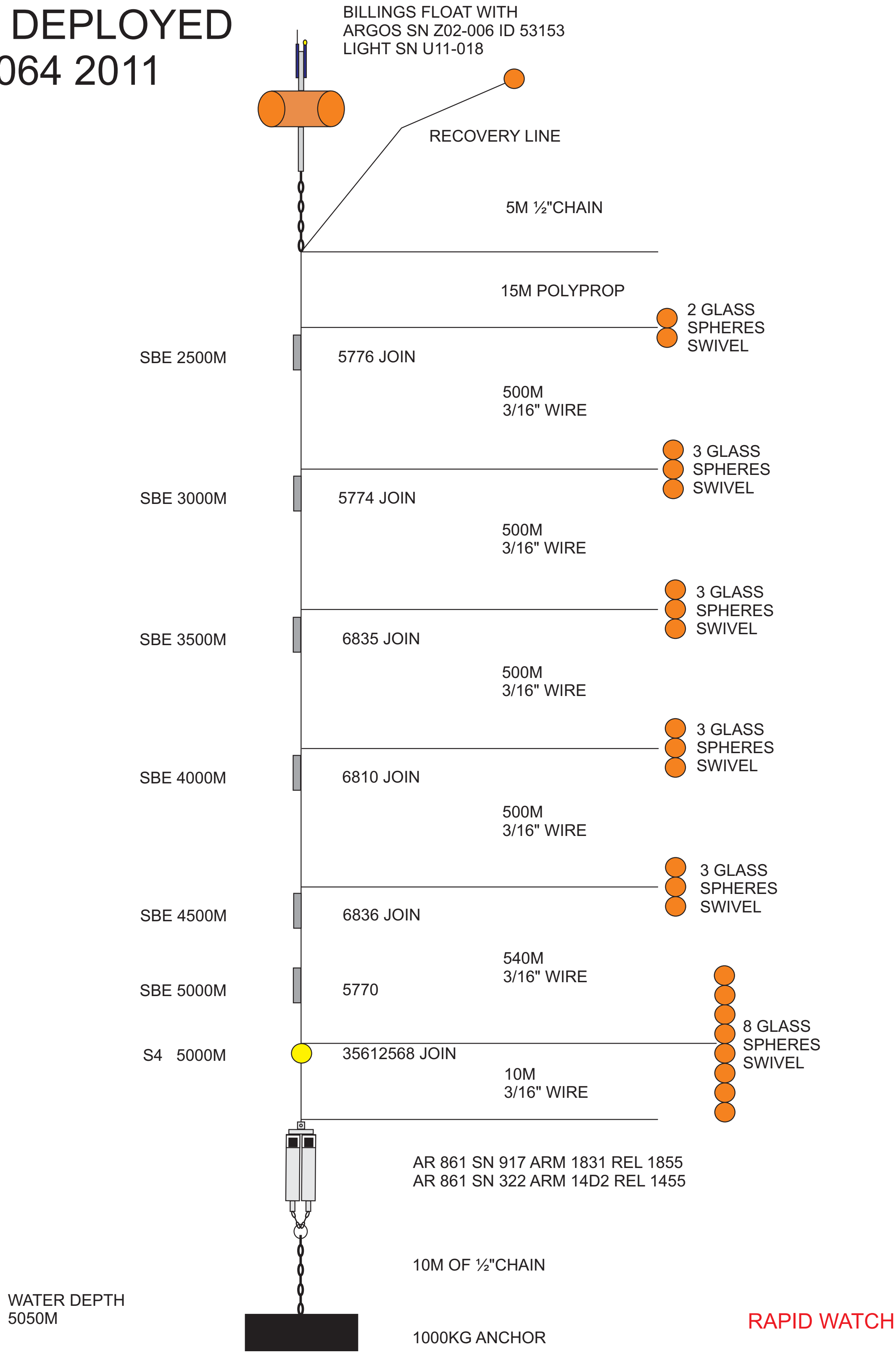




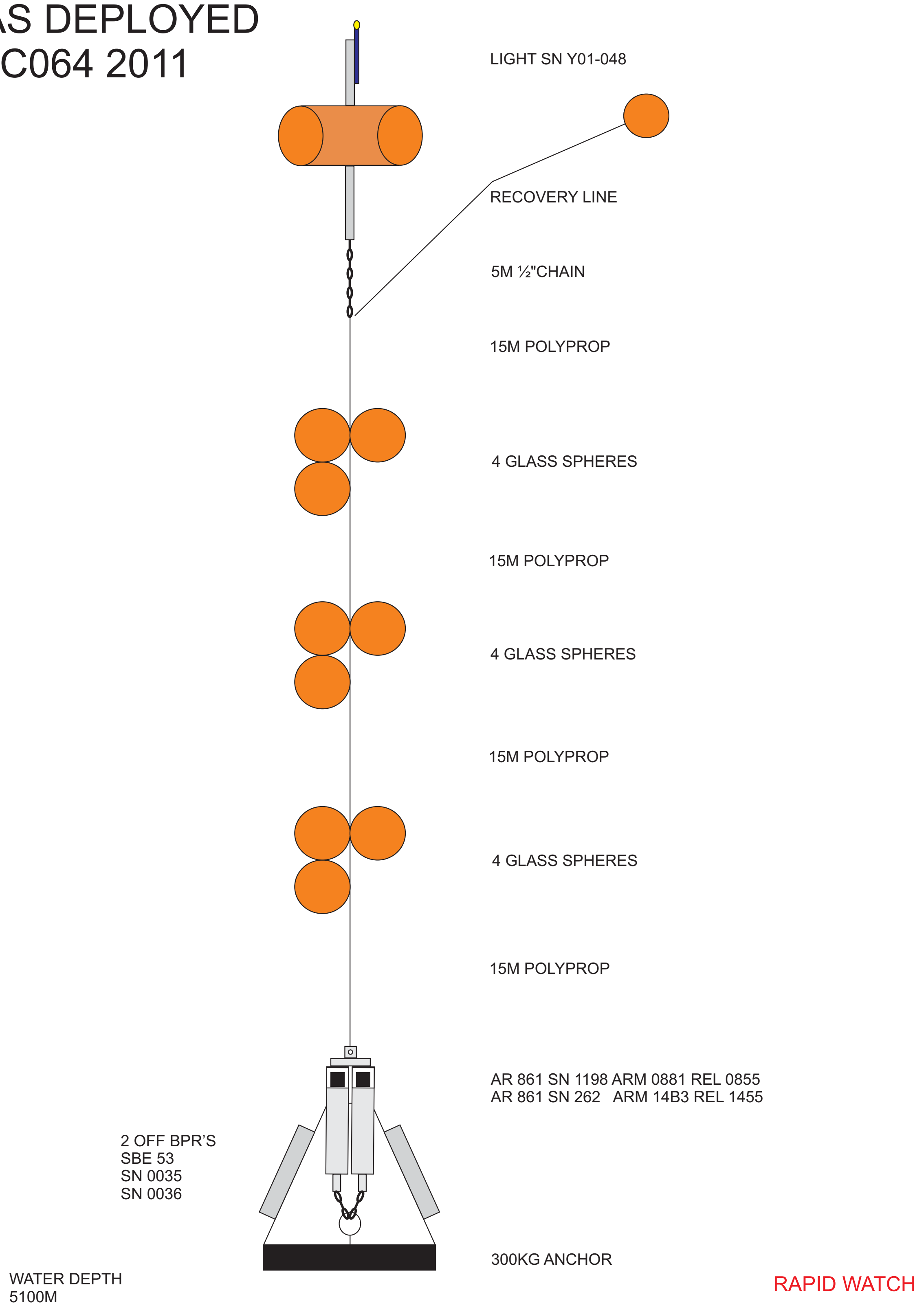
# MAR 2
# AS DEPLOYED
# JC064 2011



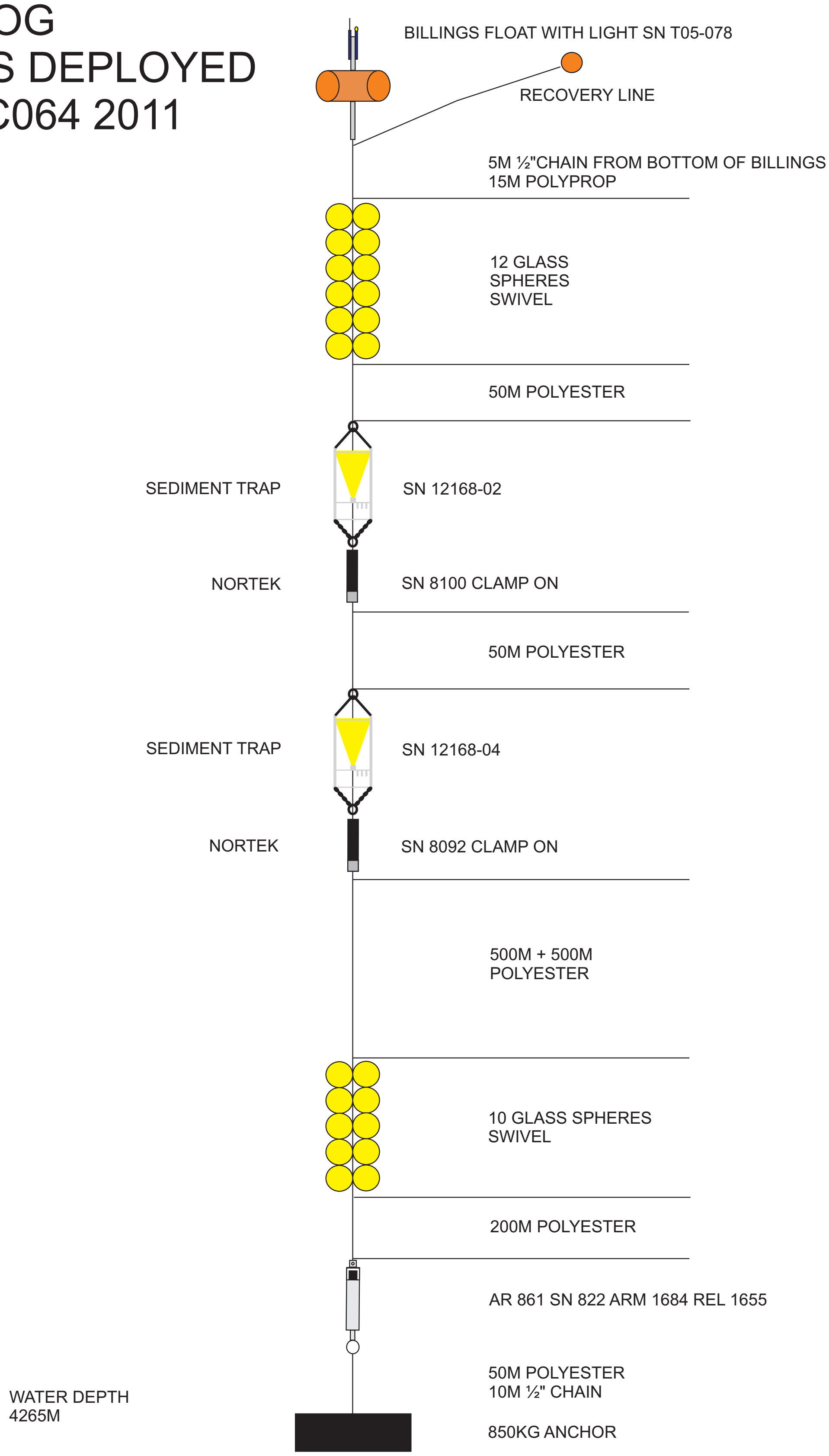
# MAR 3
# AS DEPLOYED
# JC064 2011



# MAR3L7
# AS DEPLOYED
# JC064 2011



# NOG
# AS DEPLOYED
# JC064 2011



# I Mooring Recovery Logsheets

## RECOVERY

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EB1L6** |
| Date ~~1232~~ 16/9/11 | | | DOY 259 | |
| Site Arrival Time 1332 | | | | |
| Setup Distance (nm) ~~1.5nm~~ 2.56nm | | | | |

AKA EBL3

### Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 13:43 | 23° 47,47' | -24° 08,24' | 4705 | 4738 |

### End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 15:25 | 23° 49,16' | -24° 06,38' | 5056 | 5099 |

| Release s/n | Arm | Release |
|---|---|---|
| 262 | 14B3 | |
| 316 | 14CC | |

Ascending @ ~ 60 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 262 | 1333 | – | – | |
| | | – | – | |
| | | – | – | |
| 316 | 133620 | 6390 | – | |
| | 1338 | – | – | |
| | 3845 | 6378 | – | |
| | | | | |
| 316 | 133450 | – | 6379 | release ok |
| | 134045 | 6378 | 6379 | " |
| | 134145 | 6380 | 6379 | " |
| | | | | |
| 262 | 1343 | – | – | sent release |
| | 134350 | – | – | " |
| | | | | |
| 316 | 1 | 6269 | 6258 | |
| | 1346 | 6219 | 6209 | |
| | 1347 | 6158 | 6149 | |
| | 1349 | 6047 | 6038.5 | |

not moved from seabed

– no response

61 m/min | 60 m/min

56 m/min | 56 m/min

| | EB1L6 AKA EBL3 | | | Date | GMT |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Billings float, light & flag | | | | ~~15 36~~ 1816 |
| **2** | 5m chain | | | | " |
| **3** | Recovery line | | | | " |
| **4** | 4 glass spheres | | | | " |
| **5** | 15m polyprop | | | | " |
| **6** | 4 glass spheres | | | | 18 21 |
| **7** | 15 m of polyprop | | | | " |
| **8** | BPR1 | 5083 | 392 | | 18 25 |
| **9** | BPR2 | 5083 | 419 ✓ | | " |
| **10** | AR1 | | | | " |
| **11** | AR2 | | | | " |
| **12** | Tripod, ~~anchor~~ ~~(300kg)~~ | | | | " |

# RECOVERY

**CRUISE** JC064 **MOORING** **EB1**

| | |
|---|---|
| Date 16/9/11 | DOY 259 |
| Site Arrival Time 0758 | |
| Setup Distance (nm) 0.5 | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 09:39 | 23° 45.72' | -24° 09.41' | 5043 | 5085 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 13:25 | 23° 47.44' | -24° 08.28' | – | 5065 |

