National Oceanography Centre

Cruise Report No. 01

RV *Oceanus* Cruise OC459-1

23 MAR-04 APR 2010

RAPID mooring cruise report

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ABSTRACT

This cruise report covers scientific operations conducted during RV Oceanus OC459-1. Mooring operations conducted on RV Ronald H. Brown RB10-09 are given as an Appendice. Cruise OC459 departed from Woods Hole on 23rd March 2010 and arrived in Freeport, Grand Bahama on 04th April 2010.

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

The RAPID transatlantic array consists of 24 moorings of which 21 are maintained by the UK, and 17 bottom landers of which 15 are maintained by the UK. The moorings are primarily instrumented with Sea-Bird 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 which is on the continental slope and is instrumented over a limited depth range. During OC459-1 we recovered and redeployed: WB1, WB2, WB6, WBH2, WBADCP, WB2L4 and WB4L4. WBAL1 was deployed on OC459-1. Mooring WB4 was recovered and redeployed on RB10-09.

On OC459-1, 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), sea temperatures and salinities, water depth and navigation. Sea-water samples from CTD stations and of the sea-surface were obtained for calibration.

KEYWORDS

anderra RCM11, bottom pressure, conductivity, current meters, eastern boundary, Interocean S4, landers, microCAT, Mid-Atlantic Ridge, MOCHA, moorings, pressure, RAPID-WATCH, RAPID, SBE26, SBE37, SBE53, SBE911, Sea-Bird, temperature, tide gauges, velocity, western boundary

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1) Scientific and Ship's Personnel

Table 1: Scientific and Ship's Personnel

Name	Position	Institute
Anthony Mello	Master	Woods Hole Oceanographic Institute (WHOI)
Ethan J. Galac	Chief Mate	Woods Hole Oceanographic Institute (WHOI)
Logan Johnsen	2nd Mate	Woods Hole Oceanographic Institute (WHOI)
Pimenio C. Cacho	Bosun	Woods Hole Oceanographic Institute (WHOI)
Leo Fitz	Able Seaman	Woods Hole Oceanographic Institute (WHOI)
Emily A. Rizzo	Able Seaman	Woods Hole Oceanographic Institute (WHOI)
Charles H. Bean	Seaman	Woods Hole Oceanographic Institute (WHOI)
Michael W. Thorwick	Chief Eng.	Woods Hole Oceanographic Institute (WHOI)
John Christian	Jr. Eng.	Woods Hole Oceanographic Institute (WHOI)
Kyle R. Luetjen	Jr. Eng.	Woods Hole Oceanographic Institute (WHOI)
Michele A. Fetterley	Steward	Woods Hole Oceanographic Institute (WHOI)
Joseph G. Harte	Messman	Woods Hole Oceanographic Institute (WHOI)
Sean Guss	SSSG	Woods Hole Oceanographic Institute (WHOI)
Stuart A. Cunningham	Co-Principal Scientist	National Oceanography Centre (NOC)
Julie Collins	Scientist	British Oceanographic Data Centre (BODC)
Colin Hutton	Mooring Technician	National Marine Facilities Sea Systems (NMFSS)
Robert McLachlan	Principal Mooring Technician	National Marine Facilities Sea Systems (NMFSS)
Christopher Meinen	Principal Scientist	Atlantic Oceanographic and Meteorological Laboratory
Pedro Pena	CTD/LADCP Technician	Atlantic Oceanographic and Meteorological Laboratory
Paul Provost	Mooring Technician	National Marine Facilities Sea Systems (NMFSS)
Zoltan Szuts	Scientist	Max Planck Institute for Meteorology (MPI)
Erik Van Sebille	Scientist	Rosenstiel School of Marine and Atmospheric Sciences, University of Miami (RSMAS)
David Childs	Mooring Instrument Technician	National Marine Facilities Sea Systems (NMFSS)
Christian Crowe	Mooring Instrument Technician	National Marine Facilities Sea Systems (NMFSS)
Stephen Whittle	Mooring Technician	National Marine Facilities Sea Systems (NMFSS)

2) Itinerary

Depart Woods Hole, MA 23rd March 2010, arrive Freeport, Grand Bahama 4th April 2010.

3) Acknowledgements

We would like to thank the officers and crew of the RV *Oceanus* for their work in safely recovering and deploying moorings. The NMF technicians successfully executed a complex set of mooring operations, working with the ship's crew to the benefit of the science programme. The whole team demonstrated a strong personal commitment to achieving the best results for the science programme.

4) Introduction

The RAPID-MOC observing system has been operational since spring 2004. The purpose of this cruise was to recover and redeploy the western boundary mooring sub-array deployed off Abaco Island, Bahamas.

This cruise is the 20th in total since Spring 2004. The cruises to date are shown in Table 2. The project web site is http://www.noc.soton.ac.uk/rapidmoc. The RAPID-MOC programme has completed the initial four years of planned deployments and has now moved into a second phase (NERC Directed Programme RAPID-WATCH http://noc.soton.ac.uk/rapid/rw/) through to 2014.

Table 2: Summary of RAPID-MOC 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 2004	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 2004	Emergency deployment of replacement EB2 following loss	Appendix in RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
CD170	RRS *Charles Darwin*	Apr 2005	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
KN182-2	RV *Knorr*	May 2005	Service and redeployment of UK and US Western Boundary Moorings and Western Boundary Time Series (WBTS) hydrography section	RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
CD177	RRS *Charles Darwin*	Nov 2005	Service and redeployment of key Eastern Boundary moorings	RRS *Charles Darwin* Cruise CD177. National Oceanography Centre Southampton Cruise Report, No. 5, 2006
WS05018	RV *F.G. Walton Smith*	Nov 2005	Emergency recovery of drifting WB1 mooring	No report published
RB0602	RV *Ronald H. Brown*	Mar 2006	Service and redeployment of UK Western Boundary moorings and WBTS hydrography section	RV *Ronald H. Brown* Cruise RB0602 and RRS *Discovery* Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007
D304	RRS *Discovery*	May - Jun 2006	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RV *Ronald H. Brown* Cruise RB0602 and RRS *Discovery* Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007
P343	RV *Poseidon*	Oct 2006	Service and redeployment of key Eastern Boundary moorings	RS *Poseidon* Cruises P343 and P345. National Oceanography Centre Southampton Cruise Report No. 28, 2008.
P345	RV *Poseidon*	Dec 2006	Emergency redeployment of EB1 and EB2 following problems on P343	RS *Poseidon* Cruises P343 and P345. National Oceanography Centre Southampton Cruise Report No. 28, 2008.
SJ06	RV *Seward Johnson*	Sep – Oct 2006	Recovery and redeployment of WB2 and US Western Boundary moorings, and WBTS hydrography section	Appendix G in RV *Ronald H. Brown* Cruise RB0701. National Oceanography Centre, Southampton Cruise Report, No 29
RB0701	RV *Ronald H. Brown*	Mar - Apr 2007	Service and redeployment of UK Western Boundary moorings and WBTS hydrography section	RV *Ronald H. Brown* Cruise RB0701. National Oceanography Centre, Southampton Cruise Report, No 29
D324	RRS *Discovery*	Oct – Nov 2007	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Discovery* Cruise D324, National Oceanography Centre, Southampton Cruise Report, No 34
SJ0803	RV *Seward Johnson*	April 2008	Service and redeployment of the Western Boundary moorings	RV *Seward Johnson* Cruise SJ0803, National Oceanography Centre, Southampton Cruise Report, No 37
D334	RRS *Discovery*	Oct-Nov 2008	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Discovery* D334, National Oceanography Centre, Southampton, Cruise Report No. 38, 2009
RB0901	RV *Ronald H. Brown*	April – May 2009	Service and redeployment of the UK and US Western Boundary moorings and the WBTS hydrography section	RV *Ronald H. Brown* Cruise RB0901, National Oceanography Centre, Southampton Cruise Report, No 39, 2009
D344	RRS *Discovery*	Oct – Nov 2009	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Discovery* D344, National Oceanography Centre, Southampton, Cruise Report No. 51, 2010
D345	RRS *Discovery*	Nov – Dec 2009	Recovery and redeployment of US Western Boundary moorings, and WBTS hydrography section	Cruise report to be published
OC459	RV *Oceanus*	Mar – Apr 2010	Service and redeployment of the Western Boundary moorings	This report
RB10-09	RV *Ronald H Brown*	Nov – Dec 2010	Service and redeployment of WB4 that could not be completed on OC459	Appendix in this report

Scientific Background and description of the RAPID/MOCHA Observing System

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. However, 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. In 2004 NERC, NSF and NOAA funded a system of observations in the Atlantic at 26.5°N to observe on a daily basis the strength and structure of the AMOC. Two papers (*Cunningham, et al.*, 2007 & *Kanzow, et al.*, 2007) demonstrated that not only does the system of observations achieve a mass balance for the AMOC, it reveals dramatic and unexpected richness of variability. In the first year the AMOC mean strength and variability is 18.7±5.6 Sv. From estimates of the degrees-of-freedom the year-long mean AMOC is defined with a resolution of around 1.5 Sv so abrupt changes would be readily identified and long-term changes will be measured relative to the 2004-2005 average.

The NERC contribution to the first four years of continuous AMOC observations was funded under the directed programme RAPID Climate Change. Following an international review of the system 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 as during the period 2004-2008.

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 arrays and; To exploit the data from the RAPID-WATCH arrays 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.

The AMOC system

The 26.5°N Atlantic section 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 scatterometer observations. To monitor the mid-ocean flow we deployed an array of moored instruments along the 26.5°N section. The basic principle of the array is to estimate the zonally integrated geostrophic profile of northward velocity on a daily basis from time-series measurements of temperature and salinity throughout the water column at the eastern and western boundaries. Inshore of the most westerly measurement of temperature and salinity, the transports of the Antilles current and deep western boundary current are monitored by direct velocity measurements.

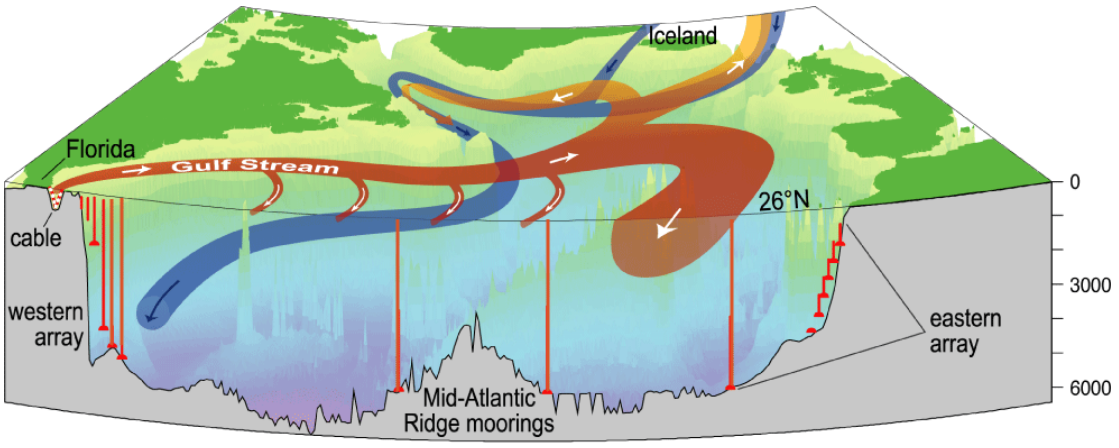


Figure 1: *Schematic of the principal currents of the Atlantic meridional overturning circulation. The vertical red lines across the Atlantic at 26.5°N indicate the main areas where moorings instrumented to measure the vertical density profile are located. The Gulf Stream transport is measured by submarine cable and the western boundary array includes current meters to directly measure transports of the shallow and deep western boundary currents. Bottom pressure recorders are located at several sites across the Atlantic to measure depth-independent fluctuations of the basin-wide circulation. Figure courtesy of Louise Bell & Neil White, CSIRO.*

Array Specification

The array as deployed in 2009-2010 consists of a total of 24 moorings, 16 landers and one inverted echo sounder. Figure 2 shows the western boundary moorings as deployed from OC459-1. The eastern boundary and mid-Atlantic ridge moorings were deployed in the Autumn of 2009 during cruise D344 and will be serviced again in Autumn 2010 from the RRS *Discovery*. 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. Details of the sub array configurations at the Eastern Boundary and the Mid Atlantic Ridge as deployed in 2009-2010 are detailed in the D344 cruise report.

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 from April 2010, WB2 comprises sixteen CTDs and eight current meters, whereas WB1 comprises fifteen CTDs and four current meters. Inshore of WB1 there is **WBADCP** 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 seven current meters. Further offshore is **WB6**, comprising five CTDs, one current meter and two bottom pressure recorders – which combined with MAR0 measures the contribution to the MOC of deep water below 5200m including the Antarctic Bottom Water. There are five landers in this sub-array; two at the site of **WB2**; two at the site of **WB4**; and **WBAL** at the site of **WBADCP**. Each lander comprises two BPRs.

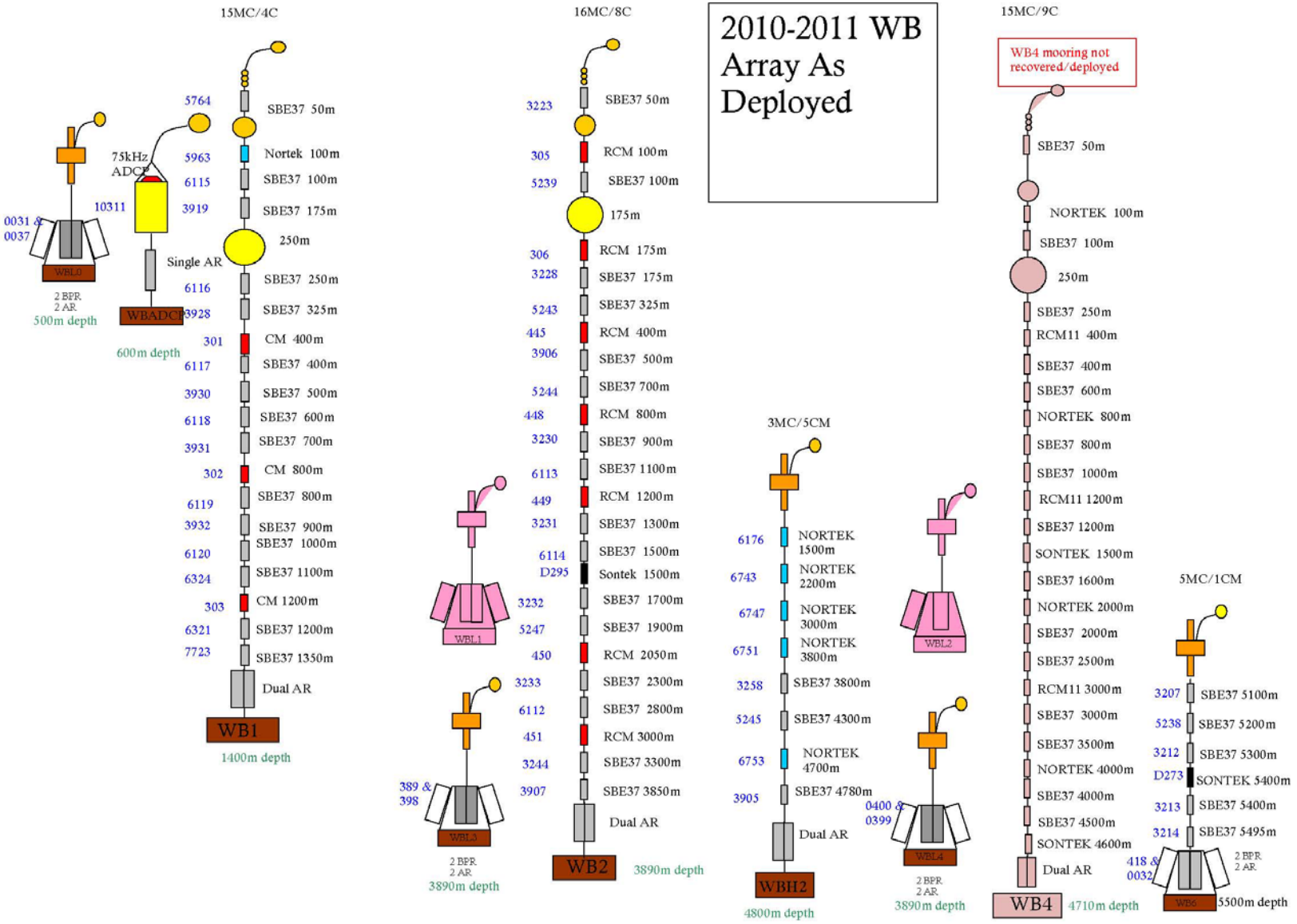


Figure 2: *Western Boundary moorings as deployed on OC459-1*

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 serviced on D345. **WB0** comprises four CTDs, four 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.

Lander naming convention

Subsequent to the cruise on the RV *Oceanus*, it was found there was a duplication of lander mooring names that referred to two different sites. Consequently, all the lander names have been renamed to make them unique and to prevent this kind of duplication again. The new names will include the mooring site and a sequential mooring number e.g. the first lander deployed at mooring site WB2 will be called WB2L1, and subsequent landers will be WB2Ln, with n being the nth lander deployed at that site. Table 3 shows a mapping of the previous lander mooring names to the new names.

Table 3: Mapping of the original lander mooring name to the new name

Original name - pre 06/2010	Alternate name	New name
ebl1_1_200517		eb1l1_1_200517
ebl3_1_200617		eb1l2_2_200617
ebl1_2_200645		eb1l3_3_200645
ebl3_2_200734		eb1l4_4_200734
ebl1_3_200824		eb1l5_5_200824
ebl3_3_200936		eb1l6_6_200936
ebl2_1_200513		ebh1l1_1_200513
ebl4_1_200618		ebh1l2_2_200618
ebl2_2_200646		ebh1l3_3_200646
ebl4_2_200735		ebh1l4_4_200735
ebl2_3_200834		ebh1l5_5_200834
ebl4_3_200933		ebh1l6_6_200933
ebl5_1_200927		ebh4l1_1_200927
marl1_1_200525		mar1l1_1_200525
marl3_1_200624		mar1l2_2_200624
marl1_2_200726		mar1l3_3_200726
marl3_2_200830		mar1l4_4_200830
marl1_3_200941		mar1l5_5_200941
marl2_1_200521		mar3l1_1_200521
marl4_1_200625		mar3l2_2_200625
marl2_2_200725		mar3l3_3_200725
marl4_2_200825		mar3l4_4_200825
marl2_3_200938		mar3l5_5_200938
wbl2_1_200531		wb4l1_1_200531
wbl4_1_200605		wb4l2_2_200605
wbl2_2_200706		wb4l3_3_200706
wbl4_2_200807		wb4l4_4_200807
wbl2_3_200911		wb4l5_5_200911
wbl4_3_201002		wb4l6_6_201002
wbl1_1_200529		wb2l1_1_200529

wbl3_1_200608		wb2l2_2_200608
wbl1_2_200705		wb2l3_3_200705
wbl3_2_200806		wb2l4_4_200806
wbl1_3_200910		wb2l5_5_200910
wbl3_3_201005		wb2l6_6_201005
wbl0_1_201007		wbal1_1_201007
mochabl_1_369	wbl3_1	wb3l1_1_369
mochabl_2_375	wbl3_2	wb3l2_2_375
mochabl_b	wblb	wb3l3_3_200809
mochabl_b_394	wbl3	wb3l4_4_394
mochael_1_370	wbl5_1	wb5l1_1_370
mochael_2_374	wbl5_2	wb5l2_2_374
mochael_3_384	wbl5_3	wb5l3_3_384
mochael_4_393	wbl5_4	wb5l4_4_393

5) RV *Oceanus*

The RV *Oceanus* was designed by John W. Gilbert Associates, Inc. and constructed by Peterson Builders Inc. of Sturgeon Bay, Wisconsin, in 1975. The ship is owned by the National Science Foundation. RV *Oceanus* was delivered to the Woods Hole Oceanographic Institution in late 1975. RV *Oceanus* completed a major mid-life renovation at Atlantic Drydock Corp. in Jacksonville, Florida in June 1994. Among other changes, a new aluminium deck-house and pilot house were added, increasing laboratory space and accommodations for scientists.