→ Swath data used. EA600m was too noisy

| Release s/n | Arm | Release |
|---|---|---|
| 822 | 1684 | |
| 921 | 1835 | |

Ascending @ ~89 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 822 | 0801 | – | 5075 | n/a |
| 921 | 080145 | 5075 | 5076 | V 8.7 |
| 822 | 0803 | 5075 | 5075 | release OK |
| | 0804 | 4994 | 4981 | |
| | 0805 | 4897 | 4885 | |
| | | | | |
| At 0900 | still only | top 4×4 glass on | surface. | |
| suddenly all up | by | 0910 | | |

release sent
} 81 m/min
} 97 m/min

| | **EB1** | | | **Date** | |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Trimsyn recovery float and line | | | | 09:39 |
| **2** | 3xTrimsyn floats | | | | 09:41 |
| **3** | 50m of 4mm wire (red) | | | | |
| **4** | SBE at top join | 50 | ✓5240 | Heavy fouling (pumps clear) | 09:41 |
| **5** | 24" syntactic, argos, light | 100 | 82952 | | 09:46 |
| **6** | 65m of 4mm wire (red) | | | | |
| **7** | SBE at top join | 100 | ✓5241 | Medium fouling (pumps clear) | 09:46 |
| **8** | 37" steel sphere, argos ✓ light ✓ | 170 | 60211 | | 09:56 |
| **9** | 325m 5mm wire | | | | |
| **10** | SBE at top join | 170 | ✓5762 | Dragged along track | 09:56 |
| **11** | SBE | 250 | ✓5763 | | 10:04 |
| **12** | SBE | 325 | ✓5766 | | 10:06 |
| **13** | SBE | 400 | ✓5767 | | 10:08 |
| **14** | 4 glass + ~~swivel~~ | 510 | | | 10:11 |
| **15** | 290m 3/16" wire (black) | | | | |
| **16** | SBE | 600 | 5768 | | 10:16 |
| **17** | 4 glass + ~~swivel~~ | 805 | | Tangled | 10:22 |
| **18** | 330m 3/16" wire (black) | | | | |
| **19** | SBE at top join | 800 | ✓5770 | | 10:22 |
| **20** | SBE | 1000 | ✓5771 | | 10:30 |
| **21** | 4 glass + swivel ✓ | 1135 | / | | 10:34 |
| **22** | 400m of 3/16" wire (black) | | | | |
| **23** | SBE | 1200 | ✓5773 | | 10:38 |
| **24** | Sontek | 1500 | D301✓ | | 10:46 |
| **25** | 4 glass | 1540 | | | 10:49 |
| **26** | 750m of 3/16" wire (black) | | | damaged at bottom | |
| **27** | SBE | 1600 | ✓5774 | | 10:56 |
| **28** | SBE | 2000 | ✓4774 | | 11:07 |
| **29** | 4 glass + swivel | 2300 | | tangled | 11:16 |
| **30** | 1000m of 3/16" wire (black) | | | damaged at top | |
| **31** | SBE | 2500 | ✓5776 | | 11:26 |
| **32** | SBE | 3000 | ✓5778 | tangled | 11:41 |
| **33** | 4 glass spheres + swivel | 3300 | | | 12:05 |
| **34** | 600m 1/4" wire | | | New drum | 12:28 |
| **35** | SBE | 3500 | ✓5779 | | 12:32 |
| **36** | 4 glass spheres | 3900 | | | 12:43 |
| **37** | 590m 1/4" wire | | | | |
| **38** | SBE | 4000 | ✓5780 | | 12:46 |
| **39** | 4 glass spheres | 4500 | | tangled | 13:01 |
| **40** | 430m 1/4" wire | | | | |
| **41** | SBE | 4500 | ✓5781 | | 13:05 |
| **42** | 60m 1/4" wire | | | | |
| **43** | 20+40m, 1/4" wire | | | | |
| **44** | SBE | 5000 | ✓4710 | | 13:18 |
| **45** | RCM | 5000 | ✓ 395 | | 13:18 |
| **46** | 8 glass + swivel | 5050 | | | 13:23 |
| **47** | AR1 | | 921 | | 13:23 |
| **48** | AR2 | | 822 | | 13:23 |
| **49** | ~~Anchor (1450kg)~~ | 5090 | | | |

NB: Double barrel with its own hydraulic power pack hauls at 50m/min when plumbed into the ship's hydraulics we usually get 60m/min.

# RECOVERY

| CRUISE | JC064 | | MOORING | EBH1L7 | |
|---|---|---|---|---|---|
| Date | 6/10/11 | | DOY | 279 | |
| Site Arrival Time | 12-10 | | | | |
| Setup Distance (nm) | | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 12:13 | 27° 16.41 | -15° 24.50 | 2940 | 2942 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 13-41 | 27° 16.21 | -15° 24.80 | | 2940 |

| Release s/n | Arm | Release |
|---|---|---|
| 824 | 1686 | |
| 281 | 14B9 | |

Ascending @ ~65 m/min

12:11:30 3119 3119

ARM: 1686

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 824 | 121300 | 3123 | 3123 | Release OK |
| | 12 14 00 | 3073 | 3066 | " " |
| | 12 15 00 | 3002 | 3993 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| 281 | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

} 60 m/min

} 70 m/min

7 / 300 / 44

ARM: 14B9

eta @ surface 13:00.

| EBH1L7 | | | | Date | |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Billings float, light & flag | | | Dragged @ 13.25 / Hit Helon deck | 13.31 |
| **2** | 5m chain | | | | |
| **3** | Recovery line | | | } Tangled | 13.29 1st |
| **4** | ~~3~~ 4 glass spheres | | | | 13.29 |
| **5** | 15m polyprop | | | | |
| **6** | ~~4~~ 4 glass spheres | | | | 13.37 |
| **7** | 15 m of polyprop | | | | |
| **8** | BPR1 | | √ 0060 | | 13.41 |
| **9** | BPR2 | | √ 0064 | | 13.41 |
| **10** | AR1 | | 281 | | 13.41 |
| **11** | AR2 | | 824 | | 13.41 |
| **12** | Tripod, ~~anchor (300 kg)~~ | | | | 〃 |

# RECOVERY

| | | | | | |
|---|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | EBH1L8 | |
| Date 6/10/11 | | | DOY 279 | | |
| Site Arrival Time 1056 | | | | | |
| Setup Distance (nm) 0.5 | | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 10:56 | 27° 16.35' | -15° 24,63' | 2954 | 2957 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 12:08 | 27° 16.38' | -15° 24,54' | 2945 | 2947 |

| Release s/n | Arm | Release |
|---|---|---|
| 282 | 143A | |
| 354 | 14EA | |

Ascending @ ~ 68 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 282 | 105645 | 2957.6 | 2957.8 | release OK |
| | 105745 | 2897.6 | 2889.7 | |
| | 105845 | 2825.7 | 2818.8 | |
| | 105945 | 2761.6 | 2754.7 | |
| | 110045 | 2704.1 | 2699.0 | |
| | 110145 | 2648.1 | 2542.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

] 72m/min
] 64m/min
] 57m/min
] 58m/min ETA 1147

| | **EBH1L8** | | | **Date** 6/10/11 | | |
|---|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** | |
| **1** | Billings float, light & flag | | | | 12.00 | 1st |
| **2** | 5m chain | | | | | |
| **3** | Recovery line | | | 11.56 Gripped. } Tangled | | |
| **4** | 3 glass spheres | | | | 12.01 | |
| **5** | 15m polyprop | | | | | |
| **6** | 3 glass spheres | | | | 12.05 | |
| **7** | 15 m of polyprop | | | 3 glass spheres + 15m polyprop | 12.12 | last |
| **8** | BPR1 | | ✓ 396 | | 12.08 | |
| **9** | BPR2 | | ✓ 397 | | " | |
| **10** | AR1 | | ✓ 282 | | " | |
| **11** | AR2 | | ✓ 354 | | " | |
| **12** | Tripod, ✓ ~~anchor~~ (300 kg) | | | | | |

3 glass spheres

on surface 11.43 ish

# RECOVERY

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | EBH1 |
| Date 6/10/11 | | | DOY 279 | |
| Site Arrival Time 0800 | | | | |
| Setup Distance (nm) 0.5 | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 08:24 | 27° 16,10' | -15° 24,90' | 2985 | 2988 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 10:53 | 27° 16,37' | -15° 24,61' | 2994 | 2997 |

| Release s/n | Arm | Release |
|---|---|---|
| 1200 | 0883 | |
| 827 | 1689 | |

Ascending @ ~60m/min

| Release | time | range1 | range2 | diagnostic | |
|---|---|---|---|---|---|
| 1200 | 0813 | – | – | release sent but echo on | |
| | 081330 | 3187.2 | – | no ans. | |
| | 081430 | 3187.2 | – | no ans | |
| | 081530 | 3187.5 | – | no answer | |
| | | | | | |
| 827 | 081630 | – | – | no answer | |
| | 081730 | – | – | no answer | |
| | 081830 | – | – | no answer | |
| | 0822 | – | – | no answer | |
| 827 | 08:24:30 | 3186.7 | 3186.8 | release OK | |
| | 08:25:30 | 3133.0 | 3126.5 | | |
| | 08:26:30 | 3065.9 | 3059.6 | | ] 70m/min |
| | 08:27:30 | 3005.8 | 2999.8 | | ] 60m/min |
| | 0903 | – | – | | |
| | 0904 | – | – | | |
| 1200 | 0905 10 | 1119.5 | 1116.7 | | ] ~~17m~~/min 23m/min |
| | 0906 10 | 1096.9 | 1094.0 | | ] 18m/min |
| | 0907 10 | 1074.1 | 1076.9 | | ] 18m/min ETA 0940 |
| | 0909 10 | 1041.3 | 1034.4 | | ] 16m/min ETA 1022 |
| | 0916 10 | 939.7 | 936.5 | | ] 33m/min ETA 0945 |
| | 0923 10 | 706.2 | 705.5 | | ] 14m ETA ~~0945~~ 1005 |
| | 09 ~~[illegible]~~ 35 10 | 528.5 | 527.6 | | ] 5.7m/min |
| | 0945 10 | 471.5 | 470.7 | | ] 7m/min ETA 1054 |
| | 0949 10 | 453.5 | 453.2 | | |
| | 1005 30 | 293 | 291 | | |

## EBH1

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Argos float with light | | | Grappled @ 1017 | 10.28 |
| 2 | Recovery line and float | | | | |
| 3 | 5m chain | | | | |
| 4 | 15m polyprop | | | | |
| 5 | 2 glass spheres with swivel ✓ | 2500 | | Tangled | 10.27 1st |
| 6 | 250m of 8mm polyester | | | | |
| 7 | SBE at top join | 2500 | ✓3215 | | 10.27 |
| 8 | 2 glass spheres | | | | 10.41 |
| 9 | 150m of 8mm polyester | | | | |
| 10 | RCM at bottom join | 2900 | ✓ 301 | | 10.48 |
| 11 | 100m of 8mm polyester | | | | |
| 12 | SBE at bottom join | 3000 | ✓3244 | | 10.53 |
| 13 | 3 glass + swivel, 1m chain | | | | 10.53 |
| 14 | AR | | 1200 | Dragged on deck | 10.53 |
| 15 | AR | | 827 | | 10.53 |
| ~~16~~ | ~~Anchor~~ (500kg) | | | | |

# RECOVERY

| CRUISE | JC064 | | MOORING | EBH1L6 |
|---|---|---|---|---|
| Date | 13/09/11 | | DOY | 256 |
| Site Arrival Time | | 0958 | | |
| Setup Distance (nm) | | 4 cables | | |

AKA EBL4

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 11:15 | 27° 17,29' | -15° 26,17' | 2997 | 3000 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 11:31 | 27° 17,43' | -15° 26,24' | 2994 | 2997 |

| Release s/n | Arm | Release |
|---|---|---|
| 322 | 14D2 | |
| | | |

Ascending @ 65 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 322 | 10 0400 | 3074 | 3074 | 4.0 V |
| | 100530 | 3075 | 3075 | REL OK |
| | 100700 | 2984 | 2978 | " |
| | 100800 | 2919 | 2913 | " |
| | 1009 00 | 2840 | 2834 | " |
| | 10 10 00 | 2780 | 2782 | " |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

ARM: 14D2

REL: 1455

65m/min 65 m/min

~~70m~~ 70 m/min 65 m/min

eta 10.55

[illegible]

| | EBH1L6 | | | Date | |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Billings float, light & flag | | | } | 11:25 |
| **2** | 5m chain | | | | |
| **3** | Recovery line | | | | 11:15 |
| **4** | 2 glass spheres | | | } All tangled | 11:20 |
| **5** | 15m polyprop | | | | |
| **6** | 3 glass spheres | | | | 11:27 |
| **7** | 15 m of polyprop | | | | |
| **8** | BPR1 | 3010 | ✓395 | | 11:31 |
| **9** | AR1 | | 322 | | " |
| **10** | Tripod, ~~anchor (300kg)~~ | | | | " |

# RECOVERY

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EBH1** |
| Date | 13/09/10 | | DOY | |
| Site Arrival Time | 06:16 | | | |
| Setup Distance (nm) | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 07:13 | 27° 16.73' | -15° 25.57' | 3013 | 3016 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 07:47:21 | 27° 17.10' | -15° 25.79' | 3005 | 3008 |

| Release s/n | Arm | Release |
|---|---|---|
| ~~1864~~ | | |
| 930 | 1864 | |

Ascending @ ~ 93 m/min

s/n=930

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 1864 (arm) | 0617 — | | 3093 | 8.7 V |
| | 061818 | 3092 | | |
| | 061930 | 3002 | | |
| | 062030 | 2901 | ~~[illegible]~~ | |
| | 062130 | 2816 | 2807 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

RELEASE OK

} 101 m/min

} 85 m/min

eta 06.50

# EBH1

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Billings float with light | | | | 07:23 |
| 2 | 5m chain | | | | |
| 3 | Recovery line and float | | | | 07:13 |
| 4 | 3 glass spheres with swivel | 2500 | | Tangled | 07:24 |
| 5 | 250m of 8mm polyester | | | | |
| 6 | SBE at top join | 2500 | 5787 | Scratched ~~and~~ ~~h~~ / Dragged on deck | 07:24 |
| 7 | 2 glass | | | | 07:37 |
| 8 | 150m of 8mm polyester | | | | |
| 9 | RCM at bottom join | 2900 | 426 | | 07.43 |
| 10 | 100m of 8mm polyester | | | | |
| 11 | SBE at bottom join | 3000 | 5786 | | 07.47 |
| 12 | 3 glass + swivel, 1m chain | | | | 07.47.21 |
| 13 | AR | | | | 07.47 |
| 14 | ~~Anchor (500kg)~~ | | | | |

# RECOVERY

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | EBH2 |
| Date | 12/09/11 | | DOY | 255 |
| Site Arrival Time | 1620 | | | |
| Setup Distance (nm) | 0.5 | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 1623 | 27° 36.37' | -14° 12.72' | 2022 | 2022 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 17 32 | 27° 36.95' | -14 12.80' | 2021 | 2021 |

| Release s/n | Arm | Release |
|---|---|---|
| 819 | 1681 | |
| | | |

Ascending @ 74 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 819 | 1621 | 2159 | | |
| | 1621 30 | 5154 | | |
| | | | | |
| | 162315 | 2152.6 | 2169.2 | Release OK |
| | 162415 | 2048 | 2037 | |
| | 162515 | 1961 | 1930 | |
| | 1627 | 1793 | 1785 | |
| | 162730 | 1756 | 1748 | |

74 m/min

## EBH2

Date

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Billings float with light | | | | 17:09 |
| 2 | 5m chain | | | | |
| 3 | Recovery line and float | | | | 17:03 |
| 4 | 2 glass spheres with swivel | | | tangled | 17:11 |
| 5 | 200m of 8mm polyester | | | | |
| 6 | SBE at top join | 1600 | 4473 | | 17:11 |
| 7 | 2 glass | | | | 17:20 |
| 8 | 100m of 8mm polyester | | | | |
| 9 | SBE at top join | 1800 | 5775 | | 17:21 |
| 10 | RCM at bottom join | 1900 | 443 | | 17:27 |
| 11 | 100m of 8mm polyester | | | | |
| 12 | SBE at bottom join | 2000 | 4475 | | 17:32 |
| 13 | 3 glass + swivel, 1m chain | | | | 17:32 |
| 14 | AR | | | | 17:32 |
| 15 | ~~Anchor (500Kg)~~ | | | | |

# RECOVERY

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | EBH3 |
| Date | 12/09/2011 | | DOY | 255 |
| Site Arrival Time | 10:01 | | | |
| Setup Distance (nm) | 0.42 | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 10:06 | 27°48.08 | -13°45.06 | 1420 | 1422 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 11:33 | 27°48.93 | -13°44.66 | 1423 | 1425 |

| Release s/n | Arm | Release |
|---|---|---|
| 253 | 14AA | |
| | | |

Ascending @ 60 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 253 | 10:02 | – | – | |
| 253 | 10:04 | 1532.2 | 1532.9 | V/ 8.6V |
| 253 | 10:05:45 | 1532.0 | 1532.1 | RELEASEOK |
| 253 | 10:06:45 | 1483.0 | | |
| 253 | 10:07:45 | 1423.0 | | |

} 49m/min
} 60m/min

# EBH3

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Billings float with light | | | light not working | 10:56 |
| **2** | 5m chain | | | | |
| **3** | Recovery line and float | | | | 10:53 1st on |
| **4** | 2 mini trymsyn (2000m rated) | | | | 11.00 |
| **5** | 100m of 8mm polyester | | | | |
| **6** | SBE at top join | 900 | 4708 | | 11:04 |
| **7** | 2 mini trymsyn | | | ] tangled together | 11:09 |
| **8** | 100m of 8mm polyester | | | | |
| **9** | SBE at top join | 1000 | 4709 | 4709 | 11:09 |
| **10** | 2 mini trymsyn | | | | 11:17 |
| **11** | 100m of 8mm polyester | | | | |
| **12** | SBE at top join | 1100 | 5782 | | 11:19 |
| **13** | 2 mini trymsyn | | | | 11:22 |
| **14** | 100m of 8mm polyester | | | | |
| **15** | SBE at top join | 1200 | 4711 | | 11:23 |
| **16** | RCM at bottom join | 1300 | 444 | | 11:29 |
| **17** | 100m of 8mm polyester | | | | |
| **18** | SBE at bottom join | 1400 | 4715 | light fouling on casing | 11:33 |
| **19** | 3 glass + swivel, 1m chain | | | | 11:33 |
| **20** | AR | | 253 | | 11:33 |
| **21** | Anchor (500kg) | | | | |

# RECOVERY

| CRUISE | JC064 | | MOORING | EBH4L1 |
|---|---|---|---|---|
| Date 11/9/11 | | | DOY 254 | |
| Site Arrival Time 1630 | | | | |
| Setup Distance (nm) 3cm | | | | |

AKA EBL5

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 1631 | 27°51.85° | 13°31.03 | N/A | N/A |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 1706 | 27°52.09 | -13°31.05 | 1014 | 1018 |

| Release s/n | Arm | Release |
|---|---|---|
| 917 | 1831 | |
| | | |

Ascending @ 62 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| s/n 917 ~~163110~~ | 163110 | 1112 | 1112 | release OK |
| | 163210 | 1061 | 1055 | |
| | 163310 | 999 | 936 | |

} 62 m/min

| | EBH4L1 | | | Date 11/09/11 | |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Billings float, light & flag | | | } light fouling | 16:58 |
| **2** | 2x12" Glass + mast | | | | 16:58 |
| **3** | 1m chain | | | | |
| **4** | Recovery line | | | | |
| **5** | 2 glass spheres | | | Does not exist | ~~17:02~~ |
| **6** | 15m polyprop | | | | |
| **7** | 3 glass spheres | | | | 17:02 |
| **8** | 15 m of polyprop | | | | |
| **9** | BPR1 | 1005 | 40 | | 17:06 |
| **10** | AR1 | | | | |
| **11** | Tripod, anchor (300kg) | | | | |

# RECOVERY

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EBH4** |
| Date 11/9/11 | | | DOY 254 | |
| Site Arrival Time 0500 | | | | |
| Setup Distance (nm) 0.5 | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 07:07 | 27° 50.823 | -13° 32.662 | 1060.89 | 1064 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 08:06 | 27° 51.1974 | -13° 32.35 | 1059.4 | 1063 |

| Release s/n | Arm | Release |
|---|---|---|
| 923 | 1837 | |
| 1197 | 0880 | - |

Ascending @ ~ 65 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 923 | 0621 | 1267.5 | — | |
| | 062130 | 1267.1 | | |
| 1197 | 0623 | — | 1267 | |
| | | 1267.2 | — | |
| | | | | |
| 923 | 0626 | 1268 | 1268 | release ok |
| | 0627 | 1206.4 | 1199.1 | |

61m/min / 69m/min

## EBH4

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Billings float with light | | | light not working | 07:15 |
| **2** | 5m chain | | | mild fouling | 07.14 |
| **3** | Recovery line and float | | | first on | 07:07 |
| **4** | 1 glass sphere | 290 | | | 07:20 |
| **5** | 100m 4mm wire | | | | |
| **6** | SBE | 325 | 4719 | clean, imp | 7:24 |
| **7** | 100m 4mm wire | | | | |
| **8** | SBE | 400 | 4718 | clean, imp, magnet missing | 7.26 |
| **9** | SBE | 500 | 4720 | @join. clean | 7-32 |
| **10** | 2 glass + swivel | 500 | | | |
| **11** | 200m 3/16" wire | | | | |
| **12** | SBE | 600 | 4721 | mild fouling | 7:41 |
| **13** | SBE at bottom join | 700 | 6824 | ✓ | 7:4 |
| **14** | 2 glass + swivel | 700 | | | 7:48 |
| **15** | 350m of 3/16" wire | | | | |
| **16** | SBE | 800 | 6825 | ✓ | 0757 |
| **17** | 4 glass + swivel, 1m chain | | | | |
| **18** | AR 1 & 2 | | | 923 + 1197 | 0806 |
| **19** | ~~Anchor (500kg)~~ | | | | |

first on

# RECOVERY

| CRUISE | JC064 | | MOORING | EBH5 |
|---|---|---|---|---|
| Date | ~~0841~~ 11/9/11 | | DOY 254 | |
| Site Arrival Time | 0841 | | | |
| Setup Distance (nm) | 0·5 | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 09:17 | 27° 50,64' | -13° 32,84 | 1070·15 | 1070 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 10:07 | 27° 51,22' | -13° 32,69 | 1076·29 | 1081 |

| Release s/n | Arm | Release |
|---|---|---|
| 821 | 1683 | |
| 1203 | 0886 | |

Ascending @ ~ 60 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 821 | 0624 | – | 1075 | |
| | 0625 | 1076 | 1076. | |
| | | | | |
| 821 | 0843 | 1179 | 1179 | |
| | | | | |
| 1203 | ~~[illegible]~~ 0841 | 1179 | 1179 | |
| | | | | |
| 821 | 084445 | 1179 | 1178 | release OK |
| | 084545 | 1121 | 1115 | |

} 58 m/min / 63 m/min

## EBH5

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Billings float with light | | | } Heavy fouling | 09:26 |
| 2 | 5m chain + swivel | | | } light not working | " |
| 3 | Recovery line and float | | | Heavy fouling | 09:17 1st |
| 4 | 40m of 4mm wire | | | | |
| 5 | SBE at top join | 107 | 6826 | medium fouling | 09:30 |
| 6 | 2 glass | 146 | | | 09:32 |
| 7 | 295m of 5mm wire | | | | |
| 8 | SBE | 175 | 6827 | | 09:35 |
| 9 | SBE | 250 | 3282 ~~3382~~ | | 09:38 |
| 10 | 2 glass + swivel | 442 | | | 09:43 |
| 11 | 290m of 3/16" wire | | ✓ | | |
| 12 | ~~Sontek~~ S4 | 442 | 35612577 | | 09:43 |
| 13 | 2 glass | 734 | | | 09:54 |
| 14 | 310m of 3/16" wire | | | | |
| 15 | RCM at top join | 734 | ✓ 507 | | 09:54 |
| 16 | Sontek | 934 | D303 ~~D359~~ | ~~(on tape, I think that's wrong)~~ | 10:01 |
| 17 | ~~4~~ 5 glass + swivel, 1m chain | 1045 | | | 10:07 |
| 18 | AR x 2 | | | | 10:07 |
| 19 | ~~Anchor (500kg)~~ | | | | |

S4 35612577 0943

# RECOVERY

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EBHi** |
| Date 0625 Thur 15th | | | DOY 258 | |
| Site Arrival Time | | | | |
| Setup Distance (nm) 0·5 | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 07:40 | 24° 56.20' | -21° 16.42' | 4473 | 4499 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 08:23 | 24° 56.73' | -21° 16.20' | 4474 | 4500 |

| Release s/n | Arm | Release |
|---|---|---|
| 1198 | 0881 | |
| | | |

Ascending @ 72m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| wed 14, | ranging | tests. Dist | 2·9nm | |
| | | | | |
| 2' 1198 | 213130 | — | 6749·8 | |
| | 213250 | — | 2665 | V, 12·7 |
| | 213330 | 6749·7 | 6750 | |
| | | | | |
| | | | | |
| | 0625 | 4528·1 | 4528·4 | |
| | 062630 | 4526·2 | 4526·6 | Release OK |
| | 0628 | 4427·3 | 4417·8 | |
| | 0629 | 4353·7 | 4346·0 | |
| | 0633 | 4062 | 4053 | |
| | 0635 | 3919 | 3911 | |

] 72m/min

# EBHi

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Billings float with light | | | } Tangled | 07:47 |
| **2** | 5m chain | | | | |
| **3** | Recovery line and float | | | | 7:40 |
| **4** | 2 glass spheres with swivel | ~~2500~~ | | | 07:47 |
| **5** | 500m of 8mm polyester | | | | |
| **6** | SBE at top join | 3500 | ✓ 5783 | | 07:47 |
| **7** | 2 glass | | | } Tangled | 08:05 |
| **8** | 400m of 8mm polyester | | | | |
| **9** | SBE at top join | 4000 | ✓ 5784 | | 08:05 |
| **10** | RCM at bottom join | 4400 | ✓ 399 | | 08:18 |
| **11** | 100m of 8mm polyester | | | | |
| **12** | SBE at bottom join | 4500 | ✓ 5785 | | 08:23 |
| **13** | 4 glass + swivel, 1m chain | | | | " |
| **14** | AR | | 1198 | | 08:23 |
| **15** | ~~Anchor (500kg)~~ | | | | |

# RECOVERY

| CRUISE | JC064 | | MOORING | EBP1 |
|---|---|---|---|---|
| Date | 16-09-2011 | | DOY | 25 |
| Site Arrival Time ~~04~~ 16:20 | | | | |
| Setup Distance (nm) 4 cables, closed to 0nm | | | | |

## Start

| Time | Lat | Lon | Depth (u/c | Depth corr |
|---|---|---|---|---|
| 18:30 | 23° 49,16' | -24° 06,37' | 5059 | 5102 |

## End

| Time | Lat | Lon | Depth (u/c | Depth corr |
|---|---|---|---|---|
| 18:44 | 23° 49,51' | -24° 06,29' | 5059 | 5102 |

| CLEAR | TELEM | BEACON | XPND | RELEASE |
|---|---|---|---|---|
| | | | | |

| | Mooring Element | Serial num | Comment |
|---|---|---|---|
| 1 | Recovery float & line | | VHF ch 77 @ 156.875MHz |
| 2 | PIES | 136 | |
| | | | |

**EBP1_2_200832**
**EBP1**
**Serial Number 136**

| | | | |
|---|---|---|---|
| **XPND** | **69** | section 5-5 | ACS commands |
| **TELEM** | **65** | section 8.2 | Recovery |
| **BEACON** | **73** | | |
| **RELEASE** | **8** | | |
| **CLEAR** | **76** | | |

**weight in air 36 kgs**
**Time of pings** [ timing
XPND [check range]
~~Release at 1600~~

1. Listening in remote, Rx 12kHz. Did not detect IES pings at 10min intervals. ∴ no clock drift check possible. No response to XPND command
2. Sent release command repeatedly for ~45mins. At 1636 finally heard pinging at 4s intervals indicating release in progress.
3. Ascent verified on 'Line recorder'
4. surfaced at 1822, heard on VHF & spotted.