Table 4: Operating characteristics of the RV Oceanus

Length	54m
Beam	10m
Draft	5.2m
Full Speed	14.5kn
Cruising Speed	12kn
Cruising Range	7000nm
Fuel Capacity	48000gallons
Displacement	962 long tons
Endurance	30 days
Complement	12 officers and crew, 15 scientists

Electrical Power

All electrical power on the ship is generated as 480VAC at 60 cycles. The voltage and frequency are precisely regulated at the generator units. All laboratory spaces are provided with numerous 120VAC electrical outlets on 20 amp circuits. 480VAC outlets on 30 amp circuits are available on the weather decks and in all laboratory spaces. 60A 3-phase 220VAC power is available.

Deck Loading

RV *Oceanus* is designed and constructed to maximize the external working deck area available for the placement and carrying of transient scientific equipment. Two deck areas, the Main Deck and the Upper (01) Deck, are dedicated to science use. These deck areas comprise the

entire after part of the ship. The starboard side of the Main Deck of the ship is unobstructed for 84 feet from the stern forward. The aftermost 34 feet of the fantail spans the entire breadth of the ship. Pertinent particulars of the weather deck spaces are: Main Deck: 1,600 sq. ft. Upper Deck: 500 sq. ft.

The total allowable transient scientific payload is 40 tons. Most users of the ship do not approach this value. The Master will evaluate the distribution of all weights aboard the ship to assure that safe stability conditions will exist during the voyage.

The ship's crane serves all working deck spaces and points over the side. All bulwarks, railings and fittings on the after part on the ship are removable. There is direct access by ladder between the decks. There is direct access to the internal laboratory spaces from the working deck areas. It is possible to put a maximum of three 8 ft. x 20 ft. laboratory vans on the ship. Two vans may be carried on the Upper (01) Deck, keeping the Main Deck area clear for stowing and handling of instruments. Peck & Hale fittings are recessed into the Upper Deck at fixed locations to facilitate rapid securing of two such vans. Additional mounting plates may be required. All deck areas are illuminated by Halogen floodlights mounted on the mast. Localized spotlights are placed to light normal and overside work areas at points where instruments are launched. Low intensity deck lighting is provided on the deck areas.

A-Frame

Inside Horizontal Clearance: 9 feet (2.7 m)
Maximum Vertical Clearance: 14 feet (4.2 m)
Maximum Inboard Reach: 6 feet (1.8 m)
Maximum Outboard Reach: 4 feet (1.2 m)
Safe Working Load: 26,000 lbs.

Crane

The working radius of the crane ranges from 10 to 65 feet. The at-sea load rating ranges from a maximum of 40,000 lbs. to 6,890 lbs. fully extended.

Winches

Markey DESH-5 hydrographic winch with 30000 feet of 5/16 inch hydro wire or a 0.322 inch coaxial cable and Dynacon traction winch capable of 30000 feet of 9/16 inch trawl wire or a 0.680 inch coaxial or fiber-optic cable.

6) General Cruise Narrative

S. Cunningham

Times reported in this narrative are local time: UK is GMT up to Sunday 28th when UK time is GMT+1, US and ship time is GMT-4

Fri 19th March 2010, doy=78

Julie Collins joins the science party at short notice.

20th March, 79

Visit HM Customs and Excise in Heathrow T3. By phone received permission to check the IXSEA transducer cable and present paperwork for export clearance. Arrive Boston 1800 local, passed immigration and customs – though the cable was X-rayed.

21st, 80

Loading and lab setup from moorings team underway. Zoli, Julie and I began linking macs and setting up processing on external disk. Creating directory structure and info.dat files. Really hope the container turns up tomorrow. Begin task of assignments for cal-dips. Mid-afternoon it was realised we have no battery holders for the microcats. The containers due from the Bahamas tomorrow are also unlikely to have the holders as they will have been taken out with the batteries when the container was refused shipment. So, someone from NOC will fly out tomorrow with the battery holders. Took this opportunity to arrange for a mac mini to be sent out. Finished on ship about 1630.

22nd, 81

Moved aboard. Mobilisation continuing.

23rd,82

Containers from Bahamas arrive at 0715. Sailed at 0945 on schedule. Heavy rain, mist. Forecast looks very bad once we clear the vineyard channel. F5-6, seas up to 5m. Moderating in the south by Thursday. 1400 cleared Martha's vineyard, turned due south. Swell and ship's motion increasing. Air temperature only 7°C. Very rough.

24th, 83

Ship struggling south through 30-35kn winds and 4-5m swell. Motion is very lively. Deck cargo shifting. Hove too. Deck crew working to secure deck load. Eventually steaming south again by 1600. No lab work possible. Notably we crossed the Gulf Stream today approximately 37°N, 71°W starting about day-of-year 83.2. Maximum eastward velocities were in excess of 160 cm/s (Figure 3).

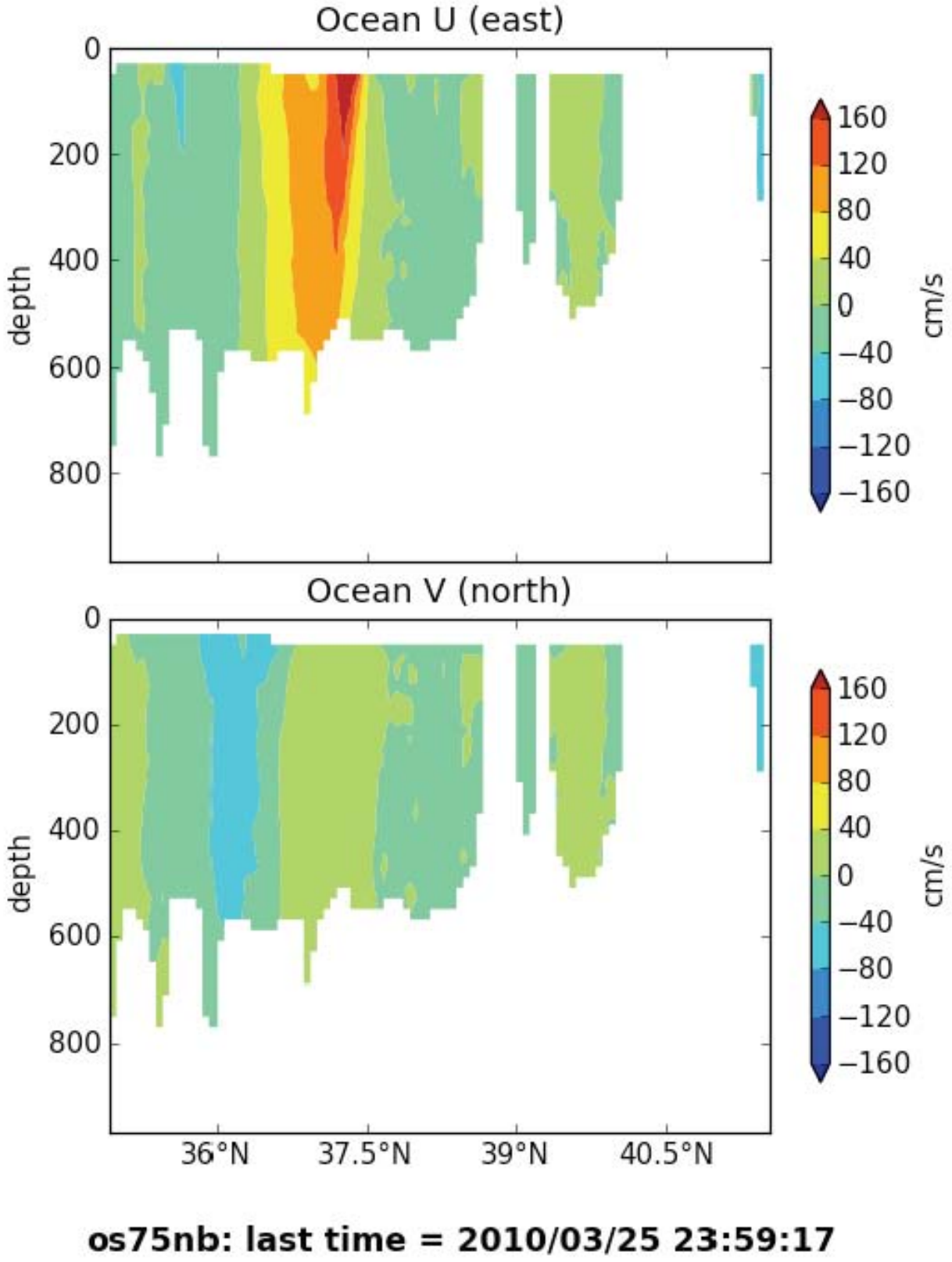


Figure 3: *Real-time absolute water velocities in cm/s from the shipboard ADCP OS75 khz instrument, processed using the University of Hawaii UHDAS data acquisition system and the Common Ocean Data Access System (CODAS).*

25th, 84

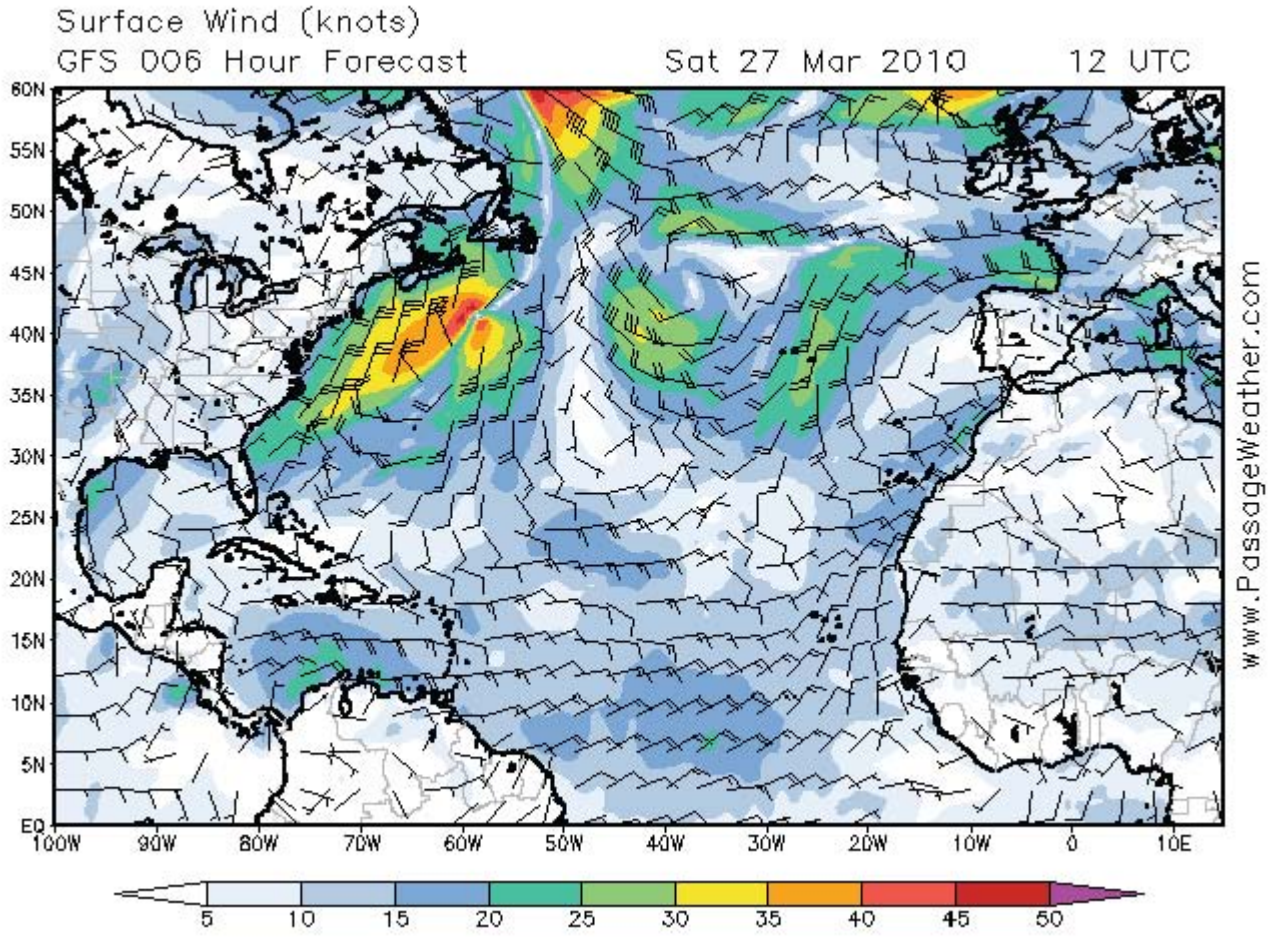
Weather has moderated significantly. Ship's motion is easy. Most people feeling much better now, with no problems working at computers. Ship's governer is u/s and limiting speed to 9 knots. At 1030 hove to for repairs. U/way by 1130. The governer fix seems to have worked and we are now making in excess of 12 knots. At 1400 stopped for a test CTD station to 200m. 2 microcats with new type of Kistler pressure sensor and one release as a test of the new super-transducer. The xducer was deployed using an air-driven winch. Highly effective. CTD inboard and u/way by 1440. Stopped again about 1700 for further work on the governer. u/way at 1915.

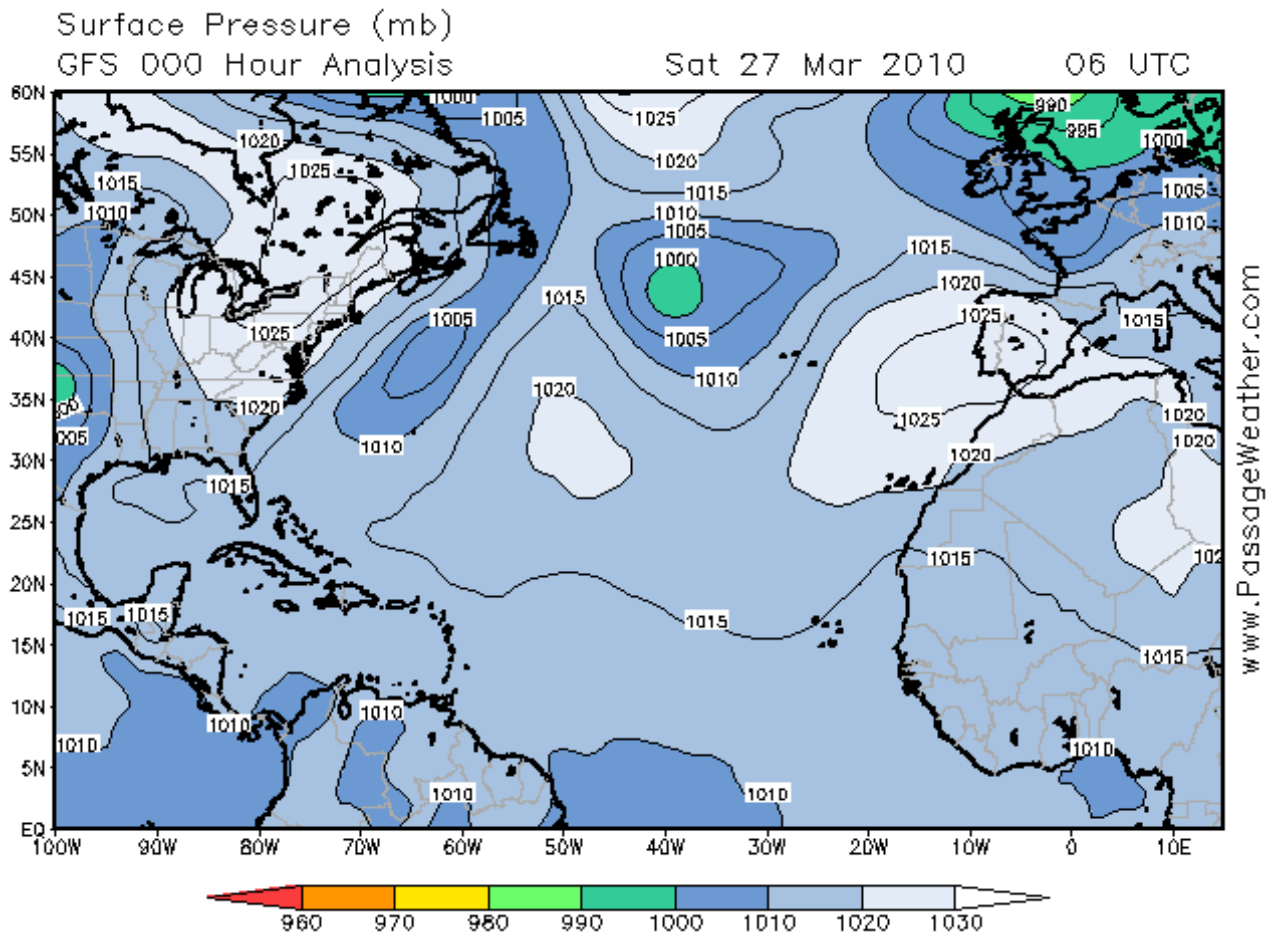
26th, 85

Weather has again deteriorated during the night. F4-F5, swell 2-3m. Motion very lively. Planned CTD cal dip postponed. Wire winding not possible. Continuing due south at 11knots. Forecast moderating overnight. Sporadic lab work due to the unfriendly motion.