# RECOVERY

**CRUISE** JC064 **MOORING** **MAR0**

| | |
|---|---|
| **Date** 26/9/11 | **DOY** 269 |
| **Site Arrival Time** 1019 | |

**Setup Distance (nm)**

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 10.16 | 25° 05,84' | -52° 00.45' | 5523 | 5586 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 12.23 | 25° 06,67' | -52° 00.92' | 5443 | 5503 |

Ascending @ ~ 60m/min

ARM 14CE

| Release | Time | Range 1 | Range 2 | Diagnostic |
|---|---|---|---|---|
| 318 | 101645 | 5591 | 5589 | Release ok |
| | 101745 | 5530 | 5579 | |
| | 101845 | 5460 | 5457 | |
| | 102000 | 5376 | 5366 | |
| | 1021 | 5315 | — | |
| | 1022 | 5253 | 5244 | |
| | 1052 | 3508 | 3501 | |

~ 61 m/min

~ 62 m/min

~ 58 m/min

ETA surface 1140 ~ 0940

ETA surface 1145.

| | Mooring Element | Depth | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Recovery float and line | | | | 12:04 |
| 2 | Join | | | | |
| 3 | 3 Glass spheres | | | | 12:10 |
| 4 | Top join 125m of 10mm polyester | | | | |
| 5 | SBE (at top join) | 5100 | ✓ 4306 | | 12:10 |
| 6 | Bottom join 125m of 10mm polyester | | | | |
| 7 | Top join 125m of 10mm polyester | | | | |
| 8 | SBE (at top join) | 5225 | ✓ 6127 | | 12.18 |
| 9 | Bottom join 125m of 10mm polyester | | | | |
| 10 | 2 glass spheres + swivel ✓ | | | glass spheres imploded | 12.23 |
| 11 | Top join 50m of 10mm polyester | | | | |
| 12 | SBE (at top join) | 5350 | ✓ 4307 | Hit the ground | 12.23 |
| 13 | Bottom join 50m of 10mm polyester | | | | |
| 14 | Join | | | | |
| 15 | Current Meter S4 | 5400 | ✓ 35612574 | | 12.32 last package |
| 16 | Join | | | | |
| 17 | Top join 70m of 10mm polyester | | | | |
| 18 | SBE (at bottom join) | 5475 | ✓ 6128 | | 12.30 |
| 19 | SBE (at bottom join) | 5475 | ✓ 4466 | ~~Hit the ground~~ | 12.30 |
| 20 | Bottom join 70m of 10mm polyester | | | | |
| 21 | 6 glass spheres + swivel | | | | 12.30 |
| 22 | Join | | | | |
| 23 | 20m of 10mm polyester | | | | |
| 24 | Join | | | | |
| 25 | Acoustic Release | | | | 12.23 |
| 26 | Acoustic Release | | | | 12.23 |
| 27 | BPR 1 | 5500 | 0391 | | 12.23 |
| 28 | BPR 2 | 5500 | 0003 | | 12.23 |
| 29 | ~~Anchor 600kg~~ | | | | |

Twisted

# RECOVERY

**CRUISE** JC064 **MOORING** **MAR1L5**

| | |
|---|---|
| Date 25/9/11 | DOY 268 |
| Site Arrival Time 0815 | |
| Setup Distance (nm) 0.5nm | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 08.28 | 24° 12,01' | -49° 44,80' | 5176 | 5226 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 10.14 | 24° 12,30' | -49° 44,30' | 5175 | 5225 |

| Release s/n | Arm | Release |
|---|---|---|
| 370 | 14FA | |
| 216 | EC47 | |

Ascending @ 63 m/min

| Release | time | range1 | range2 | diagnostic | |
|---|---|---|---|---|---|
| 370 | 0827 | 5191.7 | 5191.6 | | |
| | 0828 | 5192.1 | 5191.3 | release OK | |
| | | 5165.5 | 5135.6 | | ] 64m/min |
| | | 5081.5 | 5071.8 | | ] 62m/min |
| | | 5019.5 | 5004.8 | | ] 63m/min |
| | | 4956.5 | 4947.6 | | |
| | | ETA surface 0950 | | | |
| | | | | | |
| | 0917 | 2135 | 2129 | | ]65m/min |
| | 0918 | 2072 | 2067 | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## MAR1L5

**Date**

| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time i/b** |
|---|---|---|---|---|---|
| **1** | Billings float, light & flag | | | imploded | 10:06 |
| **2** | 5m chain | | | | |
| **3** | Recovery line | | | | 10:01 |
| **4** | 4 glass spheres | | | | 10:06 |
| **5** | 15m polyprop | | | Rope damaged, half cut | |
| **6** | 4 glass spheres | | | | 10:11 |
| **7** | 15 m of polyprop | | | | |
| **8** | BPR1 | | 420 | | 10.14 |
| **8** | BPR2 | | 393 | | " |
| **9** | AR1 | | 370 | | " |
| **10** | AR2 | | 216 | | " |

# RECOVERY

**CRUISE** JC064 **MOORING** **MAR1**

| | |
|---|---|
| **Date** 24/9/2011 | **DOY** 267 |
| **Site Arrival Time** 09.35 | |
| **Setup Distance (nm)** | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 09.39 | 24° 09,82' | -49° 43,82' | 5145 | 5194 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 14 25 | 24° 10,66' | -49° 40,93' | 5151 | 5201 |

Ascending @ ~ 95m/min

| | | Release | Time | Range 1 | Range 2 | Diagnostic | |
|---|---|---|---|---|---|---|---|
| S/N 1194 | ARM | 087D | 093550 | 5205 | 5263 | | |
| | | | 0939 | 52348 | 5235.0 | Release OK | |
| | | | 0940 | 5152 | 5137 | | ] 100m/min |
| | | | 0941 | 5052 | 5037 | | ] 91m/min |
| | | | 0942 | 4901 | 4949 | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| S/N 1199 | ARM | 0882 | 0937 | – | 5241 | | |
| | | | 093745 | 5237 | 5237.2 | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

# MAR1

Date GMT

| | Mooring Element | Depth | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Recovery float and line | | | mild fouling | 11·00 |
| 2 | 3 trymsin floats | | | | 11·06 |
| 3 | ~~40 m 4mm wire~~ | | | | " |
| 4 | SBE (at top join) | 50 | 6331 | heavy fouling | " |
| 5 | Syntactic | | | | |
| 6 | Argos + light sphere | 90 | | | |
| 7 | 1m chain | | | | |
| 8 | 60m 4mm wire | | | | 11:12 |
| 9 | SBE | 100 | ✓ 3902 | | |
| 10 | 37" + Argos + light + swivel, 1m chain | 150 | | | 11:18 |
| 11 | 630m 5mm wire | | | | |
| 12 | SBE | 175 | ✓ 4068 | | 11:22 |
| 13 | SBE | 250 | ✓ 6121 | | 11:24 |
| 14 | SBE | 325 | ✓ 6129 | | 11:27 |
| 15 | SBE | 400 | ✓ 4722 | | 11:29 |
| 16 | SBE | 600 | ✓ 4071 | Heavy tangle with 5mm and 3/16 wire | 11:38 |
| 17 | 8 glass + swivel | 787 | | } Tangle | 11:45 |
| 18 | 990m 3/16" wire | | | | |
| 19 | SBE (at top join) | 800 | ✓ 6122 | | 11:45 |
| 20 | SBE | 1000 | ✓ 4072 | | 11:53 |
| 21 | SBE | 1200 | ✓ 6828 | | 11:58 |
| 22 | Sontek | 1500 | D320 ✓ | | 12:04 |
| 23 | SBE | 1600 | ✓ 7468 | Hit the vessel. } small tangle | 12:16 |
| 24 | 8 glass | 1793 | | | 12:16 |
| 25 | 700m 3/16" wire | | | | |
| 26 | SBE | 2000 | ✓ 6123 | | 12:29 |
| 27 | 4 glass + swivel | 2509 | | | 12:43 |
| 28 | 500m 1/4"wire | | | | |
| 29 | SBE (at top join) | 2500 | ✓ 4178 | | 12:44 |
| 30 | 4 glass | 3017 | | ] Tangled | 13:00 |
| 31 | 460m 1/4" wire | | ? ✓ | | |
| 32 | SBE (at top join) | 3000 | ? 6124 | | 13:00 |
| 33 | 4 glass + swivel | 3484 | | | 13:17 |
| 34 | 540m 1/4" wire | | | New drum | |
| 35 | SBE (at top join) | 3500 | ✓ 4180 | | 13:17 |
| 36 | 4 glass | 4032 | | | |
| 37 | 710m 1/4" wire | | | | |
| 38 | SBE (at top join) | 4000 | ✓ 6327 | | 13.42 |
| 39 | SBE | 4500 | ✓ 4305 | Clamp broken | 14.00 |
| 40 | 5 glass | 4750 | | } tangled | 14.06 |
| 41 | 290m 1/4" wire | | | | |
| 42 | SBE (at top join) | 4995 | ✓ 6126 | | 14.20 |
| 43 | 100m 1/4" wire | | | | |
| 44 | S4 at top join | 5000 | ✓35612576 | | 14.20 |
| 45 | 9 glass + swivel | 5151 | | | 14.25.00 |
| 46 | AR | | | | 14.25.03 |
| 47 | AR | | | | |
| 48 | Anchor (1800 kg) | | | | |

# RECOVERY

**CRUISE** JC064 **MOORING** **MAR2**

| | | | |
|---|---|---|---|
| **Date** 24/9/11 | | **DOY** 267 | |
| **Site Arrival Time** 1508 | | | |
| **Setup Distar** 0.5nm | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 15.14 | 24° 11.71' | -49° 45.89' | 5181 | 5231 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 19.47 | 24° 11.98' | -49° 43.57' | 5177 | 5227 |

| Release s/n | Arm | Release |
|---|---|---|
| | | |
| 920 | 1834 | |

Ascending @ 105m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 920 | 1509 | 5219.4 | – | |
| | 151230 | 5352 | | |
| | 151330 | – | – | sent release, no response |
| | 151430 | 5179.5 | 5162.4 | release OK |
| | 151530 | 5004 | 5049 | |
| | | | | |
| | | | | |
| | 16.20 – | 701m | 701m | |
| | 162130 | 685m | 681m | |
| | 162230 | 668 | 664 | |
| | 162330 | 658 | 658 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

] 105m/min

# MAR2

Date GMT

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Billings float with light | | | | 16.59 |
| 2 | 5m chain | | | | |
| 3 | Recovery line and float | | | | 1645 |
| 4 | 4 glass spheres with swivel ✓ | | | Tangled | 16.58 |
| 5 | Join: Top of 700m 3/16" wire | | | | |
| 6 | SBE at join | 1100 | ✓ 4070 | | 16.58 |
| 7 | SBE at mark | 1400 | ✓ 4468 | | 17.12 |
| 8 | SBE (no mark) | 1600 | ✓ 3934 | | 17.18 |
| 8 | Join: Bottom of 700m 3/16" wire | | | | |
| 9 | 4 glass spheres with swivel | 1787 | | | 1724 |
| 10 | Join: Top of 450m 3/16" wire | | | Tangled | " |
| 11 | SBE at join | 1800 | ✓ 6137 | | " |
| 12 | Join: Bottom of 450m 3/16" wire | | | | |
| 13 | 3 glass spheres | 2244 | | | 17.41 |
| 14 | Join: Top of 495m of 3/16" wire | | | | " |
| 15 | SBE at join | 2250 | ✓ 6320 | | " |
| 16 | Join: Bottom of 495m 3/16" wire | | | | |
| 17 | 3 glass spheres with swivel | 2745 | | | 17.57 |
| 18 | Join: Top of 990m of 3/16" wire | | | | |
| 19 | SBE at join | 2750 | ✓ 6322 | | 17.57 |
| 20 | SBE at mark | 3250 | ✓ 4470 | | 18:13 |
| 21 | Join: Bottom of 990m of 3/16" wire | | | | |
| 22 | 3 glass spheres with swivel | 3741 | | | 18:27 |
| 23 | Join: Top of 500m of 3/16" wire | | | Tangled / New drum | |
| 24 | SBE at join | 3750 | ✓ 6323 | | 18:27 |
| 25 | Join: Bottom of 500m of 3/16" wire | | | | |
| 26 | 3 glass spheres with swivel | 4246 | | | 18:57 |
| 27 | Join: Top of 890m of 3/16" wire | | | | |
| 28 | SBE at join | 4250 | ✓ 6325 | | 18:57 |
| 29 | SBE at mark | 4750 | ✓ 6326 | | 19.29 |
| 30 | Join: Bottom of 890m of 3/16" wire | | | | |
| 31 | 4 glass spheres with swivel ✓ | 5142 | | Tangled | 19.41 |
| 32 | Join: Top of 20m of 3/16" wire | | | 2 glass spheres imploded | |
| 33 | S4 current meter at join | 5150 | ✓ 35612565 | | 19.41 |
| 34 | SBE at mark | 5160 | ✓ 4471 | | 19.44 |
| 35 | Join: Bottom of 20m of 3/16" wire | | | Tangled | |
| 36 | 5 glass spheres with swivel ✓ | 5170 | | | 19.44 |
| 37 | Join: Top of 10m of 3/16" wire | | | | |
| 38 | Join: Bottom of 3/16" wire | | | | |
| 39 | Acoustic release | | | | 19.47.47 |
| 40 | 10m 1/2" chain | | | | |
| 41 | Anchor | 5200 | | | |

# RECOVERY

**CRUISE** JC064 **MOORING** **MAR3L5**

| | |
|---|---|
| **Date** 27/9/2011 | **DOY** 264 |
| **Site Arrival Time** | |
| **Setup Distance (nm)** | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 15 10 | 25° 23,32' | -49° 38,44' | 4820 | 4860 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 16 51 | 25° 26,83' | -49° 14,71' | 4323 | 4258 |

| Release s/n | Arm | Release |
|---|---|---|
| 928 | 1862 | 1855 |
| 826 | 1688 | 1655 |

Ascending @ 74 m/min

| | Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|---|
| | | | | | |
| 928 | 1862 | 122800 | – | – | |
| | | 122900 | 6226 | 6226 | |
| | | | | | |
| | | 150830 | – | – | |
| | | 150930 | 5065 | – | |
| | | 151030 | 5065 | 5065 | Release OK |
| | | 151200 | 4969 | 4960 | " |
| | | 151300 | 4897 | 4886 | " |
| | | 151500 | 4748 | 4738 | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| 826 | 1688 | 123045 | – | 6226 | |
| | | 123200 | 6226 | 6226 | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

72 m/min | 74m/min

eta 16.20 GMT

74m/min | 74 m/min

## MAR3L5

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Billings float, light & flag | | | Tangled (rows 1–4) | 16 43 |
| **2** | 5m chain | | | | |
| **3** | Recovery line | | | | 16 37 |
| **4** | 4 glass spheres | | | | 16 43 |
| **5** | 15m polyprop | | | | |
| **6** | 4 glass spheres | | | | 1648 |
| **7** | 15 m of polyprop | | | | |
| **8** | BPR1 | 5041 | ✓ 13 | | 16 51 |
| **8** | BPR2 | 5041 | ✓ 38 | | 16 51 |
| **9** | AR1 | | ~~[illegible]~~ → 928 | | 16 51 |
| **10** | AR2 | | 826 | | 16 51 |

# RECOVERY

**CRUISE** JC064 **MOORING** **MAR3**

| | |
|---|---|
| **Date** 21/9/11 | **DOY** 264 |
| **Site Arrival Time** 0400 | |
| **Setup Distar** 0.5nm | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 0747 | 23° 51,29' | -41°06,38' | 4967 | 5007 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 11 24 | 23° 51,60 | -41° 03,99' | 5040 | 5082 |

| Release s/n | Arm | Release |
|---|---|---|
| 1202 | 0885 | |
| 922 | 1836 | |

Ascending @ 90,7 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 1202 | 071550 | 5914 | 5430 | |
| | 0717 | 5145 | — | |
| | 071730 | 5145 | 5146.5 | |
| 922 | 071830 | — | 1133 | |
| | 0719 | 5147 | — | |
| | 071930 | 5146.1 | — | |
| | | | | |
| 1202 | 074715 | 5146.1 | 5145.6 | release OK |
| | 4815 | 5072.2 | 5058.6 | |
| | 4915 | 4981.5 | 4969.2 | |

] 90.7 m/min

ETA surface 0819

## MAR3

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Billings float with light | | | | 09:10 |
| **2** | 5m chain | | | | |
| **3** | Recovery line and float | | | | 09:01 |
| **4** | 2 glass spheres with swivel | 2500 | | Tangled | 09:10 |
| **5** | Join: Top of 500m 3/16" | | | | |
| **6** | SBE at join | 2500 | ✓ 6215 | Hit billings | 09:10 |
| **7** | Join: Bottom of 500m 3/16" | | | | |
| **8** | 3 glass spheres | 3000 | | | 0945 |
| **9** | Join: Top of 500m 3/16" | | | Tangled | |
| **10** | SBE at join | 3000 | ✓ 3933 | | 0931 |
| **11** | Join: Bottom of 500m 3/16" | | | | |
| **12** | 3 glass spheres | 3500 | | | 0959 |
| **13** | Join: Top of 500m 3/16" | | | | |
| **14** | SBE at join | 3500 | ✓ 6333 | Extremely Scratched | |
| **15** | Join: Bottom of 500m 3/16" | | | tangled | |
| **16** | 3 glass spheres + swivel | 4000 | | | 0959 |
| **17** | Join: Top of 500m 3/16" | | | | |
| **18** | SBE at join | 4000 | ✓ 6332 | Small damage | |
| **19** | Join: Bottom of 500m 3/16" | | | | |
| **20** | 3 glass spheres | 4500 | | tangled with previous | 10.18 |
| **21** | Join: Top of 540m 3/16" | | | package | |
| **22** | SBE at join | 4500 | ✓ 4472 | Broken clamp | 10.18 |
| **23** | SBE at mark | 5000 | ✓ 7363 | | 11.21 |
| **24** | Join: Bottom of 540m 3/16" | | | | |
| **25** | S4 | 5015 | ✓ 35612564 | tangled | 11.22 |
| **26** | 8 glass spheres with swivel | 5017 | | | 11.22 |
| **27** | 10m 3/16" | | | | |
| **28** | AR1 | | | | 11.24.07 |
| **29** | AR2 | | | | 11.24.07 |
| **30** | 10m of 0.5" chain | | | | |
| **31** | Anchor (1000kg) | 5050 | | | |

In surface it was really tangled. Billings (no 1) were tangled with S4 and 8 glass spheres (no. 25 & no. 26). It untangled when starting the recovery.