27th, 86

Since sailing a dominant low pressure system hooking right handed out of the Labrador Sea and down the eastern seaboard of the U.S. to around 30°N, has been creating winds up to 40 knots and 4-5 m waves. This continues but we are now south of the main low-pressure system, into the general belt of sub-tropical high pressure. Figure 4 shows a typical weather pattern over the past week, taken from http://www.passageweather.com/ forecast on Sat 27th March 2010 at 1200 GMT. Our position at 1118 GMT on this day was 28° 20.9'N, 070° 34.2'W. Estimated F3 today, but still decks are often washed over. 0930 stopped for cal dip. On powering the CTD deck unit alarm sounded. Fuse blown. Remove CTDs and put in bucket while investigation u/way. Microcats removed from bucket and stopped. 1030 u/way while investigation continues. 1400 stopping for CTD 1. Cast depth 5400 m. Release tests: no communication from releases. Suspect it is the 12kHz pinger on the frame interfering. We had this problem twice before but we are not learning! Releases fired. See what comes up on deck. On haul wire is laying badly so some veer/haul to correct. Extremely slow haul with many periods of veer/haul to try and correct the lay. Communications failure between CTD and deck unit at 50 m. Last bottle not fired. All releases open. On deck at 2023. Remain on station working on underwater connection. Frame now fully rigged with 12 microcats and releases. CTD 2 in water at 2136.


Surface Wind (knots)
GFS 006 Hour Forecast
Sat 27 Mar 2010
12 UTC
60N
55N
50N
45N
40N
35N
30N
25N
20N
15N
10N
5N
EQ
100W
90W
80W
70W
60W
50W
40W
30W
20W
10W
0
10E
5
10
15
20
25
30
35
40
45
50
www.PassageWeather.com


Surface Pressure (mb)
GFS 000 Hour Analysis
Sat 27 Mar 2010
06 UTC
60N
55N
50N
45N
40N
35N
30N
25N
20N
15N
10N
5N
EQ
100W
90W
80W
70W
60W
50W
40W
30W
20W
10W
0
10E
960
970
980
990
1000
1010
1020
1030
www.PassageWeather.com

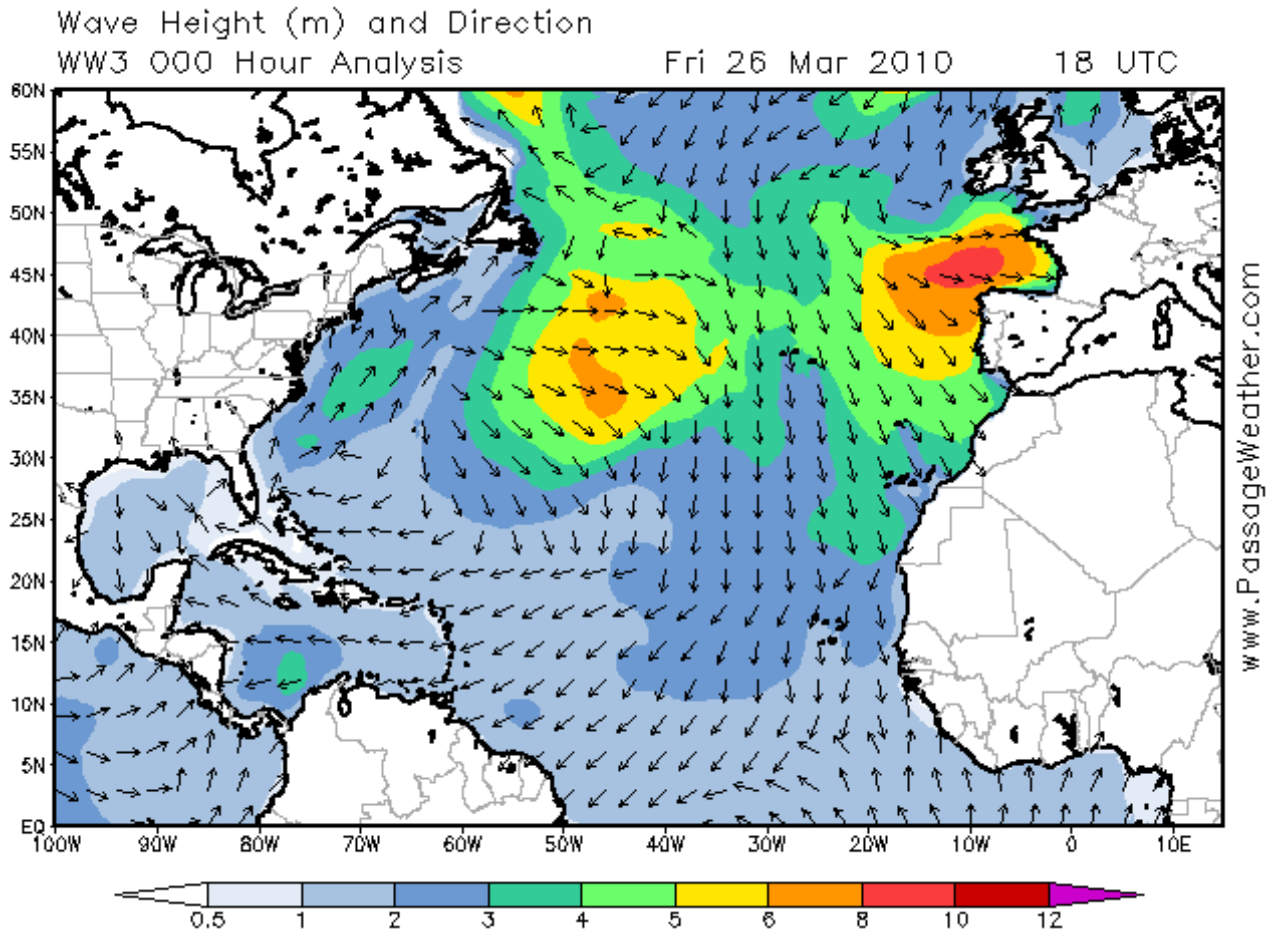


Figure 4: *Wind speed (knots), surface air pressure (mbars) and Wave height (m) and direction from http://www.passageweather.com/ at 1800 UTC on Sat 27th March 2010.*

28th, 87

UK changed to summertime, GMT+1. Hydraulic power pack is still u/s. Water ingress into electronics sometime during the bad weather has caused a short. The prospect of winding handraulically incentivises repairs! Ship's evaporator is reported to be non-operational at present. WHOI mooring winch: Measured drum diameter = 52 cm => circumference = 163.4 cm. Measured circumference = 162.6 cm. Average circumference = 163 cm. At full speed 10 rotations in 33.2 s. Therefore, haul speed is 49 m/min. WB6 recovery. On site at WB6 0816. Initially deployment of the IXSEA acoustic module on ship's starboard side just immediately aft of the wet lab (approximately mid-ships). No reliable ranges to either release. Repositioned ship on top of mooring and deployed the transducer on the starboard side about 20 m further aft. This is further from the engine spaces that are toward the bow. Good communications established to both releases. Fired at 0854, ascending at 100 m/min. All inboard by 1020. Preparations for WB6 deployment. Lander and releases have only been in the water 6 months, therefore just redeploy. Deployment started at 1145, finished by 1158. Watched the lander down to bottom, descent rate around 100 m/min. U/way to WB4.

29th, 88

AM: Ship continuing to roll heavily and ship awash with water as we steam westward at 12 knots. No wire winding possible. Therefore, cannot prepare WB4 for deployment. Assessing possibility of leaving WB4 in water for further year. SBE37: Sampling should be good for 5 yrs. Memory capacity is fine. Nortek: Sampling should be good for 790 days. Memory capacity is fine. RCM11:

only 446 days. Releases: Both unaffected by corrosion issue and batteries good for 4 years. On site at WBL4 at 1455. No ranges to release, but solid ranges of 7500 m to WB4 at 3.1 nm distance. Decided to send release to WBL4. After 3 minutes started getting solid decreasing ranges, ascent rate 120 m/min. Trouble spotting mooring on surface due to large swell and whitecapping but Chris Crowe to the rescue as usual after range established at 330 m. Nothing on VHF, but aerial missing and Billings was tipped because of insufficient chain length to buoyancy below. Recovered by 1617. BPR has only two records. CTD cal dip and winding on WBH2. Deployment of WBL3 scheduled at 2200. WBL4 deployment. Rob nearly went overboard and got whacked on the shoulder by the release hook. Operations are really nearly impossible - even the lander work is dodgy. Thunder and lightening all round. Big tropical storm approaching.

Mon Mar 29, 7:35 PM
By The Associated Press
FREEPORT, Bahamas - A tornado touched down during a fierce thunderstorm in the Bahamas on Monday and toppled a port crane, killing three people and injuring at least four. The crane collapsed at the Freeport Container Port on the western side of Grand Bahama, where trees were uprooted and windows blasted out of hotels as at least one tornado cut a destructive path on the island about 60 miles (100 kilometres) east of Florida. Two people were inside the crane when it fell and both died, said Capt. Stephen Russell, director of the Bahamas National Emergency Management Agency. Russell said a third person was also killed and four were injured at the port, but he had no details. Witness Glen Marchesani told The Tribune newspaper that the dead and injured were part of a crew of around 10 men doing maintenance work on one of the port's 10 cranes when it came crashing down. The foundation of the crane was ripped from the ground. Mangled metal from the toppled crane splashed into the roiling water at the port or came to rest on a rocky embankment. A government statement said the tornado damaged six of the port's cranes. The Bahamas Information Services said the port will likely be closed for days and is expected to operate at a reduced capacity when it reopens. Godfrey Smith, director of the Freeport Container Port, declined to release the victims' names, saying company executives were still trying to contact relatives. He said further details about the fatalities would be released following an investigation. Elsewhere on Grand Bahama, the storm blew out windows, stripped shingles and peeled off a few roofs. Wind-whipped debris hung from trees. After hitting Grand Bahama, the storm moved toward Abaco island and the capital of Nassau on New Providence. No damage was immediately reported on those islands. Hurricanes are common in the Bahamas but tornadoes are relatively rare. Pat Butler, a forecaster with the Bahamas Meteorology Department, said they occur about once every three years in the island chain. Damage on Grand Bahama appeared to be greatest in and around Port Lucaya and Freeport, with witnesses reporting many uprooted trees, broken windows and damaged roofs and cars. Several guests at the Island Seas Resort were taken to the hospital with minor scrapes from debris but none were seriously injured, said Hubert Gibson, the hotel's activity director. "Everybody's OK. Everybody's in good shape. It just caught us off guard," he said.
Racquell Harvey, who works at the Port Lucaya Marina, said five boats were damaged as they seesawed in their berths while the storm whipped up white-crested waves around noon.
"The tornado just came out of nowhere," Harvey said at the marina's office. "We were thinking it was just a rain storm, then we saw it coming all of a sudden. It was kind of scary."

30th, 89

We are having lots of problems with acoustics on this trip. For releases on frames we never get confirmed release though we have 12/12 ok released. WBH2: From 0600 to 0900 we have been trying to recover. On site 4 cables at 1002 GMT. Using super X'ducer. Nothing from either release but Paul could hear the releases reply. We tried repositioning ship, moving transducer location, different deck units, no bow thruster, engine declutched. Finally moving on top of mooring we got 4 solid ranges from 2 pings: 4632, 4634/ 4630, 4634. These were finally obtained 50 mins after we sent release command for the first time. We then switched immediately to diagnostics and got

4634 m then no answer (all on release 497). Only once did we get one range from 819 which was 4650 m. No funny 'noisy' ranges received at any time, always no reply. We tried releasing many times throughout keeping a constant look out on the bridge. So the funny thing is the water depth is 4699 m uncorrected. The release has a 25 m rope below it plus 5 m chain to the anchor. So release range should be 4700-30=4670m. Therefore, the 5 ranges of 4632 suggest the releases are 30m shallower than they should be. Duh, this is the depth of the transducer! And, the water-depth reported at this mooring site was 4699 m uncorrected / 4736 m corrected. When we crossed it at 1956 GMT on 30/3/10 the depth was 4682 m uncorrected / 4719 m corrected. Therefore ranges of 4632 m + 30 m to seabed + 20 m transducer depth are consistent with a water depth of 4682 m. And it also suggests the releases are upright. After waiting another hour after the last release we have left the site and are heading in toward WB2. Hoping to recover that and the lander. Spend the afternoon/evening winding off WB2 and on with the new WB2 for tomorrow. We will come back to WBH2 overnight. We tried both new deck units, the old 6301 deck unit and the small transducer. Left site and steamed to WB2. After considerable trouble with communicating to releases WB2 surfaced. Recovered successfully though deck operations very cramped. Initial look suggests MicroCAT records complete on all instruments. Shallowest instrument was about 80 m depth. U/way to water depth of 4800 m for cal dip 4 and 5. Winding WB2 until 2300.

31st, 90

On site WB2 at 0800 for drift test. WB2 buoyancy and top of mooring being setup on deck. Begin deployment at 1120. Upper part of mooring deployed smoothly with crane lifting the 51” syntactic over the starboard rail. Towing on anchor at 1441, but still over 2 nm to drop site because of very cautious choice of setup distance. Anchor deployed at1642. Confirmed releases on the bottom. Then triangulate position. After dinner building glass for WBH2.

1st April, 91

Stationary high pressure bringing settled conditions. Wind F2-3, swell 1 m, sunny. On site WBL3 at 0630. Released at 0631. On surface and inboard by 0742. Release s/n 920 part of batch with potential dissimilar metal problem. No evident corrosion, so likely unaffected. Begin deployment at 0945 of WBH2 at site away from WBH2 not yet recovered. Note on SBE 53 bottom pressure recorders: WBL4, SBE53 s/n 0030 only recorded 2 samples after startup; WBL3, SBE53 s/n 0029 recorded 7 samples after startup and s/n 0028 full record; WB6, SBE53 s/n 0037 and SBE26 s/n 0390 both full records. When one SBE53 batteried for deployment it indicated low battery. Speculation is that an oxide layer may form in the double D lithium batteries that the SBE53 is not able to break down. Therefore, two options: 1. Run instruments for days at regular sampling or hours at high frequency sampling to break down this layer and to check data acquisition or; 2. Build a load unit (effectively put a high resistance across the battery). However, on inspection there is a smell of burnt electronics in the releases and one unit has a blown resistor on the end cap. So, maybe a more fundamental problem. We didn’t want to take them apart in case we disturb the electronics before SeaBird has a chance to look at these units. WBH2 deployment at previously unoccupied site to the east and north of WBH2 still in the water. The new site is 90 m deeper than planned, and to compensate we have added 80 m of nylon below the releases. Deployment started at 0942 and anchor released at 1201. We tracked WBH2 releases to seabed, and then interrogated the old WB2 at range of about 2.5 nm. Immediate communication and diagnostics with both releases. Releases upright and voltages of 9.3 V. Range intersects the known location. Decided to go ahead with recovery and return to triangulate the new WBH2 in the evening. Steamed to 0.25 nm from old WBH2, but unable to communicate. Therefore, steamed back 2.5 nm. At this distance communication with the releases excellent. Sent release command and confirmed mooring rising. Estimated we would see 60 m of range decrease for every 100 m of ascent. We then steamed slowly toward the mooring, spotting it on the surface at a range of 0.5 nm. Thereafter, recovery proceeded normally. Inboard by 1641. Returned to WBH2 deploy for triangulation survey. Deploy WBL3 at 2113. Steamed off shore for cal dip cast 6, for post deployment calibration of WBH2 MicroCATs

but also as a test of MicroCAT pressure sensors. In previous cruise reports we have identified a lagged pressure response due to temperature changes. We investigated here by a 30 min bottle stop on the upcast at a depth of 450 m. This has been identified as the depth where the CTD-microcat pressure difference is largest, due to the large temperature change as the package rises through the thermocline. The 30 min bottle stop will provide a timeseries of the change in pressure between CTD and MicroCAT. We tested the three types of pressure sensor available: Druck, Paine and Kistler. Initial inspection of the 30min stop shows the Kistler to have a much faster thermal equilibration than Druck or Paine types.

2nd, 92

Weather settled, heading for WBADCP. Arrived WBADCP 0800. Time of first ranging 0829, release 0833 and recovered by 0914. Recovered on to the starboard deck on the outside of the A-frame. Working space just larger than buoy making it dangerous for people to work round because there is no space. Crane used to lift buoy clear. Release heavily stained with rust, probably from the shackles. Begin recovery of WB1 at 1039. Slow but all inboard by 1225. All microcats have full records. Deepest instrument mean pressure 1342 dbar, equals 1329 m. 32 m rope and chain to seabed suggesting water depth only 1372 m. Shallowest instrument at 40 m. Remainder of afternoon spent winding off and on WB1, and building WBADCP and WBL0. WBADCP deployed at 1941. WBL0 deployed at 2030. New site selected from KN182 swath survey. CTD 7 cal dip at 2200.

3rd, 093

Concerned about depths of WB1 mooring which is designed for 1390 m water depth. Visited anchor site from RB09 last year. Measured depth is 1375 m, consistent with the estimates of water depth based on the pressure record of the deepest instrument and the mooring design. Surveyed to find a new site 26° 30.012’N, 076° 49.032’W where water depth is 1376 m u/c / 1384 m corrected. Will aim to put anchor at this position using a fallback of 1 cable. Started deploying at 0919. On deploying the 30” syntactic it was spotted that the 50m of 4mm was below the syntactic rather than above it. Recovered all inboard, spun round to start position. Second deployment started at 0942 and towing on anchor at 1123. We were still a long way from the anchor drop, which was finally deployed at1251. Confirmed releases on seabed and vertical. Range was 1318 m which is 1326 m corrected and with transducer depth of 28 m and release height above seabed of 30 m the implied depth is 1382 m. The echosounder read 1386 m u/c 1394 m corrected when the anchor was deployed, so there is a discrepancy of 12 m, which is somewhat similar to the discrepancy on RB09. Triangulated anchor and fall back estimated as 1 cable. End of mooring operations. En route to Freeport. Completing last of data processing and packing lab after dinner.

4th, 094

ETA Freeport, Grand Bahama 1000.

7) Computing

A small local area network consisting of two Mac Mini’s and three MacBooks was built for processing shipboard and mooring data. The primary server was a Mac Mini (2 GHz Intel Core 2 Duo, 2 Gb memory) and data were stored on its 150 Gb hard drive. Attached to this Mac Mini, a portable hard disk provided storage for an independent backup of the data, using Apple’s Time Machine software. Time Machine conveniently stores an incremental backup of all important data every hour.

The primary Mac Mini could be accessed by the other computers through Bonjour (within the Finder) or ssh (within the terminal). The only inconvenience in this setup was that data were

available at /Users/surman/rpdmoc from the primary Mac Mini, while they were available at /Volumes/surman/rpdmoc from all other computers. This complicated writing Matlab scripts, and was addressed by querying the hostname and adjusting the basedir at the beginning of each script.

Two of the three scientist's MacBooks had standalone licenses for Matlab. The two Mac Mini's were shipped from NOCS with the network licensed version of Matlab. It took some time at the beginning of the cruise to organise two standalone serial numbers for the Mac Mini's and adjust the Matlab versions so that they could work without an internet connection. Retrospectively this would not have been necessary as the ship's satellite internet connection was up for virtually the entire cruise and the two network Matlab licenses would probably have worked with a Virtual Private Network connection to the NOCS server.

A Canon flatbed scanner was brought on the cruise for scanning of hand-written logsheets. Limited lab space and a short scanner cable meant the scanner was not regularly taken out of its box. Instead, almost all log-sheets were scanned at the end of the cruise.

The ship was equipped with three printers that could be used by the science party. Only one of these was a colour printer, and inconveniently, this printer broke down halfway through the cruise.

8) Mooring Operations

Mooring Summary

Tables 5 and 6 summarise the mooring operations on OC459-1.

Table 2: Summary of UK mooring recoveries on OC459-1

Mooring name	NMFD mooring number	Deployment cruise	Deployment date/time	Recovery date/time
wbh2_3	2009/12	RB0901	28/04/2009 16:24	28/03/2010 14:21
wb2_7	2009/07	RB0901	29/04/2009 22:04	01/04/2010 21:09
wb1_6	2009/06	RB0901	30/04/2009 19:03	30/03/2010 18:31
wbadcp_6	2009/09	RB0901	18/04/2009 13:52	02/04/2010 16:25
wb2l4_4	2008/06	SJ08-03	24/04/2008 18:58	02/04/2010 13:14
wb4l4_4	2008/07	SJ08-03	28/04/2008 19:46	01/04/2010 11:42
wb6_3	2009/44	D344	15/11/2009 18:02	29/03/2010 20:17

Table 3: Summary of UK mooring deployments on OC459-1

Mooring name	NMFD mooring number	Latitude N	Longitude E	Depth (m)	Deployment date/ time
wb6_4	2010/01	26.4942	-70.5233	5491	28/03/2010 15:45
wbh2_4	2010/04	26.481	-76.579	4824	01/04/2010 13:42
wb2_8	2010/03	26.516	-76.7465	3900	31/03/2010 15:20
wb1_7	2010/08	26.4995	-76.8187	1394	03/04/2010 13:18
wbadcp_7	2010/06	26.525	-76.808	609	04/02/2010 22:57
wb2l6_6	2010/05	26.5087	-76.745	3882	02/04/2010 01:05
wb4l6_6	2010/02	26.2663	-75.707	4708	30/03/2010 01:40
wbal1_1	2010/07	26.525	-76.8761	498	03/04/2010 00:11

The vessel was woefully inadequate for the size of operation we were carrying out. The Aft deck was so full of equipment that we had just a small walkway along the STBD side to deploy and recover moorings through. The vessel is also a very unstable platform in anything of a sea state; this reduces the operating window which can impact on how much we can do.

Due to time restraints, mooring WB4 was left in the water. The mooring will cope fine with the extra time in the water; the releases are good for five years.

Those two things aside; all mooring operations were completed successfully.

Diary of Mooring Operations

23rd March 2010
Mobilisation complete and set sail at 09:45. Straight in to rough seas.

24th
Bad weather is starting to become tiresome, lots of people not feeling well, anchor boxes shifting around on deck. Ship had to be stopped to re-secure items on deck and in the lab.
Ship hove to in an effort to ride out the weather.

25th
The weather has vastly improved. We started sorting through things in the lab, started splicing recovery lines. It was found that water had leaked into the starter of the hydraulic power pack. This was dried out and will hopefully be ok.
A trial CTD was carried out to prove the system, down to 200m. We decided to put two of the Kistler upgraded SBE's on the frame to see how they perform as well as an acoustic release in an effort to trial the new "Super Ducer". Good communication was received from the release. Both SBE data series were fine and the release had released.
Mooring diagrams were updated.
CTD some time in the morning. 4 releases to be test dipped.
The batteries were installed into the Norteks.

26th
Bad weather restricted any work.

27th
Set up SBEs for cal dip and attached them to the CTD frame, along with the four releases that we secured to the frame yesterday. The plan was to wind on WB4 whilst the CTD was underway; however, a problem occurred with the CTD.
We decided to measure and mark the WB6 ropes ready for deployment. The SBEs were removed from the CTD frame and stopped. We decided to keep steaming whilst the CTD problem is investigated further, this ruled out the wire winding of WB4 as the back deck was awash with waves whilst steaming.
The Reeler HPU starter is now caput, the water that had found its way in has caused a short and the switch is not serviceable. The chief may have a replacement or we may be able to use the aft gantry power pack.
The CTD problem was located at the slip ring, this has now been resolved and the CTD is underway.
None of the releases responded to interrogation, at a depth of 5400m, we tried with the normal transducer and this didn't work either. We decided to recover and NOT to try at shallower depths in order to establish if the initial test had worked but just didn't communicate.
The CTD has now started to show problems with the scrolling. The CTD took 6.5 hours. The scrolling is being manually altered during recovery.
Upon recovery of the CTD communication was lost at around 50m, however, all of the releases had fired, so that was good.

All of the SBEs were removed from the CTD, washed and downloaded. The releases were removed and replaced with 4 more. 11 more SBEs were secured to the frame for the next cast.

Again we could not establish comms with the releases, we changed deck units and this made no difference.

28th
All of the releases on the CTD had fired at a depth of 5400m.
We started preparations for the WB6 recovery.
We started communication with mooring WB6 using the "Super Ducer" in the wet lab. No good ranges were received from either release so we took the equipment further aft. This gave better results, though still not as good as expected. The release (sn 361) was fired and the ascent rate was calculated at around 100m/min. the mooring was then recovered with some minor tangles to contend with.
WB6 to deploy was then prepared re-using the recovered Lander frame and releases.
The mooring was then deployed and was confirmed as being on the seabed.

29th.
We have had a discussion about leaving WB4 in the water due to the weather and time constraints that we are contending with.
We started to double up the releases. SN's 907 and 320, sn's 256 and 910.
Another release dip cast was carried out to 3900m, 4 releases tested.
We wound on mooring WBH2, the Reeler worked fine. We also built up WBL4 to deploy using releases 907 and 320.
Mooring WBL4 was deployed at around 22:00 local.
The four releases all worked on the CTD cast.

30th
05:45, started trying to communicate with WBH2, no ranges received. Tried lowering the transducer and tried the port side. Received some ranges indicating that the releases were 100m from the bottom. Two hours were spent trying to release the mooring without success. The decision was made to head for WB2 and start recovery.
Arrived at WB2 site and started comms, again this proved more than difficult, no good ranges received, tried moving the ship and lowering the transducer, the lot.
Eventually one of the releases must have fired because the mooring surfaced and recovery commenced.
When this was finished we wound the recovered mooring off of the winch.
We then wound on WB2 to deploy.
We had trouble setting the conductivity cells on the RCM11's, comms port trouble.
We finally managed to get connected using Darren's old laptop.

31st
Rigged up WB2 ready to deploy, the mooring was deployed without incident although we had to tow for quite some time before releasing the anchor.
The mooring was confirmed as being on the bottom with good ranges from both releases. The mooring was then triangulated.
We got everything ready for the WBH2 deployment in the morning, built up glass, releases and billings.

1st April
Started comms with WBL3 at 06:30 local, both releases giving good ranges with sn 920 used to release. Ascent rate calculated at around 70m/min.
Lander recovered.

We got everything ready for the WBH2 deployment. Deployment commenced and was completed; the mooring was then confirmed as on the bottom and vertical, good ranges received.
Whilst we had the transducer in the water we decided to try comms with 2009 WBH2 that failed to release earlier in the week, good ranges were received. We decided to head toward the recovery position but we failed to establish comms again so we headed back to where we had good ranges and released the mooring, again with good ranges. The mooring was recovered with a few tangles to say the least, releases and instruments being recovered at various stages throughout.
We then built up WBL3 ready for deployment. We also broke down all of the recently recovered glass.
WBL3 was then deployed.

2nd
Started comms with the ADCP mooring after breakfast, good communication was established with the release confirmed as vertical. The release command was sent and the ADCP took about five minutes to surface. The recovery line was tangled with the shackle on the frame and had worn almost completely through, a boat hook was used to secure another line to the frame, and this was used for recovery.
We then headed for WB1 recovery, comms were established with the release and the mooring surfaced, recovery commenced and was completed.
The ADCP to deploy was then prepared and subsequently deployed without incident.
We then prepared the new Lander, WBL0. The Lander was deployed.

3rd
We started the day with preparations for the WB1 deployment. Deployment commenced when we realised that, at the bottom of the small syntactic, we had rigged the mooring wrong by attaching the 50m of 4mm wire directly to the syntactic instead of to the trymsins. The 50m was recovered and the rigging corrected. We then started deployment again and all went well. The mooring was confirmed as on the bottom and a triangulation was carried out.

End of mooring operations.

9) Mooring Instrumentation

Summary of Instruments Recovered and Deployed

A summary of instrument numbers and type recovered and deployed by mooring is listed in Table 7. There were no instrument losses and only 5 instruments that returned no useful data records. Data record lengths by instrument and mooring are tabulated in Appendix A.

Table 4: Summary of instruments deployed and recovered. Appendix A lists individual instruments and record lengths. Appendix F lists setup details of deployed instruments.

Instrument Type	Manufacturer and model	Total intended for recovery	Total recovered	Total deployed
CTD	SeaBird SBE37 SMP MicroCAT SeaBird SBE37 IMP MicroCAT	37 2	37 2	39
Single point current meter	Aanderaa RCM11 Nortek Aqaudopp Sontek Argonaut	11 5	11 5	10 6 2
Current profiler	RD Instruments 75kHz Longranger ADCP	1	1	1
BPR	SeaBird SBE26 SeaBird SBE53	1 4	1 4	5 3

Instrument Problems

SBE53 BPR
Two instruments, s/n 0030 and s/n 0029, returned only 2 and 7 records, respectively.
s/n 0030 had a slight smell of burnt electronics.
s/n 0029 had a low battery so for download it was connected to an external power supply. The end cap was opened and it was found that the resistor on adaptor plate blown. On lifting, can hear something rattling around in electronics end. Instruments deployed were started logging a day or two before deployment to see if issue reoccurred. All were found to be logging and were subsequently deployed.

SBE37 SMP MicroCATs
Serial numbers 5246, 3229, 3913, 3902 were found to have bad pressure/conductivity sensors from looking at the calibration dip cast data.
Serial numbers 6816 and 6818 would not download straight away. Connected to external power supply and one downloaded straight away. The other was opened and the battery pack looked at. The batteries were put back in and download attempted again. It worked straight away. Serial number 6819 complained of a low battery when the instrument was stopped logging.

Serial numbers 3209 and 6839 on mooring recovery were found to be missing the sensor guard and on 3209 the temperature sensor was bent. The temperature data on initial look does not seem to be affected. Serial numbers 6838 and 3224 had no end cap bracket on recovery.

The MicroCAT (serial number 3224) located at 1000 m on wb1_6_200906 slid down 100 m on the mooring line, 36 days into the deployment period. When recovered, the white plastic clamp/guide at the connection plug was found at the nominal location marked with red tape, while the instrument itself was located 100 m deeper.

RCM11
Serial number 381 had no data on the DSU. All settings were checked and found to be correct. No water was present but there was some corrosion on the base plate inside

the instrument. The battery read 7.1mV connected to instrument, and read 1mV disconnected. Serial number 383 had more records than other instruments and would not download. Serial number 520 downloaded but the conversion to ascii did not work correctly as the station information was unavailable.

10) Mooring Instrument Processing

ADCP

The ADCP data were downloaded from the instrument into binary format using RDI software. The data are then passed on to our American colleagues for post processing.

SBE37 MicroCAT CTD Processing

The standard processing scripts were used for this cruise, but a slightly different naming convention was used: appending `_oc459` to each file name to delineate the working version of the file. The stage 1 and stage 2 m-files were cleaned up by Z Szuts adding descriptive headers, more thorough comments, and better internal consistency between them. Raw data and capture files are located on Brian King's Mac mini in `raw/oc459/microcat/` or `raw/oc459/microcat_cal_dip/` (relative to `/Users/surman/rpdmoc/rapid/data/moor)/`); stage1 caldip data is in `proc_calib/oc459/cal_dip/` along with the `info.dat` file; and stage1 and later mooring data is in `proc/[mooring_name]/`.

Stage 0

The MicroCAT data were downloaded with the SeaBird SBE Seaterm software, and the capture and data files were transferred to the processing computers. The standard filenames were: `XXXX_data.asc` and `XXXX_recover.cap` for instruments recovered from moorings; `XXXX_cal_dip_data.asc` (or `.cnv` and `.xml` for the version 3.0 firmware microcats) and `XXXX_rec.cap` for calibration dip files.

Stage 1

The file used for processing mooring data was `mc_call_2_oc459.m` (copied from `mc_call_2_003.m`), and that for processing calibration dips was `mc_call_caldip_oc459.m` (copied from `mc_call_calib2_d344.m`). Functionality for MicroCATs with firmware 3.0 was added during cruise D344 by Darren Rayner to the function `microcat2rodb_3.m`, which is called for converting each individual microcat record to rodb format.

Stage 2

The script used was `microcat_raw2use_003_oc459.m`. This stage trims the deployment and recovery period from the data files.

CTD calibration casts

To estimate any trend in conductivity, temperature and pressure reported by the SBE37 MicroCATs during their year-long deployment (for example due to biofouling or sensor drift), each instrument is lowered on the CTD package to provide pre or post deployment calibrations. Up to 16 SBE37 CTDs are clamped to straps on the CTD frame and secured by plastic cable ties. The sampling rate is set to a period of 10s, which is the fastest available. For pre deployment instruments the sample number is set to zero, for post deployment instruments the sample number is one more than the last sample number from the year-long deployment. The lowered CTD is a SeaBird 9/11 with recently calibrated CTP sensors with the C being adjusted to absolute values of conductivity by reference to seawater samples drawn and analysed against standard sea water.

The CTD is lowered to a minimum depth of 3500 m into where the ocean temperature and salinity distribution is stable. The maximum depth of the cast is then chosen to be the depth at which the deepest MicroCAT was deployed on a mooring. This maximum depth requirement is important for providing accurate pressure calibrations, but is not critical for temperature or conductivity. During the upcast the CTD is stopped for five minutes at several depths, providing stable comparisons between CTD and MicroCATs. CTD bottle samples are also obtained at these depths. On this cruise there were 11 niskin bottles, so 11 five minute comparisons between CTD and microcat are available.

On recovery, MicroCATs are downloaded in the usual way. They are then processed together using >*mc_call_caldip_oc459.m*. This now reads a CTD 1hz file in netcdf format. See CTD section. Three timeseries plots of conductivity, temperature and pressure are produced with all MicroCATs plotted together along with the CTD if available. Particularly for pre-deployment instruments these plots are inspected for anomalies in the MicroCAT records. Examples are lagged conductivities due to pump problems or bad pressures. These instruments are withheld from deployment. More serious calibration work waits for finally calibrated CTD data and is a post-cruise activity.

Current Meter processing

Current meter data were simply processed with the available scripts. Stage 0 is downloading the data from the instruments, converting it to a Matlab-readable format, and transferring it to the computer system. Files for Aanderaa RCM11 current meters are found in rcm/ or rcm11/ directories, and those for Nortek Aquadopp current meters are found in nor/ or nortek/. The files used are listed below for each stage with any noteworthy comments.

RCM11	both stage 1 and stage 2 called by `process_rcms_zbs_oc459.m`
Stage 1	`rcm2rodb_05_oc459.m` This script requires a version of Matlab with the 'brush' function to correct conductivity wrapping. As this was not available, the few instruments with wrapped conductivity were not corrected during OC459.
Stage 2	`rcm11raw2use.m`
Nortek	both stage 1 and stage 2 called by `process_nortek_zbs_oc459.m`
Stage 1	`nortek2rodb_01.m`
Stage 2	`nortek_raw2use_01.m`

SBE26 and SBE53 Bottom Pressure Recorder Processing

The standard processing scripts were used for this cruise, but a slightly different naming convention was used: appending `_oc459` to each file name to delineate the working version of the file. The stage 1 and stage 2 m-files were cleaned up Z Szuts by adding descriptive headers, more thorough comments, and better internal consistency between them. Raw data and capture files are located on Brian King's mac mini in `raw/oc459/seagauge/` (relative to `/Users/surman/rpdmoc/rapid/data/moor)/`), while later processing stages are located in `proc/[mooring_name]/`.

Stage 0

Data are downloaded with Seabird SBE Seaterm and transferred to the processing computer, and any comments are recorded in written logs.

Stage 1

This step is performed with `seagauge2rdb_002_oc459.m`, which is essentially unmodified other than aesthetically from previous cruises. Clock offsets, when needed, are located in `raw/oc459/clock_offset.dat`. These offsets typically come from incorrect dates entered during initial setup or while downloading from the instrument.

Stage 2

The filename `seagauge_raw2use_oc459.m` was used, which is a renamed version of `seagauge_processing_002.m`. Paul Wright changed the name initially during RB0901 (see cruise report), in order to maintain internal consistency with the expected stage2 filename for other data types. Julie Collins also modified the script to write one logfile for each instrument processed. Clock offsets at the end of the cast are treated as linear drifts and are recorded in `raw/oc459/seagauge/bpr_clock_offset.da`.

The small exponential drift (0.091 db, with an exponential decay of 62.2 days) found for SBE53 serial number 0028 on wbl3_2_200806 is the same magnitude as the remaining variability, and so it was not obvious whether the exponential drift was a sensor response or whether it was an oceanic signal. Z. Szuts wrote the script `pdrift_compare_oc459.m` to compare this data record with those recovered on an earlier cruise. The two fits (linear plus exponential, or just linear) are shown in Figure 5 – considered by itself this looks like a reasonable exponential drift.

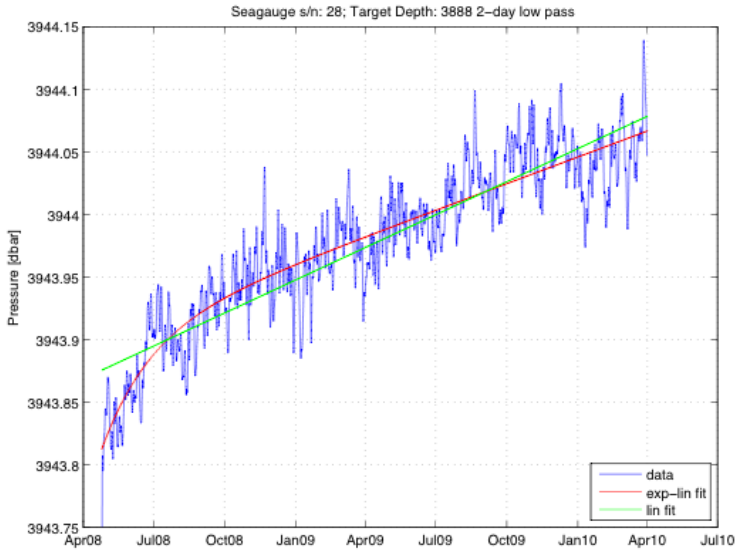


Figure 5: *The exponential plus linear and the linear fit for SBE53 serial number 0028 on wbl3_2_200806.*

When compared against two 2-year-long records collected in the previous spring cruise (RB0901), however, the use of a linear drift for wbl3_2_200806_0028 is in very good agreement with both of them. This comparison stresses a point made by Chris Meinen: unless the drift is significantly larger than the oceanic variability – say, more than 1.5-2 times the standard deviation – then it is important to consider independent data to determine whether the apparent drift is oceanic or instrumental. Some indication may be given if the exponential decay is larger than 30-50 days, which is the main distribution of this parameter as evaluated for all BPRs prior to November 2008 (see Figure 19.2 in the D334 cruise report).