5 lines tangled together → sticked with tape and cut at some parts

# RECOVERY

| CRUISE | JC064 | MOORING | NOGST |
|---|---|---|---|
| Date | 21/9/2011 | DOY | 264 |
| Site Arrival Time | 1800 | | |
| Setup Distance (nm) | 0·4nm | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 1829 | 23° 46,13' | -41° 05,81' | 4220 | 4241 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 1928 | 23° 46,22' | -41° 04,91' | 4303 | 4326 |

| Release s/n | Arm | Release |
|---|---|---|
| 926 | 1860 | 1855 |
| | | |

Ascending @ —

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| | | | | |
| | | ~~7560~~ | | |
| | | | | |
| | | | | |
| accidentally fired by senior technician @ 17·15 ship's time | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## NOGST

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Billings float, light & flag | | | | 18:29 |
| **2** | 5m chain | | | | |
| **3** | Recovery line | | | | 18:23 |
| **4** | 15m polyprop | | | | |
| **5** | 12 glass spheres | | | Tangled | 18:29 |
| **6** | 50m polyprop | | | | |
| **7** | Sediment trap | 3000 | 12432-04 ✓ | | 18:37 |
| **8** | RCM current meter | 3000 | ✓ 423 | | 18:37 |
| **9** | 50m polyprop | | | | |
| **10** | Sediment trap | 3000 | 12432-05 ✓ | | 18:45 |
| **11** | RCM current meter | 3000 | ✓ 642 | Hit vessel | 18:45 |
| **12** | 500m polyprop | | | | |
| **13** | 500m polyprop | | | | |
| **14** | 10 glass spheres | | | | 19.15 |
| **15** | 200m polyprop | | | | |
| **16** | AR | | | | 19:27:51 |
| **17** | Anchor (850kg) | | | | |

# J Mooring Deployment Logsheets

## DEPLOYMENT

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | EB1L8 |
| Date 17/09/11 | | | DOY | |
| Site Arrival Time 16·21 | | | | |
| Setup Distance (nm) 1 cable | | | | |

### Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 16.30 | 23° 47.47' | -24° 06.82' | 5053 | 5096 |

### End

| Time | Lat | Lon | Depth (u/c) | Depth corr | |
|---|---|---|---|---|---|
| 16·33·26 | 23° 47·47' | -24° 6·80' | | 5088 | (swath) |
| | | | 5050 | 5093 | (ca 600m) |

| Release s/n | Arm | Release |
|---|---|---|
| 253 | 14AA | |
| 930 | 1864 | |

Descending at 51 m/min

4600
50 92 min

| Release | time | range1 | range2 | diagnostic | |
|---|---|---|---|---|---|
| | | | | | |
| 253 | 164100 | 431 | 436 | 15·1 V | }-50 m/min |
| | 164300 | 531 | 536 | 15·2 V | }-51 m/min |
| | 164500 | 633 | 638 | 〃 | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| 930 | 164600 | 684 | 692 | | } -51 m/min |
| | 164800 | 786 | 792 | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| EB1L8 | | | | Date | GMT |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Billings float, light | | | | 1630 |
| **2** | 5m chain | | | | " |
| **3** | Recovery line | | | | " |
| **4** | 15m polyprop | | | | " |
| **5** | 3 glass spheres | | | | 1631 |
| **6** | 15m polyprop | | | | " |
| **7** | 3 glass spheres | | | | 1632 |
| **8** | 15 m of polyprop | | | | " |
| **9** | 3 glass spheres | | | | " |
| **10** | 15m polyprop | | | | " |
| **11** | BPR1 | 416 | | 0012 | " |
| **12** | BPR2 | 418 | | 0058 | " |
| **13** | AR1 | 930 | | | " |
| **14** | AR2 | 253 | 14AA | | " |
| **15** | Tripod, anchor (300kg) | | | | 163326 |

[illegible]

# DEPLOYMENT

**CRUISE** JC064 **MOORING** **EB1**

| | |
|---|---|
| **Date** 17/9/11 | **DOY** 260 |
| **Site Arrival Time** 08 45 | |
| **Setup Distance (nm)** 4 8 nm | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 08 47 | 23° 43.43 | -24° 13.13 | 5079 | 5122 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 125830 | 23.7577 | -24.1551 | 5049 | 5097 |
| | 23° 45.46' | -24° 09.30' | | |

| Release s/n | Arm | Release |
|---|---|---|
| 1203 | 0886 | |
| 1197 | 0880 | |

Descending @ 93 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| | | | | |
| 1203 | ~~[illegible]~~ | | | |
| | 132800 | 4770 | 4784 | |
| | 132900 | — | — | |
| | 133000 | — | — | |
| | 133200 | — | 5157 | |
| | | | | |
| | 133900 | 5099 | — | |
| | 134000 | 5099 | 5099 | |
| | | | | |
| | T1 | 8128 | 8129 | Vertical |
| | 151600 | 7611 | 7600 | " |
| WP 2 | 151700 | 7568 | (2436) | " |
| | 153400 | 6137 | 6134 | |
| ~~[illegible]~~ | 155100 | 5667 | — | |
| WP3 | | | | |
| 1197 | 133400 | 5124 | — | |
| | 133700 | 5105 | 5103 | Vertical |
| | 133800 | 5101 | 5101 | |
| | | | | |
| | T1 | 8129 | 8130 | |
| | 150800 | 7985 | 7976 | |
| | 151200 | — | — | |
| ~~[illegible]~~ | 151400 | — | — | |
| | ~~[illegible]~~ | | | |
| | 155300 | — | — | |
| | 155400 | — | (3035) | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

echo sounder on

@ -93 m/min

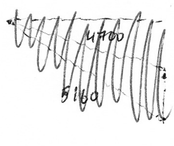
9.4V

"

"

V=12.7

s/n = 1203, 15.55.30, 0, 0 @ WP3
155700, 0, 0
155800, 0, 0
S/n = 1197, 165000, 7760, 7761 @ EBL L8
165100, 7760, 7761
S/n = 1203, 165300, 7760, 7760 @ EBIL8




200 m/min ? ✓

15/6·0

| EB1 | | | | Date 17/9/11 | GMT |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Trimsyn recovery float and line | | | | 08 47 0·5 kn |
| **2** | 3xTrimsyn floats | | | | " |
| **3** | 50m of 4mm wire (red) | | | | " 0·8 kn |
| **4** | SBE at top join | 50 | ✓5486 | | 08 49 |
| **5** | 24" syntactic, argos, light | 100 | | | 08 55 |
| **6** | 65m of 4mm wire (~~red~~) yellow | | | | " |
| **7** | SBE at top join | 105 | ✓ 3891 | | 08 59 |
| **8** | 37' steel sphere, argos light | 170 | | | 09 07 |
| **9** | 325m 5mm wire | | | | " |
| **10** | SBE at top join | 175 | ✓5484 | | 09 09 |
| **11** | SBE | 250 | ✓6804 | | |
| **12** | SBE | 325 | 6805 | | 09 16 |
| **13** | SBE | 400 | ✓ 5789 | | 09 20 |
| **14** | 4 glass | | | | 09 25 |
| **15** | 290m 3/16" wire (black) | | | | |
| **16** | SBE | 600 | ✓5247 | | 09 29 |
| **17** | 4 glass | | | | 09 37 |
| **18** | 330m 3/16" wire (black) | | | | |
| **19** | SBE at top join | 800 | ✓5245 | | 09 38 |
| **20** | SBE | 1000 | ✓6113 | | 09 45 |
| **21** | 4 glass + swivel | | | | 09 51 |
| **22** | 400m of 3/16" wire (black) | | | | |
| **23** | SBE | 1200 | ✓5244 | | 09 54 |
| **24** | Sontek | 1500 | D273 ✓ | | 10 04 |
| **25** | 4 glass | | | | 10 08 |
| **26** | 750m of 3/16" wire (black) | | | | |
| **27** | SBE | 1600 | ~~3912~~ | 6814 | 10 11 |
| **28** | SBE | 2000 | ✓3206 | | 10 23 |
| **29** | 4 glass + swivel | | | | 10 33 |
| **30** | 1000m of 3/16" wire (black) | | | | |
| **31** | SBE | 2500 | ✓6114 | | 10 41 |
| **32** | SBE | 3000 | ✓3266 | | 10 55 |
| **33** | 4 glass spheres + swivel | | | | 11 05 |
| **34** | 600m 1/4" wire | | | | |
| **35** | SBE | 3500 | ~~6814~~ | 6811 | 11 11 |
| **36** | 4 glass spheres | | | | 11 24 |
| **37** | 590m 1/4" wire white | | | | |
| **38** | SBE | 4000 | ✓6815 | | 11 27 |
| **39** | 4 glass spheres + swivel | | | | 11 43 |
| **40** | 430m 1/4" wire | | | | |
| **41** | SBE at top join | 4500 | ✓4549 | | 11 44 |
| **42** | 60m 1/4" wire | | | | |
| **43** | 20+40m, 1/4" wire | | | | |
| **44** | RCM at top join | 5000 | ✓ 303 | | 12:04 |
| **45** | SBE at top join | 5000 | ✓ 3225 | | 12:05 |
| **46** | 8 glass + swivel | | | Towing on release hook 1 on port crane | 12:17 |
| **47** | AR1 | | 1203 | | " |
| **48** | AR2 | | 1197 | | " |
| **49** | Anchor (1450kg) | 5093 | | Lifting on release hook 2 | 12 58 30 |

12·22 @ 0·6 nm from drop point

2009 4 hrs.
2010 3 hrs 20 mins

Bridge 8 cables @ 12·24 coming up to 1½ kn.

# DEPLOYMENT

| | | | | | |
|---|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | EBH1L7 | |
| Date 06/10/2011 | | | DOY 279 | | |
| Site Arrival Time | | | | | |
| Setup Distance (nm) | | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 18 07 | 27°08.30' | -15° 22.25' | 2996 | 2999 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 18:12:16 | 27° 08.34' | -15° 22.23' | 2997 | 3000 |

| Release s/n | Arm | Release |
|---|---|---|
| 824 | 1686 | |
| 281 | 1459 | |

Descending @ —

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 824 | 184435 | 3068.1 | 3067.8 | |
| 281 | 184515 | — | 3067.6 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| EBH1L7 | | | | Date | |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Billings float, light & flag | | | | 18:08:06 |
| **2** | 5m chain | | | | |
| **3** | Recovery line | | | | 18:07 |
| **4** | 3 glass spheres | | | | 18:09:02 |
| **5** | 15m polyprop | | | | |
| **6** | 3 glass spheres | | | | 18:09:42 |
| **7** | 15 m of polyprop | | | | |
| **8** | BPR1 | | 60 | | |
| **9** | BPR2 | | 64 | | |
| **10** | AR1 | | 824 | | |
| **11** | AR2 | | 281 | | |
| **12** | Tripod, anchor (300 kg) | | | | 18:12:16 |
| | | | | | 18:10:18 |

3 glass spheres (inserted between rows 7 and 8)

9 glass – 3x3

# DEPLOYMENT

| CRUISE | JC064 | | MOORING | EBH1L8 | |
|---|---|---|---|---|---|
| Date 06 / 10 / 2011 | | | DOY 279 | | |
| Site Arrival Time | | | | | |
| Setup Distance (nm) | | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 18 : 32 | 27° 08,09' | -15° 21,87' | 3003 | 3006 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 18 : 36 : 54 | 27° 08,12' | -15° 21,85' | 3002 | 3005 |

| Release s/n | Arm | Release |
|---|---|---|
| 282 | 14BA | |
| 354 | 14EA | |

Descending @ 50 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 282 | 1841 | 271.6 | 276.9 | |
| | 184130 | 246.6 | 301.5 | |
| | | | | |
| 354 | 184225 | – | 356 | |
| | 55 | 368.8 | 373.8 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

50 m/min

| EBH1L8 | | | | Date | |
|---|---|---|---|---|---|
| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
| 1 | Billings float, light & flag | | | | 18.32.20 |
| 2 | 5m chain | | | | |
| 3 | Recovery line | | | | 18.32.08 |
| 4 | 3 glass spheres + swivel | | | | 18.33 |
| 5 | 15m polyprop | | | | |
| 6 | 3 glass spheres | | | | 18.34 |
| 7 | 15 m of polyprop | | | | |
| 8 | BPR1 | | √ 396 | | 18.36.53 |
| 9 | BPR2 | | √ 397 | | " |
| 10 | AR1 | | √ 282 | | " |
| 11 | AR2 | | √ 354 | | " |
| 12 | Tripod, anchor (300 kg) | | | | " |

3 glass spheres + 15m polyprop 18.35

# DEPLOYMENT

| CRUISE | JC064 | | MOORING | EBH1L8 | |
|---|---|---|---|---|---|
| Date | 13/09/14 | | DOY | 256 | |
| Site Arrival Time | 12:23 | | | | |
| Setup Distance (nm) | 1 cable | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 12:25 | 27° 16.44 | -15° 24.67 | 2957 | 2960 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 12:31:00 | 27° 16.48 | -15 24.61 | 2954 | 2957 |

| Release s/n | Arm | Release |
|---|---|---|
| 282 | 143A | |
| 354 | 14EA | |

Descending @ ~ 50m/min

Arm 14BA

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| | | | | |
| 282 | 123630 | | 357 | |
| | 123730 | 405 | 413 | 22.9V |
| | 123830 | 455 | 459 | — |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