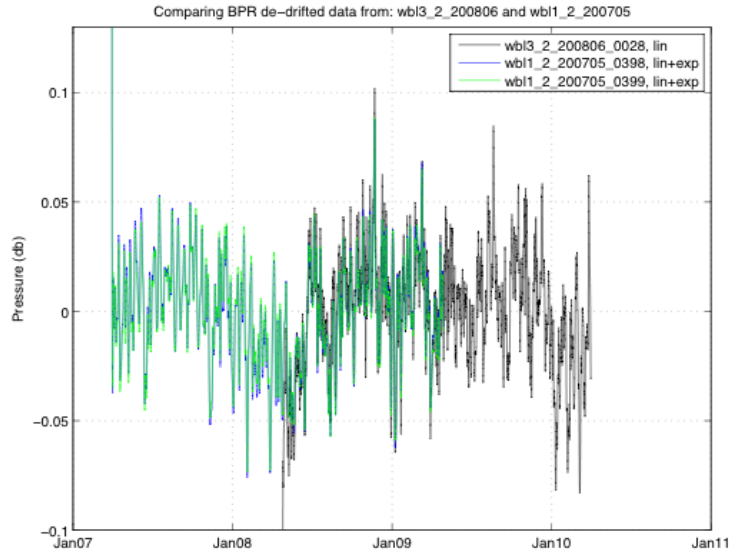


Figure 6: *Comparing the linear-fit dedrifted record from SBE53 serial number 0028 on wbl3_2_200806 against the two BPR records from wbl1_2_200705.*

11) CTD Processing

CTD data were obtained from a SeaBird 9/11 CTD system. The CTD package included 11 Niskin bottles from which seawater samples were drawn for calibration of the conductivity sensor. The CTD system was supplied and operated by Chris Meinen of NOAA/AOML. A summary of the CTD operations is given in Table 8. The CTD file header, Table 9, gives a record of variables logged and the SeaBird processing applied to the file to derive a 24hz timeseries file. The SeaBird 24Hz file was processed to 1hz, details of which can be found in Table 6. Subsequently we read file *ctd_oc459_nnn_ctm.cnv* to netcdf format using the mstar programme suite. The mexec used was *mctd_01* creating output file *ctd_oc459_nnn_raw.nc*. This is a 1hz timeseries file used for comparison with MicroCATs lowered on the CTD to obtain pre and post deployment calibrations.

Table 5: Summary of CTD operations

Station	Date	Time	Depth	Latitude	Longitude
0	25/03/2010	18:10	4500	35 27.20N	70 43.65W
1	27/03/2010	18:00	5412	27 24.45N	70 32.54W
2	28/03/2010	01:36	5410	27 25.37N	70 35.46W
3	29/03/2010	21:11	4674	26 22.42N	75 42.63W
4	30/03/2010	20:52	4619	26 30.10N	76 38.58W
5	31/03/2010	02:21	4004	26 33.47N	76 41.39W
6	02/04/2010	02:29	4540	26 31.16N	76 38.14W
7	02/04/2010	17:30	1205	26 29.71N	76 49.77W
8	02/04/2010	19:30	1130	26 30.28N	76 49.80W
9	03/04/2010	02:18	4046	26 29.50N	76 42.29W

Table 6: Header from SeaBird CTD file for station ctd_oc459_005_ctm.cnv

```
* Sea-Bird SBE 9 Data File:
* FileName = C:\data\ab1003_005.hex
* Software Version Seasave V 7.20c
* Temperature SN = 5140
* Conductivity SN = 3657
* Number of Bytes Per Scan = 37
* Number of Voltage Words = 4
* Number of Scans Averaged by the Deck Unit = 1
* System UpLoad Time = Mar 31 2010 02:23:24
* NMEA Latitude = 26 33.46 N
* NMEA Longitude = 076 41.38 W
* NMEA UTC (Time) = Mar 31 2010  02:23:22
* Store Lat/Lon Data = Append to Every Scan
** Ship:
** Station: 5
** Operator: cm
# nquan = 10
# nvalues = 12116
```

```
# units = specified
# name 0 = timeJ: Julian Days
# name 1 = timeS: Time, Elapsed [seconds]
# name 2 = prDM: Pressure, Digiquartz [db]
# name 3 = t090C: Temperature [ITS-90, deg C]
# name 4 = t190C: Temperature, 2 [ITS-90, deg C]
# name 5 = c0S/m: Conductivity [S/m]
# name 6 = c1S/m: Conductivity, 2 [S/m]
# name 7 = sal00: Salinity [PSU]
# name 8 = sal11: Salinity, 2 [PSU]
# name 9 = flag:
# span 0 =  90.099586,  90.239807
# span 1 =      0.479,  12115.396
# span 2 =      2.112,   3217.603
# span 3 =     2.6195,    22.5607
# span 4 =     2.6194,    22.5600
# span 5 =   3.254414,   5.287868
# span 6 =  -0.402011,  99.001205
# span 7 =    34.9138,    36.8280
# span 8 =     0.0000,  1999.0000
# span 9 = 0.0000e+00, 0.0000e+00
# interval = seconds: 1
# start_time = Mar 31 2010 02:23:24
# bad_flag = -9.990e-29
# sensor 0 = Frequency  0  temperature, primary, 5140, 18-Feb-10
# sensor 1 = Frequency  1  conductivity, primary, 3657, 20-Feb-10, cpcor = -9.5700e-
08
# sensor 2 = Frequency  2  pressure, 0957, 22-Sep-09
# sensor 3 = Frequency  3  temperature, secondary, 5171, 18-Feb-10
# sensor 4 = Frequency  4  conductivity, secondary, 1387, 20-Feb-10, cpcor = -
9.5700e-08
# sensor 5 = Extrnl Volt  2  Oxygen, SBE, primary, 1348, 03-03-2010
# sensor 6 = Extrnl Volt  4  Oxygen, SBE, secondary, 1266, 03-03-2010
# sensor 7 = Extrnl Volt  6  altimeter
# datcnv_date = Mar 31 2010 19:13:34, 7.18c
# datcnv_in = C:\DATA\ab1003\ctd\raw_data\ab1003_005.hex
C:\DATA\ab1003\ctd\raw_data\ab1003_005.CON
# datcnv_skipover = 0
# alignctd_date = Mar 31 2010 19:13:43, 7.18c
# alignctd_in = C:\DATA\ab1003\ctd\1Hz\proc_data\ab1003_005.cnv
# alignctd_adv = c0S/m -0.020, c1S/m 0.020
# wildedit_date = Mar 31 2010 19:13:43, 7.18c
# wildedit_in = C:\DATA\ab1003\ctd\1Hz\proc_data\ab1003_005.cnv
# wildedit_pass1_nstd = 2.0
# wildedit_pass2_nstd = 20.0
# wildedit_pass2_mindelta = 0.000e+000
# wildedit_npoint = 3000
# wildedit_vars = prDM t090C t190C c0S/m c1S/m
# wildedit_excl_bad_scans = no
# filter_date = Mar 31 2010 19:13:44, 7.18c
```

```
# filter_in = C:\DATA\ab1003\ctd\1Hz\proc_data\ab1003_005.cnv
# filter_low_pass_tc_A = 0.030
# filter_low_pass_tc_B = 0.150
# filter_low_pass_A_vars = t090C t190C c0S/m c1S/m
# filter_low_pass_B_vars = prDM
# celltm_date = Mar 31 2010 19:13:46, 7.18c
# celltm_in = C:\DATA\ab1003\ctd\1Hz\proc_data\ab1003_005.cnv
# celltm_alpha = 0.0300, 0.0300
# celltm_tau = 7.0000, 7.0000
# celltm_temp_sensor_use_for_cond = primary, secondary
# binavg_date = Mar 31 2010 19:13:47, 7.18c
# binavg_in = C:\DATA\ab1003\ctd\1Hz\proc_data\ab1003_005.cnv
# binavg_bintype = seconds
# binavg_binsize = 1
# binavg_excl_bad_scans = no
# binavg_skipover = 0
# binavg_surface_bin = no, min = 0.000, max = 0.000, value = 0.000
# Derive_date = Mar 31 2010 19:13:48, 7.18c
# Derive_in = C:\DATA\ab1003\ctd\1Hz\proc_data\ab1003_005.cnv
C:\DATA\ab1003\ctd\raw_data\ab1003_005.CON
# strip_date = Mar 31 2010 19:13:48, 7.18c
# strip_in = C:\DATA\ab1003\ctd\1Hz\proc_data\ab1003_005.cnv
# file_type = ascii
*END*
```

12) Underway Data Logging

Data for the ship's underway sensors and other equipment can be accessed via the web, SSH, or from Samba mounts. You can get real-time data feeds from UDP broadcasts or from RS-232/serial connections. From a Mac use smb://ftp.oceanus.whoi.edu/data to mount the data directory. Metadata for the logged variables are in *MetaData.txt* and *MetaDataAux.txt*. Prior to the cruise Laura Stoope also set up a data file *2010_ddd_hhhh_nnn.kea* under data/Knudsen with the variables $PKEL99,ddmmyyyy,hhmmss,Depth,Depth,SndSpd,Lat/Y,Long/X. This file was parsed to rapid_widget.m for plotting ship's course over bathymetry and for setting way points and mooring positions.

Processing

All data are collected in the ship's Athena system, which can be accessed through the ftp server. The data are saved every 60 seconds on this server and aggregated into one file for each day: OC*yymmdd*_00.csv and OC*yymmdd*_00.dat. The processing of the data is done by calling the getathenaunderwaydata.m script. Every time the script is called, the netcdf files are overwritten with all of the data available in the Athena system.

Before converting to netcdf format, all the files for the different days are concatenated into one large temporary file. This file cannot be loaded directly into MATLAB, as it

has characters in it which are not recognized. These characters (the ':' and the '/') are removed from the temporary file by calling sed commands from within MATLAB. Once this is done, the data are loaded into MATLAB.

No quality control has been performed on the data. All the variables are saved as they come from the Athena system, split into four different files; bathymetry; meteorology; navigation and thermosalinograph.

Bathymetry

The bathymetric data are saved into the file sim/sim_oc459_001_raw.nc. The variables in this file are time (in seconds after Jan 1, 2010), longitude (lon), latitude (lat), the 12kH Knudsen echosounder data (depth12) and the 3.5kH Knudsen echosounder data (depth35). For both echo sounder data streams a 4 meter transducer depth correction has been applied. Note that the echosounder was not on for the entire trip, and that when it was on there were parts where the maximum depth set on the instrument was shallower than the actual depth so that the reading is in general not very reliable.

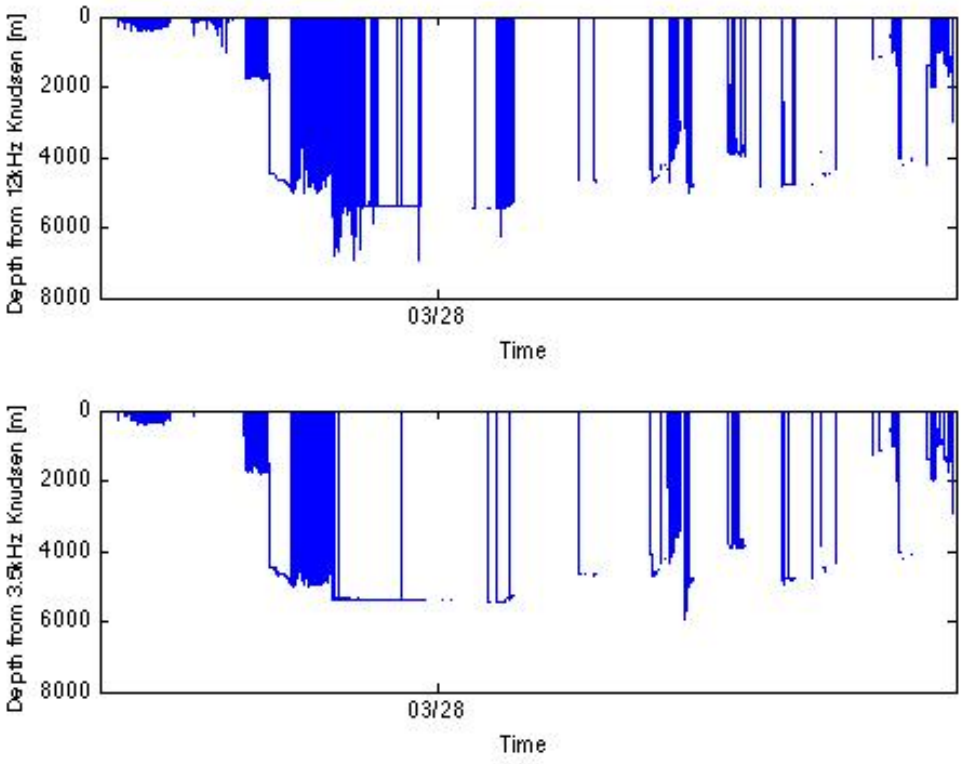


Figure 7: *Time series of the two Knudsen echosounders on board the vessel. The high frequency 12kHz data is in the upper panel, the 3.5 kHz low frequency data is in the lower panel. The data was of poor quality during rough weather, so generally the echosounders were only turned on during mooring and CTD work.*

Meteorology

The meteorological data are saved into the file met/met_oc459_001_raw.nc. There are 10 meteorological variables in the file, all obtained from the Vaisala WXT520 14.5 m above the waterline on the front of the ship. This instrument has sensors on both the port and the starboard side, and both data streams are saved. Data include: barometric pressure (corrected for sensor height), air temperature, relative humidity, relative wind direction, and relative wind speed. The wind variables are saved relative to the ship speed and heading with 0 degrees coming from the front of the ship and 90 degrees over the starboard side.

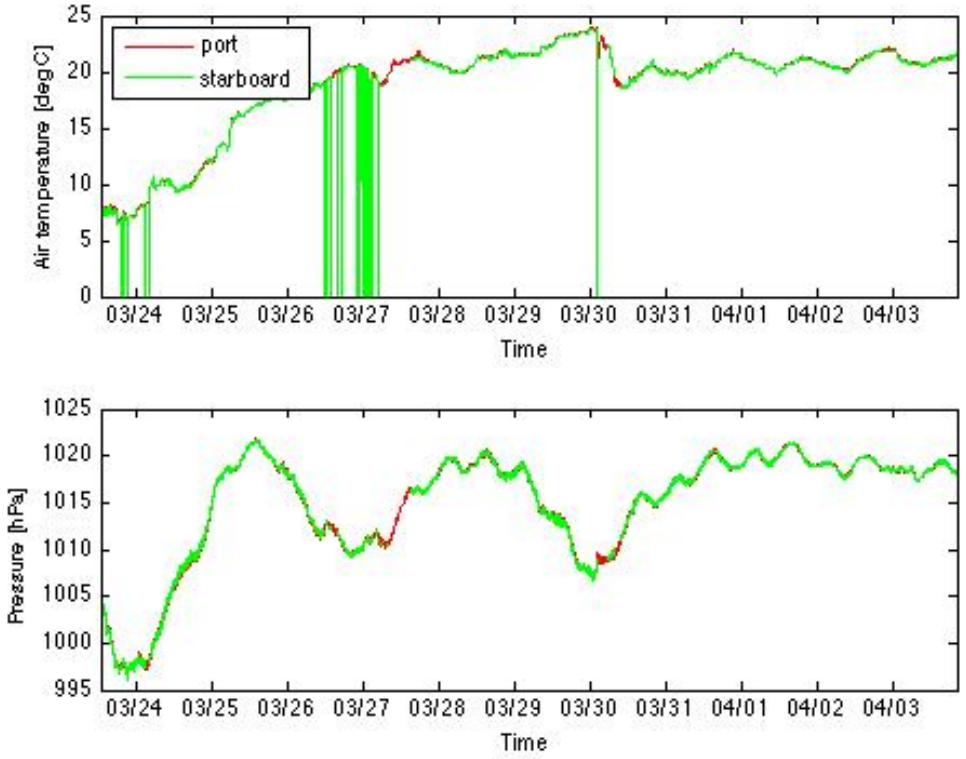


Figure 8: *Timeseries of the air temperature and pressure as measured by the two instruments on the port side and the starboard side of the ship. There were problems with the temperature sensors, but it seems that at least one of the two pressure sensors has been working for the entire cruise.*

Thermosalinograph

The thermosalinographic data are saved into the file tsg/tsg_oc459_001_raw.nc. There are 4 thermosalinographic variables in the file. The temp_r variable is measured through the hull with a magnetically coupled SBE48 which is located near the bow of the ship and the housing is contained in an insulation jacket to limit effect of ambient bow chamber air. The temp_h, cond_h, and sal_h variables are obtained from a SBE45 connected to the clean seawater system in the Wet Lab.

From a first look the system seems to have worked well during the entire cruise. The Gulf Stream crossing on March 25 is clearly visible. However, there has not been any rigorous quality control of the data on the ship.