} - 56m/min

} 50m/min 46m/min

HAPPY IT'S going down.

| | EBH1L8 | | | Date | |
|---|---|---|---|---|---|
| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
| **1** | Billings float, light & ~~flag~~ | | | | 12:26 |
| **2** | 5m chain | | | | |
| **3** | Recovery line | | | | 12:25 |
| **4** | 3 glass spheres | | | | 12:26 |
| **5** | 15m polyprop | | | | |
| **6** | 3 glass spheres | | | | 12:27 |
| **7** | 15 m of polyprop + 3 glass | | | | 12:28 |
| **8** | BPR1 | | 396 | | 12:31:00 |
| **9** | BPR2 | | 397 | | 12:31: |
| **10** | AR1 | | 282 | | 12:31 |
| **11** | AR2 | | 354 | | 12:31 |
| **12** | Tripod, anchor (          kg) | | | | 12:31:00 |

# DEPLOYMENT

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EBH1** |
| Date | 6/10/11 | | DOY | 279 |
| Site Arrival Time | 16:43 | | | |
| Setup Distance (nm) | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 16:43 | 27°08,46' | -15° 22,79' | 2994 | 2997 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 16:58:29 | 27° 08,61' | -15° 22,66' | 2994 | 2997 |

| Release s/n | Arm | Release |
|---|---|---|
| 827 | 1689 | |
| 1200 | 0883 | |

Descending @ 106 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 827 | 17.01.30 | – | – | |
| | 170230 | – | – | |
| | | | | |
| 1200 | 170330 | 649.2 | 660.2 | |
| | 170430 | 755.7 | 765.0 | |
| | | | | |
| 827 | 170530 | – | – | |
| | 170620 | – | – | |
| | | | | |
| ~~827~~ | 184715 | – | | |
| 1200 | 184850 | 3369.5 | 3369.7 | |
| | | | | |
| | | | | |
| 827 Did not communicate at any point today. | | | | |

] 106m/min

## EBH1 Date

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Argos float with light | | | | 16.44.18 |
| 2 | Recovery line and float | | | | 16.43.40 |
| 3 | 5m chain | | | | |
| 4 | 15m polyprop | | | | |
| 5 | 2 glass spheres with swivel ✓ | 2500 ~~2500~~ | | | 16.45 |
| 6 | 250m of 8mm polyester | | | | |
| 7 | SBE at top join | 2500 | ✓3215 | | 16.46 |
| 8 | 2 glass spheres | | | | 16.50 |
| 9 | 150m of 8mm polyester | | | | |
| 10 | RCM at bottom join | 2900 | ✓ 301 | | 16.53 |
| 11 | 100m of 8mm polyester | | | | |
| 12 | SBE at bottom join | 3000 | ✓3244 | | 16.56 |
| 13 | 3 glass + swivel, ✓ 1m chain | | | | 16.58.29 |
| 14 | AR | | ✓1200 | | 16.58.29 |
| 15 | AR | | ✓ 827 | | 16.58.29 |
| 16 | Anchor (500kg) | | | | 〃 |

# DEPLOYMENT

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EBH1** |
| Date 13-09-2011 | | | DOY 256 | |
| Site Arrival Time 08:30 | | | | |
| Setup Distance (nm) 2 cables | | | | |

ebh1l6

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 08:45 | 27° 16.61' | -15° 24,74' | 2973 | 2976 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 09:04:31 | 27° 16.73' | -15° 24,65' | 2985 | 2988 |

| Release s/n | Arm | Release |
|---|---|---|
| 1200 | 0883 | |
| 827 | 1689 | |

Descending @ 106 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 1200 | 090930 | 0 | 710 | 9.3V |
| | 091100 | 0 | 873 | 9.4V |
| | 091200 | 969 | 980 | 9.3V |
| | 091500 | 0 | 1299 | " |
| | 093400 | 0 | 3001.6 | 9.2V |
| | 093500 | 3000.1 | 3000.6 | 9.3V |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| 827 | 091830 | — | 5661 (?) | — |
| | 092000 | — | 1857 | 12.7V |
| | 092200 | — | — | |
| | 092600 | — | 2506 | " |
| | 092800 | — | 2724 | " |
| | 093100 | — | 3001 | " |
| | 093200 | — | 3000 | " |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

ARM: 0883
~~63 m/min~~
107 m/min
106 m/min
vertical.

ARM: 1689
vertical

# EBH1

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | ~~Argos~~ float with light | | | W03-096 | 08.45.45 |
| **2** | Recovery line and float | | | | 08.45 |
| **3** | 5m chain | | | | |
| **4** | 15m polyprop | | | | |
| **5** | 2 glass spheres with swivel ✓ | 2500 | | | 08.46 |
| **6** | 250m of 8mm polyester | | | | |
| **7** | SBE at top join | 2500 | ✓ 3215 | | 08.46 |
| **8** | 2 glass spheres ✓ | | | | 08.55 |
| **9** | 150m of 8mm polyester | | | | |
| **10** | RCM at bottom join | 2900 | ✓ 301 | | 08:59 |
| **11** | 100m of 8mm polyester | | | | |
| **12** | SBE at bottom join | 3000 | ✓ 3244 | | 09:04 |
| **13** | 3 glass + swivel, 1m chain ✓ | | | | " |
| **14** | AR | | | 1200 ARM 0883 | 09.04.31 |
| **15** | AR | | 827 | | " |
| **16** | Anchor (500kg) | | | | " |

09 04 30

BPR & AR from lander will be the yesterday's ones

# DEPLOYMENT

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EBH2** |
| Date | 12/09/11 | | DOY | |
| Site Arrival Time | | | | |
| Setup Distance (nm) | 2 cables | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 18:26 | 27° 36.73' | -14° 12.79' | 2022 | 2022 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 18 41 | 27° 36,88' | -14° 12,65' | 2019 | 2019 |

| Release s/n | Arm | Release |
|---|---|---|
| 1242 | 08AF | |
| 927 | 1861 | |

Descending @ ~ 90 m/min

@ 2000 m

| Release S/N | time | range1 | range2 | diagnostic | |
|---|---|---|---|---|---|
| 1242 | ~~1848~~ | ~~1370~~ | ~~588~~ | | echosounder on |
| | ~~184830~~ | ~~784~~ | ~~908~~ | ~~0.8V~~ | |
| | ~~184930~~ | ~~286~~ | ~~1019~~ | | |
| | ~~185030~~ | ~~1100~~ | ~~1111~~ | | |
| | 1852 | 1249 | 1260 | | 122 |
| | 1853 | 1382 | 1382 | | ] 131 m/min |
| | 54:30 | 1497 | 1508 | 9.2 V | vertical ] ~~115~~ 77 m/min; ~~126~~ 84 m/min |
| 927 | 185600 | — | 1684 | 12.7V | vertical ] 91 m/min |
| | 185800 | 1856 | 1866 | 9.3V | " |
| | 190000 | 2031 | 2032 | " | " ] 88 m/min (but final depth) |
| | 190100 | 2031 | 2031 | " | " |

## EBH2

**Date**

| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
|---|---|---|---|---|---|
| **1** | ~~Argos float with light~~ | | | | 18.26 |
| **2** | Recovery line and float | | | | 18.27 |
| **3** | 5m chain | | | | |
| **4** | 15 m polyprop | | | | |
| **5** | 2 glass spheres with swivel | | | | |
| **6** | 200m of 8mm polyester | | | | |
| **7** | SBE at top join | 1600 | 3230 | | 18.27 |
| **8** | 2 glass spheres | | | | 18.34 |
| **9** | 100m of 8mm polyester | | | | |
| **10** | SBE at top join | 1800 | 3224 | | 18.34 |
| **11** | Sontek at bottom join | 1900 | D332 | | 18.36 |
| **12** | 100m of 8mm polyester | | | | |
| **13** | SBE at bottom join | 2000 | 3265 | | 18.41 |
| **14** | 3 glass + swivel, 1m chain | | | | 18.41 |
| **15** | AR | | 1242 | | |
| **16** | AR | | 927 | | |
| **17** | 1m chain | | | | |
| **18** | Anchor (500kg) | | | | 18.41.14 |

# DEPLOYMENT

| CRUISE | JC064 | | MOORING | EBH3 |
|---|---|---|---|---|
| Date 12-09-2011 | | | DOY 255 | |
| Site Arrival Time | | | | |
| Setup Distance (nm) 2 cables | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 12:59 | 27° 48.30' | -13° 44.92' | 1419 | 1421 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 13:31 | 27° 48.45' | -13° 44.81' | 1419 | 1421 |

| Release s/n | Arm | Release |
|---|---|---|
| 925 | 1839 | |
| 908 | 1822 | |

Descending @ ~ 120 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 925 | 133730 | 185 | 216 | |
| | 38 30 | 99.2 | 961 | |
| | 39 | | | |
| | 1029 | 1043.6 | | |
| | 3930 | 1104 | — | |
| | 134030 | 1219 | 1232 | |
| | 1341 | 1280 | 1293 | |
| | 1342 | 1404 | 1416 | |
| | 134230 | 1444 | 1443 | |
| | 1343 | 1433.6 | 1443.9 | |
| | 1346 | " | " | V 9.2 |
| 908 | 1345 | — | 1443 | |
| 908 | 1347 | 1443 | 1443 | V 9.2 |

} 115 m/min
} 120 m/min
} 124 m/min

## EBH3

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | ~~Argo~~s float with light | | | No argos deployed | 12:59 |
| **2** | Recovery line and float | | | | 12:59 |
| **3** | 5m chain | | | | |
| **4** | 15m polyprop | | | | |
| **5** | 2 mini trymsyn + swivel | | | | 13:00 |
| **6** | 100m of 8mm polyester | | | | ~~13~~: |
| **7** | SBE at top join | 900 | 3907 | | 13:00 |
| **8** | 2 mini trymsyn | | | | 13:04 |
| **9** | 100m of 8mm polyester | | | | |
| **10** | SBE at top join | 1000 | 6802 | | 13:04 |
| **11** | 2 mini trymsyn | | | | 13:07 |
| **12** | 100m of 8mm polyester | | | | |
| **13** | SBE at top join | 1100 | 6801 | Dropped on deck | 13:07 |
| **14** | 2 mini trymsyn | | | | 13:10 |
| **15** | 100m of 8mm polyester | | | | |
| **16** | SBE at top join | 1200 | 6800 | | 13:10 |
| **17** | Sontek at bottom join | 1300 | D298 | | 13:13 |
| **18** | 100m of 8mm polyester | | | | |
| **19** | SBE at bottom join | 1400 | 6799 | Hit the deck twice when deploying | 13:16 |
| **20** | 3 glass + swivel, 1m chain | | | Dropped on deck from high | 13:31 |
| **21** | AR | | ~~919~~ | height. Replaced for: 925 | " |
| **22** | AR | | ~~911~~ | 908 | " |
| **23** | 1m chain | | | | " |
| **24** | Anchor (500kg) | | | | 13:31:39 |

# DEPLOYMENT

| | | | | |
|---|---|---|---|---|
| **CRUISE** | **JC064** | | **MOORING** | **EBH4L3** |
| **Date** 05/10/2011 | | | **DOY** 278 | |
| **Site Arrival Time** 19:05 | | | | |
| **Setup Distance (nm)** | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 19:05 | 27° 51.82' | -13° 30,84' | 992 | 996 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 19:10:07 | 27° 51.86' | -13° 30,85' | 994 | 998 |

| Release s/n | Arm | Release |
|---|---|---|
| 922 | 1836 | |
| 926 | 1860 | |

Descending @ ~ 45 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 922 | 71415 | — | 233.7 | |
| | 1515 | 261.9 | 266.4 | |
| | 1615 | 304.6 | 308.6 | |
| | | | | |
| 926 | 71730 | — | 372.6 | |
| | 1830 | 404.4 | 408.8 | |
| | 1930 | 450.1 | 454.6 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

] 45m/min

] 36m/min

] 46m/min

| EBH4L3 | | | | Date | |
|---|---|---|---|---|---|
| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
| 1 | Billings float, light | | | Y01-013 ID46489 [Argos] | 19:06 |
| 2 | 5m chain | | | W03-089 [Light] | |
| 3 | Recovery line and float | | | | 19:05 |
| 4 | 15m polyprop | | | | |
| 5 | 3 glass spheres | | | | 19:06 |
| 6 | 15m polyprop | | | | |
| 7 | 3 glass spheres | | | | 19:07 |
| 8 | 15m polyprop | | | | |
| 9 | 3 glass spheres | | | | 19:07 |
| 10 | 15m polyprop | | | | |
| 11 | BPR1 | | 0003 | | |
| 12 | BPR2 | | 0013 | | |
| 13 | AR1 | | 926 | | |
| 14 | AR2 | | 922 | | |
| 15 | Tripod, anchor (300kg) | | | | 19:10.07 |

# DEPLOYMENT

| CRUISE | JC064 | | MOORING | EBH4L3 |
|---|---|---|---|---|
| Date 12/9/11 | | | DOY 255 | |
| Site Arrival Time 0600 | | | | |
| Setup Distance (nm) 0 | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 07 29 | 27° 52,10' | -13° 30.86' | 1003 | 1007 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 073255 | ~~27° 52.12'~~ 27° 52,12' | -13° 30,85' | 1003 | 1007 |

| Release s/n | Arm | Release |
|---|---|---|
| 282 | 14 BA | |
| 354 | 14EA | |

Descending rate → NO descending 0 m/min

| | Release | time | range1 | range2 | diagnostic | |
|---|---|---|---|---|---|---|
| | 282/14BA | 07.39.00 | | 11.1 | 2.1V | |
| | ~~354/14EA~~ | 07.40.00 | | 182 | | |
| | | 07.40.30 | 187 | 50 | 3V | |
| | | | | | | |
| Release | | 07.45.00 | 216 | 216 | | OK |
| | | | | | | |
| | | | | | | |
| | 354/14EA | 07 41 30 | 78.2 | 125.5 | | |
| | | 42 00 | 12.9 | 26.7 | | |
| | | | | | | |
| Release | Mooring is afloat, with recovery float awash. Released anchor | | | | | |
| | proceeding with recovery. Inboard at 0840 | | | | | |

# EBH4L3

| | Mooring Element | Depth (m) | Serial num | |
|---|---|---|---|---|
| 1 | Billings float, argos & light | argos : Y | 01008 | id 46485 |
| 2 | 5m chain | light : Z | 02023 | |
| 3 | 15m polyprop | | | |
| 4 | 4*17" glass | | | |
| 5 | 15m polyprop | | | |
| 6 | 4*17" glass | | | |
| 7 | 15m polyprop | | | |
| 8 | 4*17" glass | | | |
| 9 | 15m polyprop | | | |
| 10 | BPR1 | | ~~282~~ | 396 |
| 11 | BPR2 | | ~~354~~ | 397 |
| 12 | AR1 | | ~~396~~ | 282 — 14BA |
| 13 | AR2 | | ~~397~~ | 354 — 14EA |
| 14 | Tripod, anchor (300kg) | | | |

After deployment Billings float / recovery float remained on surface. Ranges confirmed mooring has not sunk. Anchor released, proceeded with recovery.