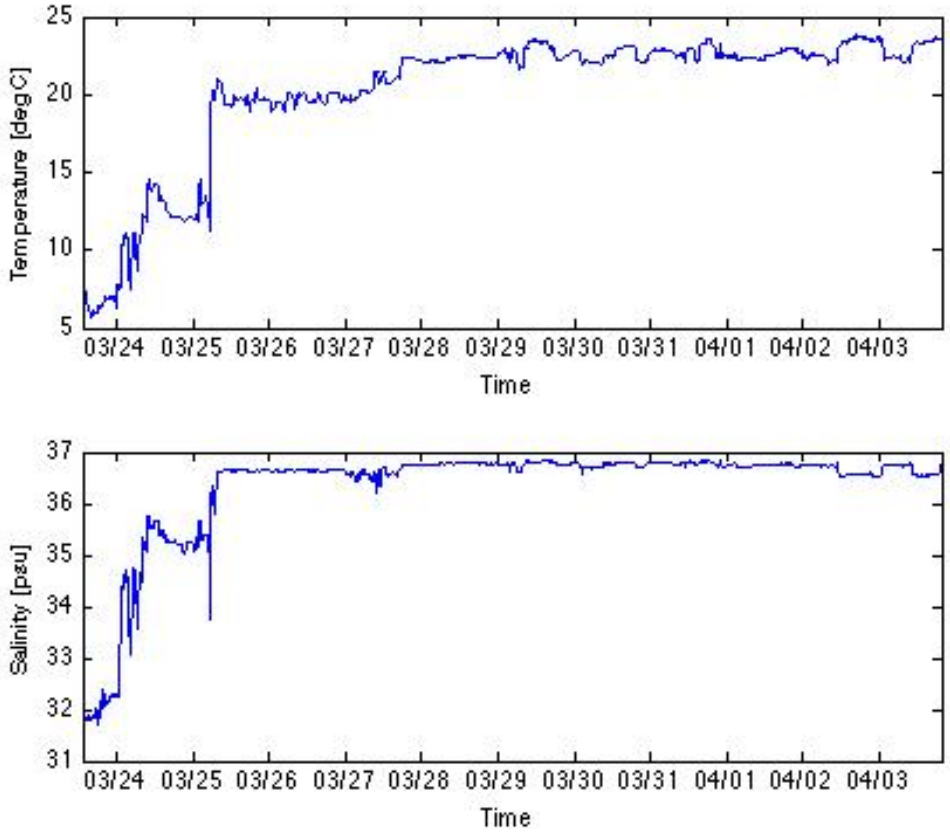


Figure 9: *Time series of the water temperature and salinity as measured by the onboard SBE system. The crossing of the Gulf Stream on March 25 is clearly visible.*

Navigation

Finally, the navigation data is saved into the file nav/nav_oc459_001_raw.nc. The file contains five variables: time, longitude (lon), latitude (lat), speed over ground (SOG), and course over ground (COG). All data are obtained from the ship's primary GPS receiver (a Furuno 1850D) NMEA GPRMC data sentence.

RAPID_widget.m

RAPID_widgit (Where is the Discovery Going In real-Time) was created by David Ham (ICL, London) during Discovery cruise D344. It is a stand-alone piece of software, but nonetheless required modification to accept the different shipboard position streams during OC459. The GPS files are logged to the Oceanus FTP server (ftp.oceanus.whoi.edu) in the `/data/knudsen/` directory, and consist of comma-separated strings with the date, the depths from the depth-sounder, and positions. These position files are loaded into Matlab by

`rapid_widgit/src/plotetopo2_plot_gps.m` starting on line 20. Otherwise, no further modifications were necessary to make rapid_widgit work.

13) Temporal response of Druck, Paine and Kistler pressure sensors operating on SeaBird MicroCAT CTDs

Introduction

Since 2004 SeaBird have supplied the SeaBird 37 CTD with three different pressure sensors (Druck, Paine and Kistler) from three manufacturers. In the RAPID programme we rely on in situ sensor calibrations by lowering the MicroCATs with a reference high precision SeaBird 911 CTD. On the upcast, at 5 minute bottle stops, data from the 911 CTD can be compared very accurately with the MicroCATs. Using this procedure pre and post deployment of the MicroCATs on moorings provides a very precise calibration of the MicroCAT conductivity, temperature and pressure timeseries. This method assumes in particular that the pressure sensors have a similar temporal response to the reference CTD, and do not suffer from significant hysteresis during a vertical CTD cast. However, we have recently become aware that the Druck and Paine pressure sensors do suffer from very long equilibration times of order 30 minutes due to thermal lag in the pressure sensor (Cunningham, 2010).

Recently SeaBird have started supplying the MicroCATs with a Kistler pressure sensor. We wished to compare the temporal response of these three sensors to the reference CTD.

Method

During calibration cast 6, the upcast bottle stop at 440 dbar lasted for 30 minutes. Three MicroCATs were processed for comparison to the reference CTD. The CTD cast maximum pressure was 3467 dbar.

Table 7: Serial numbers of three MicroCATs lowered on CTD cast 6

MicroCAT serial number	Pressure sensor type
6829	Paine
3247	Druck
3932	Kistler

Results

The CTD was stopped on the upcast at a pressure of 432 dbar (Figure 10). For the first 3 minutes after the winch was stopped the CTD package sank by 6 dbar and over the following 30 minutes sank a further 2.5 dbar. The permanent thermocline is found at a depth of 1100 dbar, and the temperature increases from 4°C at 1100 m to 18°C at 440 dbar. During the 30 minute bottle stop at 432 dbar the temperature varied by 0.2°C.

The response of the Kistler pressure sensor has a constant offset to the reference CTD of about 2 dbar. In contrast both Druck and Paine sensors have a complex response. There is a maximum difference to the reference CTD about

1.5 mins after the CTD has stopped ascending. This is followed by a strong exponential decrease in the pressure difference of 12 dbars over 30 minutes. The e-folding time of the exponential decrease is about 7.5 minutes. An approximate equilibrium is reached after about 22 minutes.

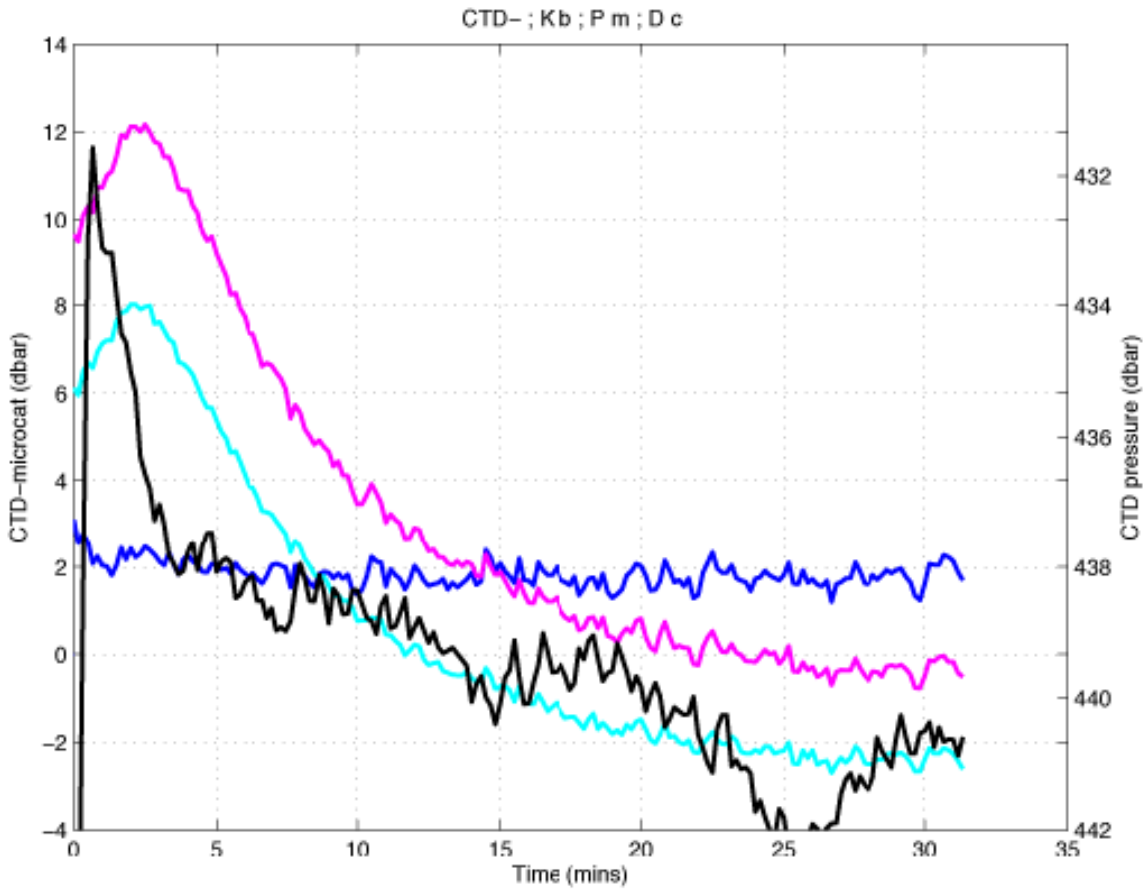


Figure 10: *(File: pressure_sensorcast6_all_pres.gif). The reference SBE 911 CTD pressure is shown in black with the scale on the right hand y-axis plotted against time. The pressure difference (CTD-MicroCAT) is shown on the left hand y-axis. Three MicroCAT instruments (Table 7) with three different pressure sensors have been plotted. Druck in cyan, Paine in magenta and Kistler in blue. To construct the difference of the reference CTD with the MicroCATs we interpolated the reference CTD data onto the 10 s sampling of the MicroCATs.*

Conclusion

The response of the pressure sensor for both Druck and Paine are close to that described for some laboratory experiments (Cunningham, 2010), where raw data from the sensors were logged during submersion in water at 4°C from air temperature around 20°C. For these experiments it was conclusive that the thermal response of the pressure sensor causes the slow equilibration. The Kistler sensor tested has no temporal response relative to the reference CTD. This could make it preferable to the Druck and Paine sensors with regard to our calibration methodology, but caution should be applied as this is only a small sample set.

14) References

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. Temporal variability of the Atlantic Meridional Overturning Circulation at 26°N. Science, **317**, 935-938, doi:10.1126/science.1141304

Cunningham S.A., Wright P.G. (ed.) (2010) RRS *Discovery* Cruise D344, 21 Oct-18 Nov 2009. RAPID Mooring Cruise Report. Southampton, UK, National Oceanography Centre Southampton, 225pp. (National Oceanography Centre Southampton Cruise Report, 51)

Kanzow T., Cunningham S.A, Rayner D., Hirschi J.J.-M., Johns W.E., Baringer M.O., Bryden H.L., Beal L.M., Meinen C.S., Marotzke J. Flow compensation associated with the meridional overturning. Science, **317**, 938-941, doi:10.1126/

Appendices

A: Instrument Record Lengths

Instrument record lengths listed by mooring. Times in GMT taken from the first and last times in the .use files.

Mooring Name	Instrument	Serial Number	Approx Depth (m)	Date of first useable record	Date of last useable record	Note
WBADCP	ADCP	5817	600	2009 04 18 15.00000	2010 04 02 11.50000	
WB1	SMP	3206	50	2009 04 30 19.50028	2010 04 01 13.00056	
	RCM	381	100			*
	SMP	3219	100	2009 04 30 19.50028	2010 04 01 13.00056	
	SMP	6837	175	2009 04 30 19.50028	2010 04 01 13.00028	
	SMP	6838	250	2009 04 30 19.50028	2010 04 01 13.00028	
	SMP	6839	325	2009 04 30 19.50028	2010 04 01 13.00028	
	RCM	383	400			+
	SMP	6840	400	2009 04 30 19.50028	2010 04 01 13.00028	
	SMP	6841	500	2009 04 30 19.50028	2010 04 01 13.00028	
	SMP	3209	600	2009 04 30 19.50028	2010 04 01 13.00028	
	SMP	3215	700	2009 04 30 19.50000	2010 04 01 13.00028	
	RCM	395	800	2009 04 30 19.50000	2010 04 01 13.50000	
	SMP	3216	800	2009 04 30 19.50028	2010 04 01 13.00056	
	SMP	3221	900	2009 04 30 19.50028	2010 04 01 13.00056	
	SMP	3224	1000	2009 04 30 19.50028	2010 04 01 13.50000	
	SMP	3225	1100	2009 04 30 19.50028	2010 04 01 13.00083	
	RCM	399	1200	2009 04 30 19.50000	2010 04 01 13.36667	
	SMP	3234	1200	2009 04 30 19.50028	2010 04 01 13.00056	
	SMP	3222	1380	2009 04 30 19.50028	2010 04 01 13.00056	
WB2	SMP	6819	50	2009 04 29 22.50028	2010 04 15 7.50028	
	RCM	519	100	2009 04 29 22.48611	2010 04 30 13.84583	
	SMP	6820	100	2009 04 29 22.50028	2010 04 30 14.00028	
	RCM	515	175	2009 04 29 22.25000	2010 04 30 14.05000	
	SMP	6821	175	2009 04 29 22.50028	2010 04 30 14.00028	
	SMP	6822	325	2009 04 29 22.50028	2010 04 30 14.00028	
	RCM	516	400	2009 04 29 22.25000	2010 04 30 14.11667	
	SMP	6823	500	2009 04 29 22.50028	2010 04 30 14.00028	
	SMP	6824	700	2009 04 29 22.50028	2010 04 30 14.00028	
	RCM	520	800	2009 04 29 22.75000	2010 03 30 13.6667	#
	SMP	6825	900	2009 04 29 22.50028	2010 04 30 14.00028	
	SMP	6826	1100	2009 04 29 22.50028	2010 04 30 14.00028	
	RCM	443	1200	2009 04 29 22.23750	2010 04 30 14.04444	
	SMP	6827	1300	2009 04 29 22.50028	2010 04 30 14.00028	
	SMP	6828	1500	2009 04 29 22.50028	2010 04 30 14.00028	
	SMP	6829	1700	2009 04 29 22.50028	2010 04 30 14.00028	
	SMP	3247	1900	2009 04 29 22.50028	2010 04 30 14.00028	
	RCM	444	2050	2009 04 29 22.25000	2010 04 30 13.71667	
	SMP	6831	2300	2009 04 29 22.50028	2010 04 30 14.00028	
	SMP	6832	2800	2009 04 29 22.50028	2010 04 30 14.00028	
	RCM	426	3000	2009 04 29 22.23750	2010 04 30 14.04444	
	SMP	6833	3300	2009 04 29 22.50028	2010 04 30 14.00028	

	SMP	6834	3850	2009 04 29 22.50028	2010 04 30 14.00028	
WBH2	NOR	5897	1500	2009 04 28 18.5000	2010 04 01 18.0000	
	NOR	5889	2200	2009 04 28 18.5000	2010 04 01 18.0000	
	NOR	5879	3000	2009 04 28 18.5000	2010 04 01 18.0000	
	NOR	5884	3800	2009 04 28 18.5000	2010 04 01 18.0000	
	SMP	6818	3800	2009 04 28 16.0028	2010 04 01 17.50028	
	SMP	6817	4300	2009 04 28 16.0028	2010 04 01 17.50028	
	NOR	5890	4600	2009 04 28 18.5000	2010 04 01 18.0000	
	SMP	6816	4780	2009 04 28 16.0028	2010 04 01 17.50028	
WBL3	SBE53	0028	3888	2008 04 24 22.25000	2010 04 01 10.00000	
	SBE53	0029	3888			*
WB6	SMP	5242	5100	2009 11 15 19.00028	2010 03 28 12.50028	
	IMP	4180	5200	2009 11 15 19.00028	2010 03 28 12.50000	^
	SMP	5764	5300	2009 11 15 19.00028	2010 03 28 12.50028	
	IMP	4473	5400	2009 11 15 19.00028	2010 03 28 12.50028	^
	SMP	5765	5495	2009 11 15 19.00028	2010 03 28 12.50028	
	SBE26	0037	5500	2009 11 16 0.00000	2010 03 28 11.50000	
	SBE53	0390	5500	2009 11 16 0.01667	2010 03 28 11.51667	
WBL4	SBE53	0030	4704			*

* No data recorded whilst deployed.
+ Data could not be downloaded
# Data could not be converted on board. Converted back at NOC.
^ Pressure sensor capped. Therefore, no pressure data.

B: Calibration Casts

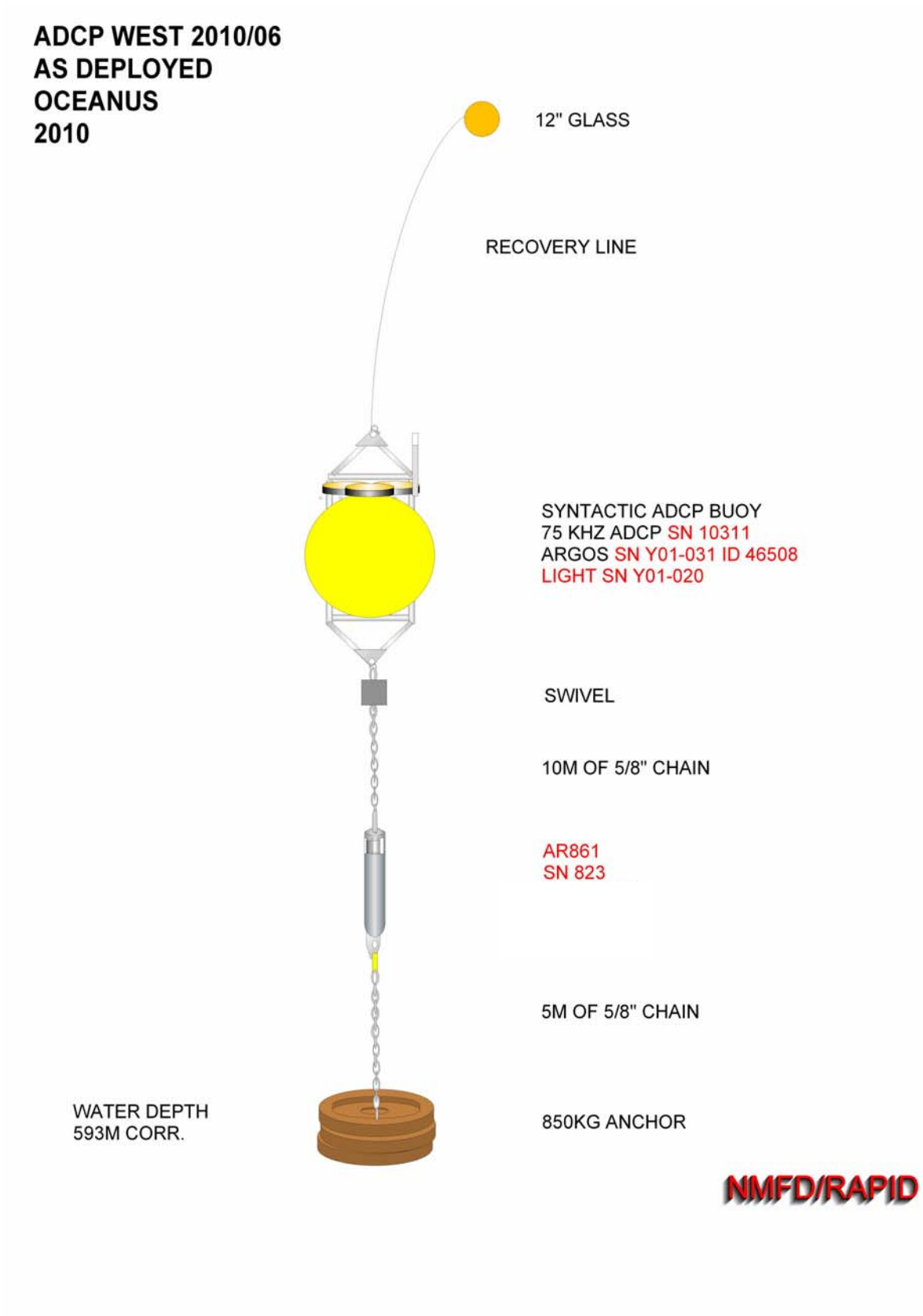
CTD number, instrument serial number, pressure sensor type (Druck – D, Paine – P, Kistler – K), pre or post deployment and mooring, comments.