All onboard by 083930

The tripod-AR-BPR setup will be used for EBH1L8 instead. When redeploying EBH4L3, change S/n

# DEPLOYMENT

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | EBH4 |
| Date | 11/09/11 | | DOY | |
| Site Arrival Time | 11·10 | | | |
| Setup Distance (nm) | 8 cables | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 12·05 | 27° 50.199 | -13° 33.0708 | 1061 | 1065 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 13·05·55 | 27°51·0112 | 13°32·4428 | 1058 | 1062 |

2

| Release s/n | Arm | Release |
|---|---|---|
| 264 | 14B5 | |
| 906 | 1820 | |

Descending rate: —

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 264 | | 1260·5 | 1260·7 | none |
| 264 | 154412 | 1260·6 | | |
| 906 | 154530 | 1264·1 | 1266·9 | none |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| 264 | 1600 | 1383·8 | 1386·1 | vertical |
| | | | | |
| 906 | 1601 | 1401 | 1403·7 | vertical |

vbatt 9·3V

vbatt 9·3V.

## EBH4

**Date**

| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
|---|---|---|---|---|---|
| **1** | Argos float with light | | | Y01-009 ID 46491/Z02-021 LIGHT | 1205 |
| **2** | Recovery line and float | | | | " |
| **3** | 5m chain | | | | |
| **4** | 15m polyprop | | | | |
| **5** | 1 glass sphere | | | | |
| **6** | 100m 4mm wire | | | | |
| **7** | SBE at top join | 325 | 3233 | | 1210 |
| **8** | 100m 4mm wire | | | | |
| **9** | SBE at top join | 400 | 3258 | | 1216 |
| **10** | 2 glass + swivel | 500 | | | 1224 |
| **11** | 200m 3/16" wire | | | | |
| **12** | SBE at top join | 500 | ✓3254 | | 1225 |
| **13** | SBE | 600 | ✓3219 | | 1229 |
| **14** | SBE at bottom join | 700 | ✓3221 | | 1233 |
| **15** | 2 glass | 700 | | | 1236 |
| **16** | 350m of 3/16" wire | | | | |
| **17** | SBE | 800 | ✓3222 | | 1240 |
| **18** | 4 glass + swivel, 1m chain | | | | |
| **19** | AR | 861 | 264 | | 13 05 |
| **20** | AR | | 906 | | |
| **21** | 1m chain | | | | |
| **22** | Anchor (500kg) | | | | 130555 |

↑
THIS WAY
UP

# DEPLOYMENT

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EBH5** |
| Date | 1/9/11 | | DOY | |
| Site Arrival Time | | | | |
| Setup Distance (nm) | 1.1 | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 1420 | 27° 49.653 | 13° 33.222 | 1068 | 1072 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 15 23.00 | 27° 50.563 | 13° 32.648 | 1057 | 1061 |

| Release s/n | Arm | Release |
|---|---|---|
| 249 | 14A6 | |
| 256 | 14AD | |

Descending rate: —

| ARM | Release | time | range1 | range2 | diagnostic | |
|---|---|---|---|---|---|---|
| 14A6 | 249 | 154850 | — | 1077.5 | none | |
| | | 155730 | 1062.6 | 1062.3 | — | |
| | | | 10 | 1056.5 | vertical | 9.2 |
| 14AD | 256 | 155100 | ~~1077~~6 | 1077.6 | — | |
| | | | 1076.0 | 1075.3 | — | |
| | | | 1055.3 | 1055.2 | vertical | vbatt 9.2 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Float from recovered EBH5

# EBH5

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Argos float with light | | | 255 ID 42747 / Z02-022 LIGHT | 1420 |
| **2** | Recovery line and float | | | | |
| **3** | 5m chain | | | | |
| **4** | 15m polyprop | | | | |
| **5** | 40m of 4mm wire | | | | |
| **6** | SBE at top join | 100 | 3223 | | 1423 |
| **7** | 2 glass + swivel | 175 | | increased speed to 1 kn | |
| **8** | 295m of 5mm wire | | | | 1428 |
| **9** | SBE | 175 | 3228 | | " |
| **10** | SBE | 250 | 3269 | | 14 31 |
| **11** | 2 glass + swivel | 450 | | | |
| **12** | 290m of 3/16" wire | | | | |
| **13** | RCM at top join | 450 | 305 | | 1441 |
| **14** | 2 glass | 750 | | | 14 58 |
| **15** | 310m of 3/16" wire | | | wire caught in capstan | 14 50 |
| **16** | Sontek at top join | 750 | D278 | | 15.00 |
| **17** | Sontek | 950 | ~~D295~~ | CHANGED TO D322 | 15.08 |
| **18** | 5 glass + swivel, 1m chain | | | | 15 23 |
| **19** | AR | | 249 | | 15 23 |
| **20** | AR | | 256 | | 15 23 |
| **21** | 1m chain | | | | |
| **22** | Anchor (500kg) | | | | 15 23 |

wire coating repaired @ 14.45

# DEPLOYMENT

| | | | | |
|---|---|---|---|---|
| CRUISE | JC064 | | MOORING | **EBHi** |
| Date 15/9/11 | | | DOY 258 | |
| Site Arrival Time 0844 | | | | |
| Setup Distance (nm) 0.5 nm | | | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 0933 | 24° 55.98' | -21° 16.39' | 4475 | 4502 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 103447 | 24° 56.44' | -21° 16.08' | — | 4505 |

→ No reasonable ea600m depth data. Swath corrected depth: 4505 m

| Release s/n | Arm | Release |
|---|---|---|
| 819 | 1681 | |
| 923 | 1837 | |

Descending @ 104 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| ~~1837~~ | 184045 | 3906 | 3917 | |
| 923 | 184145 | 4010 | 4023 | |
| | 184630 | 4469 | 4476 | |
| | 184730 | 4475 | 4475 | V, 9.4V |
| | | | | |
| | | | | |
| 819 | 184830 | 4479 | 4477 | |
| | | 4477 | 4477 | V, 9.5V |

} -104 m/min (rows 184045–184145)

## EBHi

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | ~~Argos float~~ with light | | ✓01-028 | Billings | 0933 |
| 2 | Recovery line and float | | | | |
| 3 | 5m chain | | | | |
| 4 | 15m polyprop | | | | |
| 5 | 2 glass spheres with swivel | 3500 | | | 0934 |
| 6 | 500m of 8mm polyester | | | | " |
| 7 | SBE at top join | 3500 | 3232 | ✓ | " |
| 8 | 2 glass | 4000 | | | 0948 |
| 9 | 400m of 8mm polyester | | | | " |
| 10 | SBE at top join | 4000 | 3234 | ✓ | " |
| 11 | RCM at bottom join | 4400 | 302 | ✓ | 1000 |
| 12 | 100m of 8mm polyester | | | | |
| 13 | SBE at bottom join | 4500 | 3905 | ✓ | 1005 |
| 14 | 4 glass + swivel, 1m chain | | | | |
| 15 | AR | | 819 | | |
| 16 | AR | | 923 | | |
| 17 | 1m chain | | | | |
| 18 | Anchor (500kg) | | | | 100347 |

# DEPLOYMENT

**CRUISE** JC064 **MOORING** **MAR0**

| | |
|---|---|
| **Date** 26/9/11 | **DOY** 269 |
| **Site Arrival Time** 2230 | |
| **Setup Distance (nm)** 0·4nm | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 22.59 | 25° 00,60' | -52° 00,49' | 5532 | 5595 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 23:24:10 | 25° 06,28' | -52° 00,61' | – | 5529 |

SWATH DATA (no ca 600m data available)

| Release s/n | Arm | Release |
|---|---|---|
| 826 | 1688 | |
| 1199 | 0882 | |

Descending @ 80 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 826 | 2328 | 589.2 | 603.0 | |
| | 2329 | 730.1 | 745.3 | |
| | 2330 | 873.5 | 884.0 | |
| | 2339 | 1936.6 | 1944.5 | |
| | 2340 | 2017.3 | 2025.2 | |
| | | | | |
| | | | | |
| 1199 | 2341 | 2101.7 | 2110.2 | |

at range of 0.5nm

} 80m/min / 80m/min

## MAR0

| | Mooring Element | Depth | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Billings, argos + light | | Y02-055 | 1293793 / Y01-017 | 2259 |
| **2** | Recovery line | | | | |
| **3** | 5m chain, swivel, polyprop | | | | |
| **4** | 2 Glass spheres | | | | |
| **5** | Top join 125m of 10mm polyester | | | | |
| **6** | SBE (at top join) | 5100 | ~~5764~~ | 4711 IMP | 2301 |
| **7** | Bottom join 125m of 10mm polyester | | | | |
| **8** | Top join 125m of 10mm polyester | | | | |
| **9** | SBE (at top join) | 5225 | ~~6808~~ | 5764 | 2305 |
| **10** | Bottom join 125m of 10mm polyester | | | | |
| **11** | 2 glass spheres + swivel | | | | |
| **12** | Top join 50m of 10mm polyester | | | | |
| **13** | SBE (at top join) | 5350 | ? 5771 | | 2308 |
| **14** | Bottom join 50m of 10mm polyester | | | | |
| **15** | S4 | 5400 | 35612578 | | 2310 |
| **16** | Top join 70m of 10mm polyester | | | | |
| **17** | SBE (at bottom join) | 5475 | ? 4709 | ] IMP | 2311 |
| **18** | SBE (at bottom join) | 5475 | ? 4715 | ] | " |
| **19** | Bottom join 70m of 10mm polyester | | | | " |
| **20** | ~~6~~ glass spheres + swivel | | | 8 glass | 2312 |
| **21** | Join | | | | |
| **22** | 20m of 10mm polyester | | | | |
| **23** | Acoustic Release | | 826 | | |
| **24** | Acoustic Release | | 1199 | | |
| **25** | BPR 1 | 5500 | ~~390~~ | 0032 SBE53 | |
| **26** | BPR 2 | 5500 | ~~32~~ | 0418 SBE53 | |
| **27** | Anchor 600kg | 5500 | | | 232410 |

# DEPLOYMENT

**CRUISE** JC064 **MOORING** **MAR1L7**

**Date** 25/09/11 **DOY** 268

**Site Arrival Time** 2050

**Setup Distance (nm)** 0.1

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 205230 | 24° 11.52'N | 49 44.74'W | 5172 | 5222 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 205710 | 24° 11.57'N | 49° 44.71'W | 5172 | 5222 |

| Release s/n | Arm | Release |
|---|---|---|
| 1202 | 0885 | |
| 921 | 1835 | |

Descending @ ~ 200 m/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 1202 | 210530 | 874.8 | — | |
| | 210615 | 1015.3 | 1033 | |
| | | | | |
| 921 | 210715 | 1210 | 1232 | |
| | 210745 | 1319 | 1344 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

} 187 m/min

} 218 m/min / 224 m/min

# MAR1L7

**Date**

| | **Mooring Element** | **Depth (m)** | **Serial num** | **Comment** | **Time o/b** |
|---|---|---|---|---|---|
| **1** | Billings float, light & flag | | Y01-019 | | 205230 |
| **2** | 5m chain | | | | |
| **3** | Recovery line | | | | |
| **4** | 3 glass spheres | | | | 2054 |
| **5** | 15m polyprop | | | | |
| **6** | 3 glass spheres | | | | 2055 |
| **7** | 15 m of polyprop | | | | |
| **8** | 3 glass spheres | | | | 205530 |
| **8** | 15 m of polyprop | | | | |
| **9** | BPR1 | | 033 | | |
| **10** | BPR2 | | 034 | | |
| **11** | **AR1** | | 1202 | | |
| **12** | **AR2** | | 921 | | 205710 |

# DEPLOYMENT

**CRUISE** JC064 **MOORING** **MAR1**

| | |
|---|---|
| **Date** 25/09/11 | **DOY** 268 |
| **Site Arrival Time** 1130 | |
| **Setup Distance (nm)** 6.6 | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 11:47 | 24° 06,68' | -49° 48,08' | 4952 | 4996 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 15:54:09 | 24° 10,08' | -49° 44,81' | 5165 | 5215 |

Descending @ ~ 180 m/min

S/N 920 ARM
S/N 316 ARM
44 Diag

| Release | Time | Range 1 | Range 2 | Diagnostic |
|---|---|---|---|---|
| 1834 | 155815 | 858.7 | 858.6 | |
| 14CC | 155915 | ~~[illegible]~~ | — | |
| | | | | |
| | 1601 | 1363 | 1383 | |
| | 1602 | 1561 | 1580 | |
| | 1603 | 1747 | 1765 | |
| | 1614 | 3522.6 | 3539 | |
| all S/N 920 | | | | |
| Δ0 1[illegible] | 1747 | 5859.8 | 5858.0 | |
| Δ1 2008 | 5809 | 5829 | | |
| 2009 | 5937 | — | | |
| Δ2 210845 | 6418.6 | 6428.1 | | |
| 2128 | 5567.2 | 5568.7 | | |
| 213030 | 5649.2 | 5659.9 | | |
| Δ3 2134 | 6049.9 | 6037.7 | | |
| 213510 | 6230 | 6257.3 | V, 8.6V | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