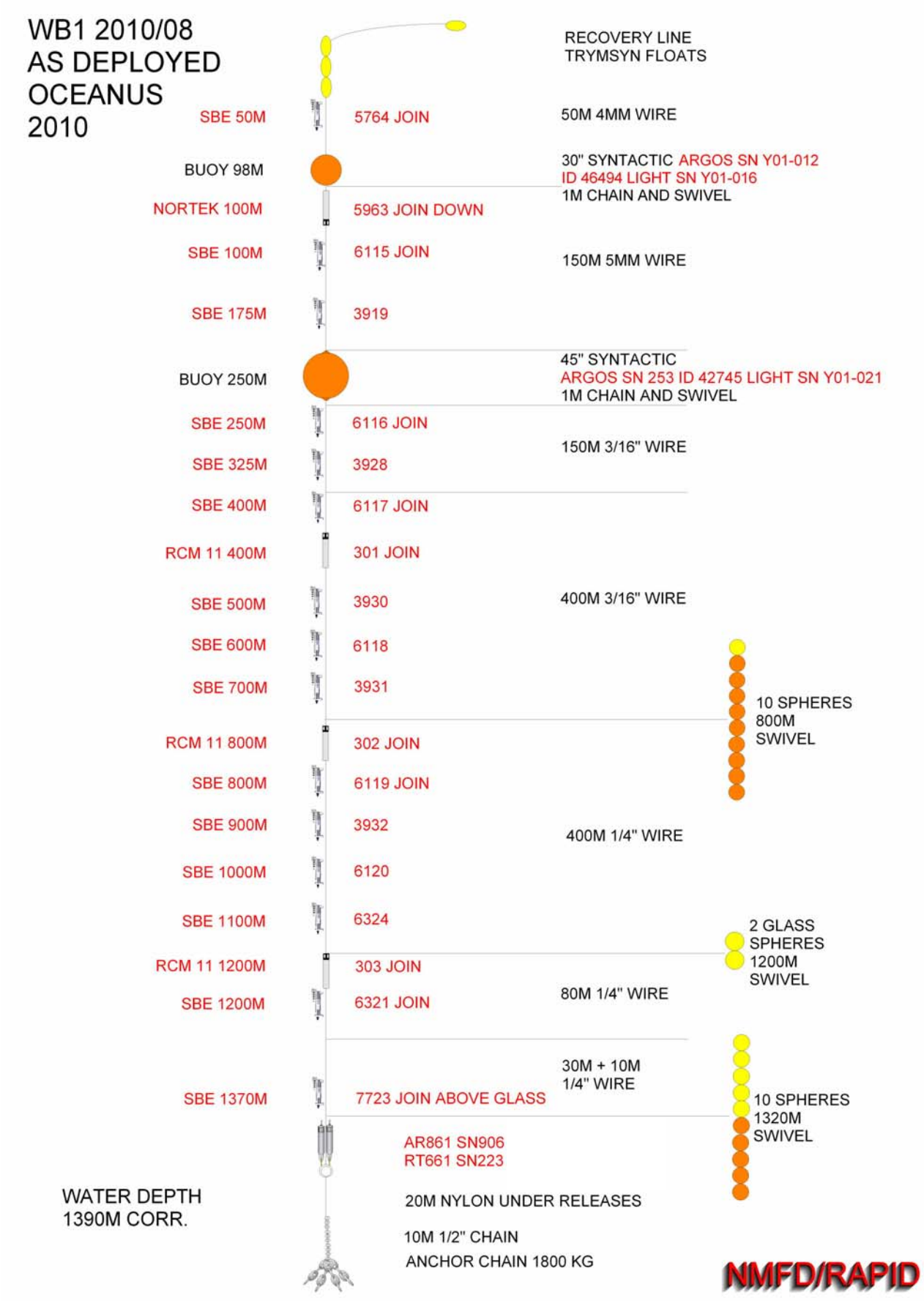
CTD	Instrument Details			
	s/n	P sensor type	Pre/post mooring	Comment
0	3223	K	Test cast to 250db	Check new instrument software
	3228	K	ditto	Check new instrument software
1	3207	K	WB6 pre	
	5238	P	WB6 pre	
	3212	K	WB6 pre	
	3213	K	WB6 pre	
	3214	K	WB6 pre	
	3231	K	WB2 pre	
	5246	P		Pressure under reading by 150db. Do not use.
	3232	K	WB2 pre	
	5247	P	WB2 pre	
	3233	K	WB2 pre	
	6112	P	WB2 pre	
	3244	K	WB2 pre	
2	3223	K	WB2 pre	
	5239	P	WB2 pre	
	3228	K	WB2 pre	
	5243	P	WB2 pre	
	3229	K		C bad, lagged response & reads low. Pump?
	5244	P	WB2 pre	
	3230	K	WB2 pre	
	5245	P	WBH2 pre	
	3258	K	WBH2 pre	
	3902	K		P reads high by 25db
	3905	K	WBH2 pre	
3	3906	K	WB2 pre	
	6113	P	WB2 pre	
	3907	K	WB2 pre	
	6114	P	WB2 pre	
	3913	K		C bad, lagged response. Pump?
	6115	P	WB1 pre	
	3919	K	WB1 pre	
	6116	P	WB1 pre	
	3928	K	WB1 pre	
	6117	P	WB1 pre	
	3930	K	WB1 pre	
	6118	P	WB1 pre	
4	3931	K	WB1 pre	

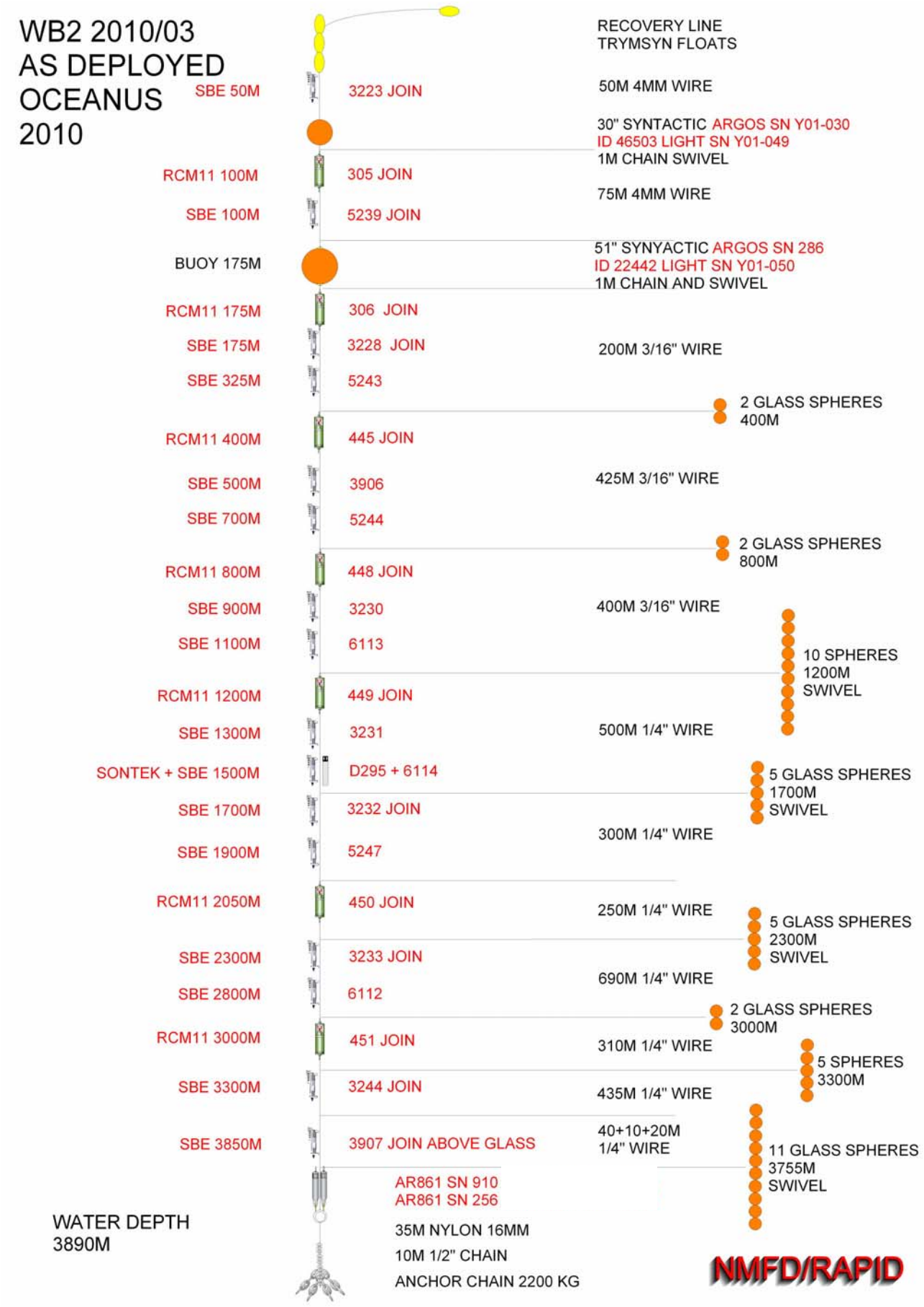
	6119	P	WB1 pre	
	3932	K	WB1 pre	
	6120	P	WB1 pre	
	6324	P	WB1 pre	
	6321	P	WB1 pre	C high
	7723		WB1 pre	Not in Darren's database
	5242	P	WB6 post	
	4180	D	WB6 post	IMP. P capped
	5764	P	WB6 post	
	4473	D	WB6 post	IMP. P capped, C low
	5765	P	WB6 post	
5	6819	P	WB2 post	1759/2039 samples. P 15db low
	6820	P	WB2 post	
	6821	P	WB2 post	
	6822	P	WB2 post	
	6823	P	WB2 post	
	6824	P	WB2 post	
	6825	P	WB2 post	
	6826	P	WB2 post	
	6827	P	WB2 post	
	6828	P	WB2 post	
	6829	P	WB2 post	
	3247	D	WB2 post	
	6831	P	WB2 post	
	6832	P	WB2 post	
	6833	P	WB2 post	
	6834	P	WB2 post	
6	6817	P	WBH2 post	
	6818	P	WBH2 post	
	3932	K	Test, WB1 pre	
	6829	P	Test	
	3247	D	Test	
	5764	P	WB1 pre	
7 or AOML 9	3206	D	WB1 post	C+0.05 mS/cm
	3219	D	WB1 post	C+0.05
	6837	P	WB1 post	1321/1361 samples
	6838	P	WB1 post	
	6839	P	WB1 post	
	6840	P	WB1 post	
	6841	P	WB1 post	
	3209	D	WB1 post	C+10mS/cm. no guard and slipped down wire
	3215	D	WB1 post	
	3216	D	WB1 post	
	3221	D	WB1 post	
	3224	D	WB1 post	

	3225	D	WB1 post	
	3224	D	WB1 post	
	3222	D	WB1 post	
	6816	P	WBH2 post	

C: Mooring Diagrams




WB1 2010/08
AS DEPLOYED
OCEANUS
2010
RECOVERY LINE
TRYMSYN FLOATS
SBE 50M
5764 JOIN
50M 4MM WIRE
BUOY 98M
30" SYNTACTIC ARGOS SN Y01-012
ID 46494 LIGHT SN Y01-016
1M CHAIN AND SWIVEL
NORTEK 100M
5963 JOIN DOWN
SBE 100M
6115 JOIN
150M 5MM WIRE
SBE 175M
3919
BUOY 250M
45" SYNTACTIC
ARGOS SN 253 ID 42745 LIGHT SN Y01-021
1M CHAIN AND SWIVEL
SBE 250M
6116 JOIN
150M 3/16" WIRE
SBE 325M
3928
SBE 400M
6117 JOIN
RCM 11 400M
301 JOIN
SBE 500M
3930
400M 3/16" WIRE
SBE 600M
6118
SBE 700M
3931
10 SPHERES
800M
SWIVEL
RCM 11 800M
302 JOIN
SBE 800M
6119 JOIN
SBE 900M
3932
400M 1/4" WIRE
SBE 1000M
6120
SBE 1100M
6324
2 GLASS
SPHERES
1200M
SWIVEL
RCM 11 1200M
303 JOIN
SBE 1200M
6321 JOIN
80M 1/4" WIRE
30M + 10M
1/4" WIRE
SBE 1370M
7723 JOIN ABOVE GLASS
10 SPHERES
1320M
SWIVEL
AR861 SN906
RT661 SN223
WATER DEPTH
1390M CORR.
20M NYLON UNDER RELEASES
10M 1/2" CHAIN
ANCHOR CHAIN 1800 KG
NMFD/RAPID


WB2 2010/03
AS DEPLOYED
OCEANUS
2010
RECOVERY LINE
TRYMSYN FLOATS
SBE 50M
3223 JOIN
50M 4MM WIRE
30" SYNTACTIC ARGOS SN Y01-030
ID 46503 LIGHT SN Y01-049
1M CHAIN SWIVEL
RCM11 100M
305 JOIN
75M 4MM WIRE
SBE 100M
5239 JOIN
BUOY 175M
51" SYNYACTIC ARGOS SN 286
ID 22442 LIGHT SN Y01-050
1M CHAIN AND SWIVEL
RCM11 175M
306 JOIN
SBE 175M
3228 JOIN
200M 3/16" WIRE
SBE 325M
5243
2 GLASS SPHERES
400M
RCM11 400M
445 JOIN
SBE 500M
3906
425M 3/16" WIRE
SBE 700M
5244
2 GLASS SPHERES
800M
RCM11 800M
448 JOIN
SBE 900M
3230
400M 3/16" WIRE
SBE 1100M
6113
10 SPHERES
1200M
SWIVEL
RCM11 1200M
449 JOIN
SBE 1300M
3231
500M 1/4" WIRE
SONTEK + SBE 1500M
D295 + 6114
5 GLASS SPHERES
1700M
SWIVEL
SBE 1700M
3232 JOIN
300M 1/4" WIRE
SBE 1900M
5247
RCM11 2050M
450 JOIN
250M 1/4" WIRE
5 GLASS SPHERES
2300M
SWIVEL
SBE 2300M
3233 JOIN
690M 1/4" WIRE
SBE 2800M
6112
2 GLASS SPHERES
3000M
RCM11 3000M
451 JOIN
310M 1/4" WIRE
5 SPHERES
3300M
SBE 3300M
3244 JOIN
435M 1/4" WIRE
SBE 3850M
3907 JOIN ABOVE GLASS
40+10+20M
1/4" WIRE
11 GLASS SPHERES
3755M
SWIVEL
AR861 SN 910
AR861 SN 256
WATER DEPTH
3890M
35M NYLON 16MM
10M 1/2" CHAIN
ANCHOR CHAIN 2200 KG
NMFD/RAPID