] 200m/min
] 180 m/min
] 161 m/min

Anchor on seabed approx. 24.1655°N, 49.75°W

# MAR1

**Date**

| | Mooring Element | Depth | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Recovery float and line | | | | 11:47 |
| **2** | 3 trymsin floats | | | | 11:49 |
| **3** | 40 m 4mm wire | | | | |
| **4** | SBE (at top join) | 50 | 6335 | | 11:51 |
| **5** | 24' Syntactic, argos, light | 90 | | | 11.56 |
| **6** | 60m 4mm wire | | | | |
| **7** | SBE | 100 | 6321 | | 11:58 |
| **8** | 37" + Argos + light + swivel, 1m chain | 150 | 3702 | | 12:03 |
| **9** | 630m 5mm wire | | | | |
| **10** | SBE | 175 | 6324 | | 12:08 |
| **11** | SBE | 250 | 4721 | | 12:12 |
| **12** | SBE | 325 | 5485 | | 12:15 |
| **13** | SBE | 400 | 6806 | | 12:18 |
| **14** | SBE | 600 | 6807 | | 12:24 |
| **15** | 8 glass + swivel | 787 | | | 12:34 |
| **16** | 990m 3/16" wire | | | | |
| **17** | SBE (at top join) | 800 | (?) 4717 | | 12:36 |
| **18** | SBE | 1000 | 6809 | | 12:42 |
| **19** | SBE | 1200 | 4708 ~~6810~~ | | 12:48 |
| **20** | Sontek | 1500 | D295 | | 13:00 |
| **21** | SBE | 1600 | 5784 | | 13:03 |
| **22** | 8 glass | 1793 | | | 13:14 |
| **23** | 700m 3/16" wire | | | | |
| **24** | SBE | 2000 | 6812 | | 13:22 |
| **25** | 4 glass + swivel | 2509 | | | 13:39 |
| **26** | 500m 1/4"wire | | | | |
| **27** | SBE (at top join) | 2500 | 3932 | | 13:40 |
| **28** | 4 glass | 3017 | | | 13:56 |
| **29** | 460m 1/4" wire | | | | |
| **30** | SBE (at top join) | 3000 | 6813 | | 13:57 |
| **31** | 4 glass + swivel | 3484 | | | 14:12 |
| **32** | 540m 1/4" wire | | | | |
| **33** | SBE (at top join) | 3500 | 3919 | | 14:13 |
| **34** | 4 glass | 4032 | | | 14:32 |
| **35** | 710m 1/4" wire | | | | |
| **36** | SBE (at top join) | 4000 | 7723 | | 14:33 |
| **37** | SBE | 4500 | 5783 | | 14:49 |
| **38** | 5 glass | 4750 | | | |
| **39** | 290m 1/4" wire | | | | |
| **40** | SBE (at [redacted] join) | 4995 | 6830 | ~~At bottom join, just before S4~~ Below S4 | 15:15 |
| **41** | 100m 1/4" wire | | | | |
| **42** | S4 at top join | 5000 | 35612572 | | 15:13 |
| **43** | 9 glass + swivel | 5151 | | | 15:27 |
| **44** | AR | | 920 | ARM: 1834 | 15:28 |
| **45** | AR | | 316 | ARM: 14CC | 15:28 |
| **46** | Anchor (1800 kg) | | | | 15.54 |

# DEPLOYMENT

**CRUISE** JC064 **MOORING** **MAR2**

| | |
|---|---|
| **Date** 25/9/11 | **DOY** 268 |
| **Site Arrival Time** 1630 | |
| **Setup Distar** ~~2.5nm~~ 1.7nm | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 17:05 | 24° 09,16' | - 49° 47,05' | 5043 | 5089 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 19:37:01 | 24° 11,10' | -49° 45,39' | 5166 | 5216 |

| Release s/n | Arm | Release |
|---|---|---|
| 1194 | 087D | |
| 928 | 1862 | |

Descending @ ~ 150m/min

| | Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|---|
| | | | | | |
| | 1194 | ~~194230~~ | ~~934~~ | ~~1099~~ | |
| | | 194400 | 1337 | — | |
| | | 194500 | 1495 | 1510 | |
| | | 194600 | 1639 | 1653 | |
| | | | | | |
| Δ1 | s/9 1194 | 201015 | 6952.5 | — | |
| | | 2011 | — | – | |
| Δ2 | | 2110 | 6545 | 6550.9 | <= ? |
| | | 211045 | 6248 | 6271 | |
| | | 211130 | 6354 | 6380 | |
| | | 213630 | 5476.0 | 5492.7 | V, 8.5V |
| | | 2138 | 5656.8 | 5679.1 | |
| | | 2140 | 5954.1 | 5981.1 | |
| Δ3 | | 2143 | 6489.5 | 6523.7 | |
| | 928 | 1947 | 1784 | 1796 | |

echo sounder !

~ 150 m/min descent

Anchor on seabed approx. 24.1775°N, 49.763°W

## MAR2

Date

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Billings float with light +ARGOS | | 129416 | | 1705 |
| 2 | 5m chain | | | | |
| 3 | Recovery line and float | | | | |
| 4 | 4 glass spheres with swivel | | | | 1707 |
| 5 | Join: Top of 700m 3/16" wire | | | | |
| 6 | SBE at join | 1100 | ✓ 3931 | | 1708 |
| 7 | SBE at mark | 1400 | ✓ 3911 | | 1718 |
| 8 | SBE (~~no mark~~) | 1600 | ✓ 6115 | | 1724 |
| 8 | Join: Bottom of 700m 3/16" wire | | | | |
| 9 | 4 glass spheres with swivel | 1787 | | | 1732 |
| 10 | Join: Top of 450m 3/16" wire | | | | |
| 11 | SBE at join | 1800 | ✓ 6116 | | 1733 |
| 12 | Join: Bottom of 450m 3/16" wire | | | | |
| 13 | 3 glass spheres | 2244 | | | 1747 |
| 14 | Join: Top of 495m of 3/16" wire | | | | |
| 15 | SBE at join | 2250 | ✓ 6117 | | 1749 |
| 16 | Join: Bottom of 495m 3/16" wire | | | | |
| 17 | 3 glass spheres with swivel | 2745 | | | 1804 |
| 18 | Join: Top of 990m of 3/16" wire | | | | |
| 19 | SBE at join | 2750 | ✓ 3928 | | 1806 |
| 20 | SBE at mark | 3250 | ✓ 5243 | | 1821 |
| 21 | Join: Bottom of 990m of 3/16" wire | | | | |
| 22 | 3 glass spheres with swivel ✓ | 3741 | | | 18.37 |
| 23 | Join: Top of 500m of 3/16" wire | | | | |
| 24 | SBE at join | 3750 | ✓ 5239 | | 18.38 |
| 25 | Join: Bottom of 500m of 3/16" wire | | | | |
| 26 | 3 glass spheres with swivel ✓ | 4246 | | | 18.54 |
| 27 | Join: Top of 890m of 3/16" wire | | | | |
| 28 | SBE at join | 4250 | ✓ 5778 | | 18.55 |
| 29 | SBE at mark | 4750 | ✓ 6119 | | 19.09 |
| 30 | Join: Bottom of 890m of 3/16" wire | | | | |
| 31 | 4 glass spheres ~~with swivel~~ | 5142 | | | 1923 |
| 32 | Join: Top of 20m of 3/16" wire | | | | |
| 33 | S4 current meter at join | 5150 | ✓ 35612571 | | 1923 |
| 34 | SBE at mark | 5160 | ✓ 6120 | | 1924 |
| 35 | Join: Bottom of 20m of 3/16" wire | | | | |
| 36 | 5 glass spheres with swivel | 5170 | | | 1927 |
| 37 | Join: Top of 10m of 3/16" wire | | | | |
| 38 | Join: Bottom of 3/16" wire | | | | |
| 39 | Acoustic release X 2 | 1194 | ARM 0870 | | 19:36 |
| 40 | 10m 1/2" chain | 928 | ARM 1862 | | 19:36 |
| 41 | Anchor | 5200 | | | 19:37:01 |

# DEPLOYMENT

**CRUISE** JC064 **MOORING** **MAR3L7**

| | |
|---|---|
| **Date** 22/9/11 | **DOY** 265 |
| **Site Arrival Time** 0700 | |
| **Setup Distance (nm)** 0.1 | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 09:22 | 23° 51.90' | -41° 05.68' | 5007 | 5048 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 09 25(00) | 23° 51.91' | -41° 5.64' | 5013 | 5054 |

| Release s/n | Arm | Release |
|---|---|---|
| 1198 | 0881 | |
| 262 | 1433 | |

Descending @ 47/min

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| 1198 | 092845 | echosounder on | | |
| | 092415 | 255 | 260.4 | |
| | 093015 | 248 | 302.7 | |
| | | | | |
| 262 | 093115 | 344.5 | 348.8 | |
| | 093215 | 390.9 | 395.9 | |

1433 (left of 262 row)

47m/min (right of 093015 row)

47m/min (right of 093115 row)

# MAR3L7

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| 1 | Billings float, light & flag | | X01-048 | [confirmed on] | 0922 |
| 2 | 5m chain | | | | |
| 3 | Recovery line | | | | |
| 4 | 3 glass spheres | | | | 0923 |
| 5 | 15m polyprop | | | | |
| 6 | 3 glass spheres | | | | 092345 |
| 7 | 15 m of polyprop | | | | 092430 |
| 8 | BPR1 | 35 | 0036 | | |
| 8 | BPR2 | 36 | 0035 | | |
| 9 | AR1 | | 1198 | ARM 0881 | |
| 10 | AR2 | | 262 | | |
| 11 | Anchor | | | | 0925 |

7.1 → (between rows 7 and 8)

7.1 3 glass

# DEPLOYMENT

CRUISE JC064 MOORING **MAR3**

| | | | |
|---|---|---|---|
| Date | 21/9/2011 | DOY | 264 |
| Site Arrival Time | | | |
| Setup Distar | 1.8 nm | | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 124500 | 23° 51.4' | 41° 10.4' | 4005 | 4021 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 144335 | 23° 51.4' | 41° 5.91' | 5019 | 5061 |

| Release s/n | Arm | Release |
|---|---|---|
| 917 | 1831 | |
| 322 | ~~1402~~ 14D2 | |

Descending @ 108 m/min

ARM: 1831 917

Diag 1844

| Release | time | range1 | range2 | diagnostic |
|---|---|---|---|---|
| | | | | |
| 917 | 150300 | – | – | |
| | 150400 | 3270 | 3281 | 9.5 V |
| | 150500 | 3378 | 3389 | 9.5 V |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| ~~917~~ | 1526 | 5700 | 5700 | V 9.5V |
| ~~322~~ | | | | |
| 322 | 153030 | – | – | |
| | 31 | – | – | |
| | 3405 | 5094.6 | 5093.4 | V, 9.4V |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

(echo sounders on)
vertical
vertical

# MAR3

**Date**

| | Mooring Element | Depth (m) | Serial num | Comment | Time o/b |
|---|---|---|---|---|---|
| **1** | Billings float with light | | | | 12:45 |
| **2** | 5m chain | | | | |
| **3** | Recovery line and float | | | | 12:45 |
| **4** | 2 glass spheres with swivel | 2500 | | | 12:47 |
| **5** | Join: Top of 500m 3/16" | | | | |
| **6** | SBE at join | 2500 | ✓ 5776 | | 12:49 |
| **7** | Join: Bottom of 500m 3/16" | | | | 13:10 |
| **8** | 3 glass spheres | 3000 | | | |
| **9** | Join: Top of 500m 3/16" | | | | |
| **10** | SBE at join | 3000 | ✓ 5774 | | 13:11 |
| **11** | Join: Bottom of 500m 3/16" | | | | |
| **12** | 3 glass spheres | 3500 | | | 13.27 |
| **13** | Join: Top of 500m 3/16" | | | | |
| **14** | SBE at join | 3500 | ✓ 6835 | | 13.29 |
| **15** | Join: Bottom of 500m 3/16" | | | | |
| **16** | 3 glass spheres + swivel | 4000 | | | 13.45 |
| **17** | Join: Top of 500m 3/16" | | | | |
| **18** | SBE at join | 4000 | ✓ 6810 | | 13.46 |
| **19** | Join: Bottom of 500m 3/16" | | | | |
| **20** | 3 glass spheres | 4500 | | | 14 02 |
| **21** | Join: Top of 540m 3/16" | | | | |
| **22** | SBE at join | 4500 | ✓ 6836 | | 14 03 |
| **23** | SBE at mark | 5000 | ✓ 5770 | | 14 20 |
| **24** | Join: Bottom of 540m 3/16" | | | | |
| **25** | S4 | 5015 | ✓ 35612568 | | 14 24 |
| **26** | 8 glass spheres with swivel | 5017 | | | 14 26 |
| **27** | 10m 3/16" | | | | |
| **28** | AR1 | 417 | | | 14 43 |
| **29** | AR2 | 322 | | | 14 43 |
| **30** | 10m of 0.5" chain | | | | |
| **31** | Anchor (1000kg) | 5050 | | | 14 43 35 |

# DEPLOYMENT

**CRUISE** ~~D359~~ JC064 **MOORING** **NOGST**

| | |
|---|---|
| **Date** 22/9/2011 | **DOY** 265 |
| **Site Arrival Time** | |
| **Setup Distance (nm)** | |

## Start

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 10 47 00 | 23° 45.63' | -41° 06.76' | 4214 | 4234 |

## End

| Time | Lat | Lon | Depth (u/c) | Depth corr |
|---|---|---|---|---|
| 1204 44 | 23°46·26' | 41° 5·93' | 4226 | 4247 |

| Release s/n | Arm | Release |
|---|---|---|
| 822 | 1684 | |
| | | |

descending @ 82 m/min

| Release | time | range1 | range2 | diagnostic | |
|---|---|---|---|---|---|
| 822 | 121800 | 1644 | 1652 | vertical | 9·5 V |
| | 121900 | 1726 | 1734 | vertical | 9·5 V |
| | 122000 | 1808 | 1815 | " | " |
| | | | | | 82m/min |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |

# NOGST

Time O/B

| | Mooring Element | ~~Depth (m)~~ | Serial num |
|---|---|---|---|
| 1 | Billings float, light & flag | 10 47 | |
| 2 | 5m chain | | |
| 3 | Recovery line | | |
| 4 | 15m polyprop | | |
| 5 | 12 glass spheres | 10 50 | |
| 6 | 50m polyprop | | |
| 7 | Sediment trap | 1056 | |
| 8 | ~~RCM~~ current meter NORTEK | 11 03 | 8100 |
| 9 | 50m polyprop | | |
| 10 | Sediment trap | 11 08 | |
| 11 | ~~RCM~~ current meter NORTEK | 11 13 | 8092 |
| 12 | 500m polyprop | | |
| 13 | 500m polyprop | | |
| 14 | 10 glass spheres | 11 46 | |
| 15 | 200m polyprop | | |
| 16 | AR | 11 58 | 822 |
| 17 | Anchor (850kg) | 1204:44 | |

# References

Bindoff, N. L., Willebrand, J., Artale, V., Cazenave, A., Gregory, J., Gulev, S., Hanawa, K., Quere, C. L., Levitus, S., Nojiri, Y., Shum, C. K., Talley, L., & Unnikrishaan, A. (2007). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, chap. Observations: Oceanic Climate Change and Sea level. Cambridge University Press.

Cunningham, S. A., Kanzow, T., Rayner, D., Baringer, M. O., Johns, W. E., Marotzke, J., Longworth, H. R., Grant, E. M., Hirschi, J. J.-M., Beal, L. M., Meinen, C. S., & Bryden, H. L. (2007). Temporal Variability of the Atlantic Meridional Overturning Circulation at 26.5 °N. *Science*, *317*(5840), 935–938.

Emery, W. J. (2004). *Data analysis and methods in physical oceanography*.

Firing, E. (1991). *Acoustic Doppler Profiling Measurments and Navigation*.

Kanzow, T., & Coauthors (2007). Observed flow compensation associated with the MOC at 26.5°n in the Atlantic. *Science*, *317*, 938–941.

RDI (1996). *Principles of operation. A practical primer.*.