WB2L6 2010/05
AS DEPLOYED
OCEANUS
2010

BILLINGS FLOAT
ARGOS SN Y01-029
ID 46502
LIGHT SN W03-092

15M RECOVERY LINE

2M CHAIN

15M POLYPROP

4 x 17" GLASS

15M POLYPROP

4 x 17" GLASS

15M POLYPROP

AR861 SN265
AR861 SN251

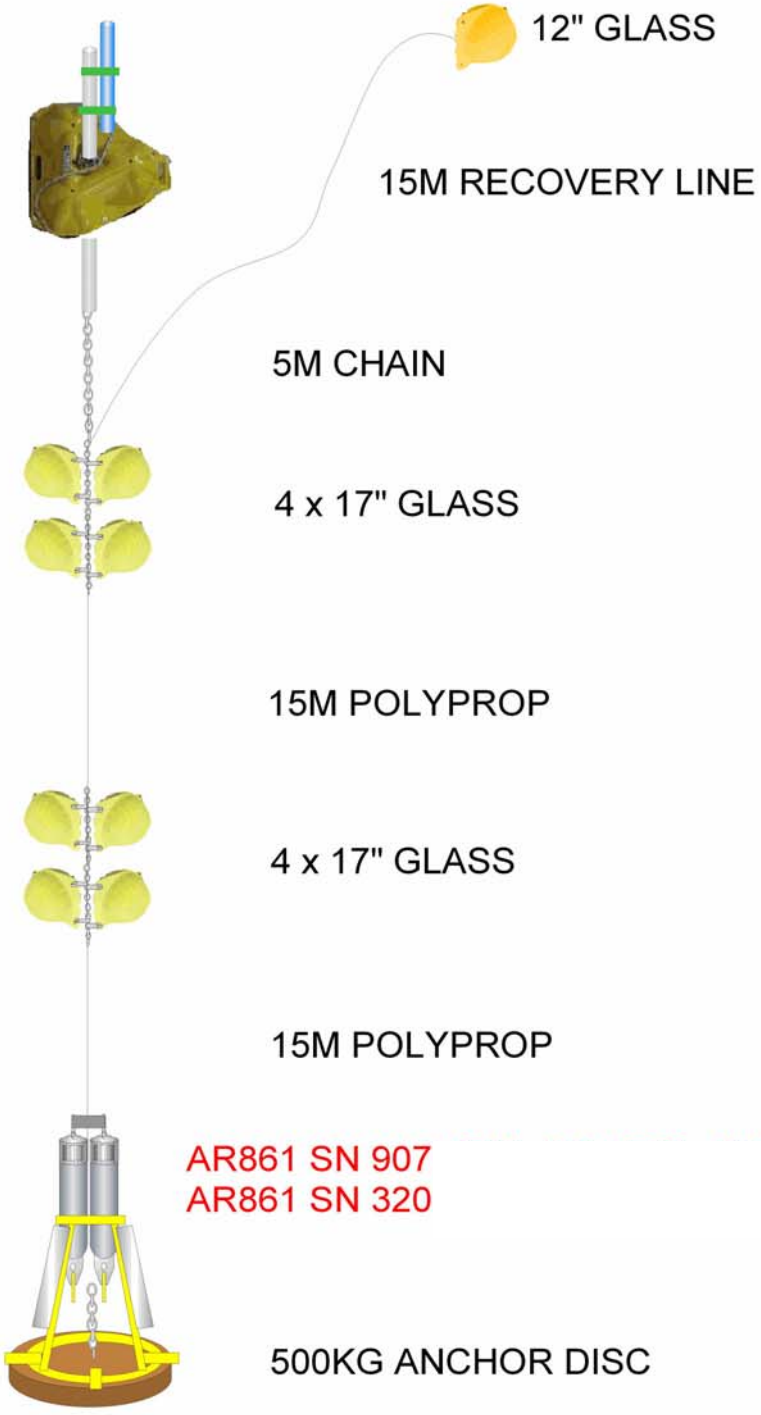
2 OFF SBE 26
SN 0389
SN 0398

600KG DISC ANCHOR

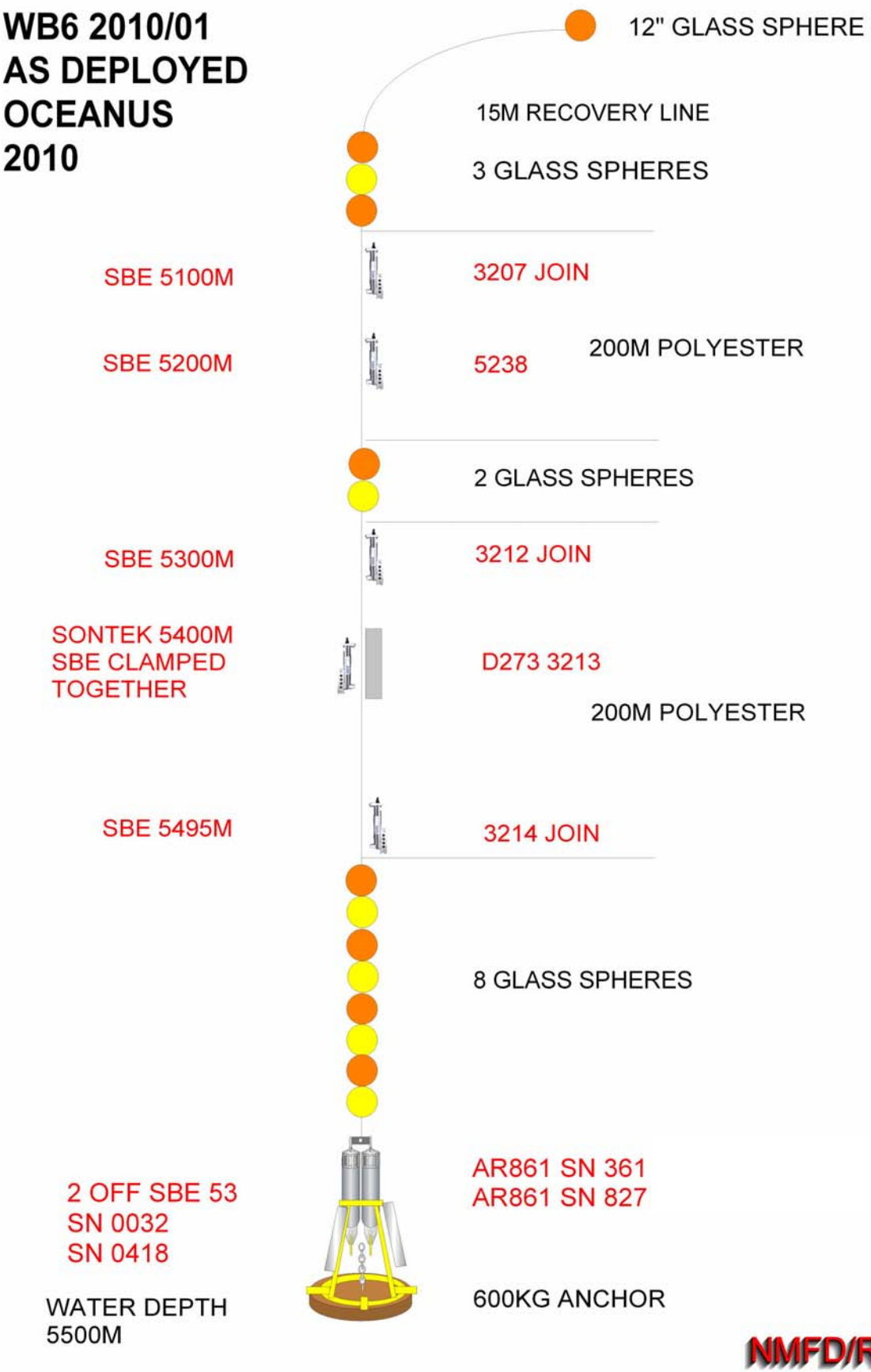
WATER DEPTH
3887M

NMFD/RAPID

WB4L6 2010/02
AS DEPLOYED
OCEANUS
2010



NMFD/RAPID


WB6 2010/01
AS DEPLOYED
OCEANUS
2010
12" GLASS SPHERE
15M RECOVERY LINE
3 GLASS SPHERES
SBE 5100M
3207 JOIN
SBE 5200M
5238
200M POLYESTER
2 GLASS SPHERES
SBE 5300M
3212 JOIN
SONTEK 5400M
SBE CLAMPED
TOGETHER
D273 3213
200M POLYESTER
SBE 5495M
3214 JOIN
8 GLASS SPHERES
AR861 SN 361
AR861 SN 827
2 OFF SBE 53
SN 0032
SN 0418
600KG ANCHOR
WATER DEPTH
5500M
NMFD/RAPID

WBAL1 2010/07
AS DEPLOYED
OCEANUS
2010

BILLINGS FLOAT
ARGOS SN Y01-028
ID 46501
LIGHT SN S01-185

15M RECOVERY LINE

2M CHAIN

15M POLYPROP

4 x 17" GLASS

15M POLYPROP

4 x 17" GLASS

15M POLYPROP

AR861 SN365
AR861 SN246

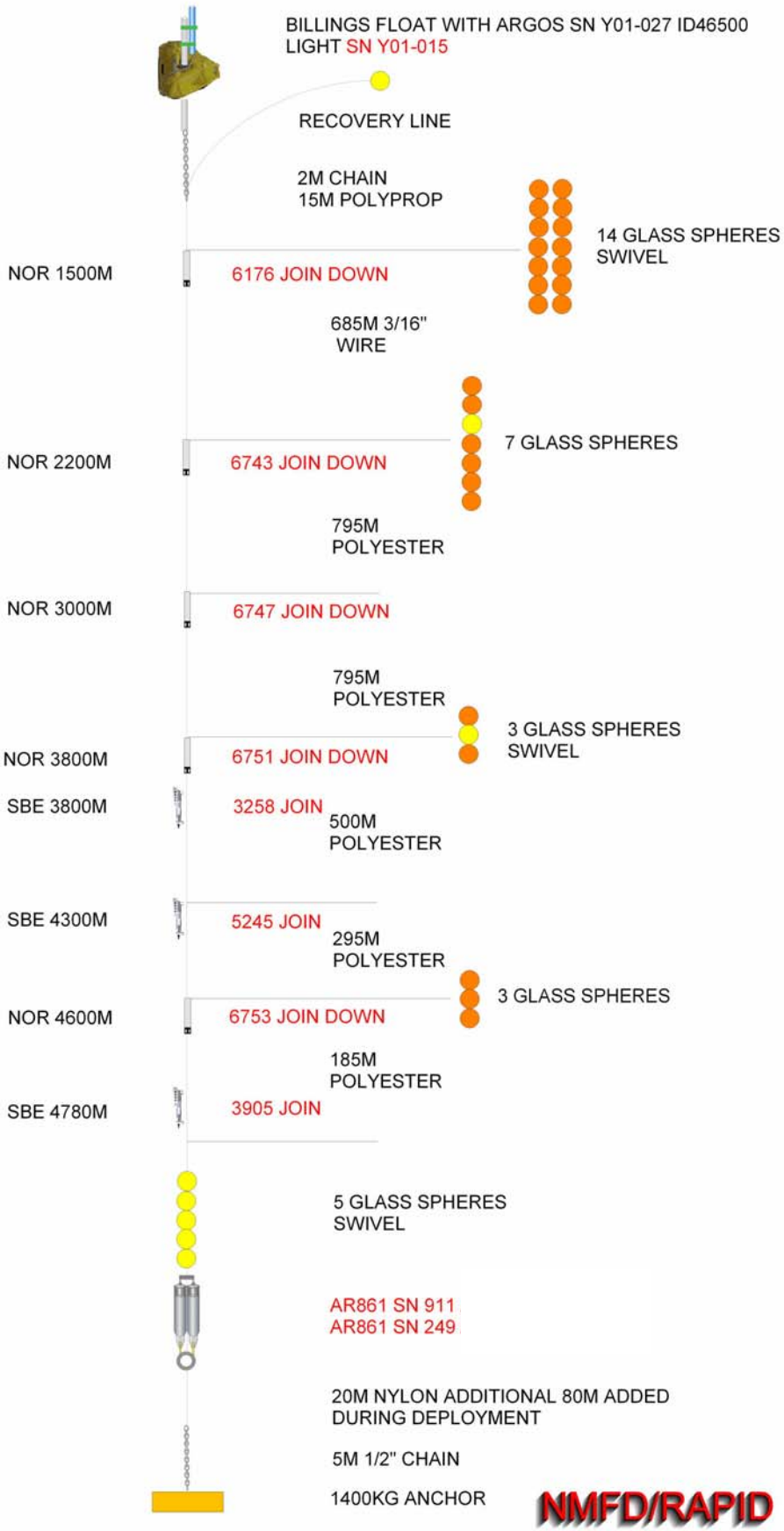
2 OFF SBE 53
SN 0031
SN 0037

600KG DISC ANCHOR

WATER DEPTH
593M

NMFD/RAPID

WBH2 2010/04
AS DEPLOYED
OCEANUS
2010



WATER DEPTH
4736M CORR.

NMFD/RAPID

D: Mooring Deployment Logsheets

RAPID-WATCH MOORING LOGSHEET DEPLOYMENT

Mooring **WB1** Cruise **OC459-1**

NB: all times recorded in GMT

Date 3/4/10 **Site arrival time** 1200

Setup distance 2.5ca

Start time 1318 **End time** 1651

Start Position

Latitude 26.4884 **Longitude** -76.8616

ITEM	SER NO	COMMENT	TIME
Recovery line			1319
3 TRYMSYN floats		Marking from previous dep.	
SBE37 Microcat	5764		
30" SYNTACTIC		Marking from previous dep.	1322 1349
ARGOS	s/n 012	ID 46494	1349
Light			1349
1m chain and swivel			1349
NORTEK	5963	pointing down	1349
SBE37 Microcat	6115		1349
SBE37 Microcat	3919		1354
45" syntactic buoy			1404
ARGOS	s/n 255	ID 42745	"
LIGHT			"
1m chain and swivel			"
SBE37 Microcat	6116		"
SBE37 Microcat	3928		1409
RCM11	301	Deployed on floating block from	1417
SBE37 Microcat	6117	this point down	1417
SBE37 Microcat	3930		1420
SBE37 Microcat	6118		1424
SBE37 Microcat	3931		1428
10 x 17" glass		40, 45, 20 1y 40/3y 20	1435 1438
RCM11	302		1439
SBE37 Microcat	6119		1441
SBE37 Microcat	3932		1445
SBE37 Microcat	6120		1450
SBE37 Microcat	6324		1457
2 x 17" glass		2y	1501
RCM11	303		1501
SBE37 Microcat	6321		1503
SBE37 Microcat	7723		1510
10 x 17" glass		40 1y / 50	1513 1516
Acoustic release #1	906	Record release codes	1520
Acoustic release #2	223	Record release codes	"

1525 towing to drop.

50m 4mm wire (red)

150m 6mm wire (yellow)

join

400m 3/16" black

join

400m 1/4" white

80m 1/4" whole

30+10m 1/4"

1342 1343 1343 1328 This part connected wrong so recovered all. Ship repositioned to 2.5ca.

50m above syntactic is 30" wrong & attached below syntactic!

2.1 to go 0.8 hr over gyre

slow to 4/10 kn

More detail needed: wires + joins on future log sheets. length colour

20m NYLON TWIST			
10m ½" chain			
Anchor 1800kg			165122

Release #1 arm code _____
Release #1 release code _____
Release #2 arm code _____
Release #2 release code _____

Anchor Drop Position
Latitude 26.4999 (26° 29.994) **Longitude** -76.8177 (-76 49.062)
Uncorrected water depth 1386 (at anchor launch)
Corrected water depth 1394 (at anchor launch)

174030

T R1 R2 Diagnostic

1705 4065

1321 1320 vertical 9.3V

1318 1318

R

2301 2301

2294 2293.7

transducer 28 m

release 30 m

58

Triangulation

water range 1318

depth (m/uc) 1376 => depth.

1643m ?

2301 2301

2294 2293.7

174030

① 26 29.405 76 48.162

26 29.405 76 48.162

② 26 30.979 76 49.032

180545 .968 .045 1362m 2242.4 2240.4

180630 .961 .055 1363m 2228.5 —

③ 26 29.510 76 50.131

182810 1135 2252.6 2250.3

182856 .503 .136 1135 2276.9 2280.6

Anchor Seabed : 26.4995 260 29.97' N 76.8187 76° 49.122' W Fallback 0.06nm

RAPID-WATCH MOORING LOGSHEET DEPLOYMENT

Mooring **WB2** Cruise **OC459-1**

NB: all times recorded in GMT

Date 31/3/10 **Site arrival time** 1520

Setup distance 6.5 nm

Start time 1520 **End time** 2042

Start Position

Latitude 26 25.03 **Longitude** 076 42.49

ITEM	SER NO	COMMENT	TIME
Recovery line			1520
3 x TRYMSYN floats			1521
SBE 37 MicroCAT	3223		"
30" SYNTACTIC			1524
ARGOS beacon		Record Argos ID Y01-030 id 46503	"
Light		Y01-049	"
1m chain and swivel			"
RCM11	305		"
SBE 37 MicroCAT	5239		"
51" syntactic buoy			1538
Argos		Record Argos ID s/n 286 id 22442	"
Light		X01-050	"
1m chain with swivel			"
RCM11	306	] Immediately below swivel	"
SBE 37 MicroCAT	3229	]	"
SBE 37 MicroCAT	5243	]	1543
2 x 17" glass		]	1549
RCM11	445	] below glass	1549
SBE 37 MicroCAT	~~6[illegible]~~	3906	1555
SBE 37 MicroCAT	5244		1558
2 x 17" glass			1609
RCM11	448		"
SBE 37 MicroCAT	3230		1606
SBE 37 MicroCAT	6113		1612
10 x 17" glass		top 5 glass	1618
Swivel		bottom " "	1622
RCM11	449		"
SBE 37 MicroCAT	3231		1625
SBE 37 MicroCAT	6114		1633
SONTEK ARGONAUT	D995		"
5 x 17" glass			1643
SBE 37 MicroCAT	3232		1646
SBE 37 MicroCAT	5247		1651
RCM11	450		1658

5 x 17" glass			1709
SBE 37 MicroCAT	3233		1713
SBE 37 MicroCAT	6112		1726
2 x 17" glass			1735
RCM11	451		"
5 x 17" glass			1748
SBE 37 MicroCAT	3244		1751
SBE 37 MicroCAT	3907	inst. above join of wire & nylon	1813
11 x 17" glass		top 6 glass	~~1818~~ 1818
Swivel		bottom 5 glass	1871
Release #1	910	Record release codes	1927
Release #2	256	Record release codes	
35M nylon		start towing off 2m chain secured	1841
10M 1/2" chain		w/ 2 ropes	
Anchor 2200 KG			2042

910 **Release #1 arm code** _____
256 **Release #1 release code** _____
Release #2 arm code _____
Release #2 release code _____
Argos beacon #1 ID _____
Argos beacon #2 ID _____
Anchor Drop Position
Latitude 26 31.11 **Longitude** 076 44.81
Uncorrected water depth 3779 (at anchor launch)
Corrected water depth 3796 (at anchor launch)

910 211015 4364 4344 on bottom & communicating
1100 4342 4341
1200 4338
1230 4337 4336

256 21 17 4312 4312
18 4309 4309
1830 4309 4308

Δ time	R1	R2	Lat	Lon	depth
213510	4429	4428	26 30.169	76 45.810	3835
213540	4422	4421	30.170	45.815	3836
215800	4246	4247	26 30.179	76 45.674	3658
2159	4249	4300	30.170	45.681	3657
22 3045	3997	3997	26 31.648	76 44.736	3670
22 3115	3998	3999			

bottom_wb.2
26° 30.871 N 076° 44.791 W
Fall back 0.24 nm

RAPID-WATCH MOORING LOGSHEET DEPLOYMENT

Mooring **WB6** Cruise **OC459-1**

NB: all times recorded in GMT

Date 28/3/10 **Site arrival time** 1540

Setup distance 3 cables

Start time 1545 **End time** 1558 39

Start Position

Latitude 26° 29.6 **Longitude** 70 31.6

ITEM	SER NO	COMMENT	TIME
Pick Up float			1545
15m polyprop			
3 x 17" glass			
Microcat at join	3207		1546
100m polyester			
Microcat about halfway	5238		1549
100m polyester			
2 x 17" glass			1552
Microcat at join	[redacted]	3212	1552
[redacted]	[redacted]		
100m polyester			
Microcat about halfway	3213	+ DZ73 SONTEK	1554
100m polyester			
Microcat at join	3214		1556
8 x 17" glass			1557
BPR #1 on tripod	0032		
BPR #2 on tripod	418		
Release #1 in tripod	827	Record release codes	
Release #2 in tripod	361	Record release codes	155839
Anchor 600 KG			

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Anchor Drop Position

Latitude 26 29.65 **Longitude** 70 31.4

Uncorrected water depth 5432 (at anchor launch)

Corrected water depth 5491 (at anchor launch)

Time	R1	R2
361 122910	–	–
55	–	3544
3055	–	–
	3692	–
3212	–	–
123300	3546	–
34	–	–

	R1	R2
123500	–	–
123630	4222	–
3730	–	–
123930	–	–
41		
44	5017	5034
45	–	5153
46	5226	–

	R1	R2
47	–	–
48	5214	←
49	–	
50	–	
51	–	
827 52	–	

RAPID-WATCH MOORING LOGSHEET DEPLOYMENT

Mooring **WBADCP** Cruise **OC459-1**

NB: all times recorded in GMT

Date 2/4/10 **Site arrival time** 2255
Start time 2257 **End time**

ITEM	SER NO	COMMENT	TIME
1 x glass			2257
15m POLYPROP 24mm			
SYNTACTIC ADCP BUOY			
75 KHZ ADCP	10311		225930
ARGOS BEACON		Record PTT below ~~4650~~	
Titanium swivel			
10m 5/8" chain			
Release	823		2307
5m 5/8" chain			
Anchor 850 KG			23 14 40

Argos beacon #1 ID (PTT) 46508
Release #1 arm code
Release #1 release code
Anchor Drop Position
Latitude 26 31.5 **Longitude** 76 48.48
Uncorrected water depth 600 (at anchor launch)
Corrected water depth 609 (at anchor launch)

T	R1	R2	
232145	585	586	
232230	589	590	vertical, 9.3V

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WBH2** Cruise **OC459-1**

NB: all times recorded in GMT

Date 2010.04.01 **Site arrival time** 1342

Setup distance _____

Start Position

Latitude 26° 26.687 **Longitude** 76° 33.711

Start time 1342 **End time** 1601

ITEM	SER NO	COMMENT	TIME
1 x 17" glass			1349
Recovery line			
Billings float			1343
Light	401-015	radio 401-087	
14 x 17" glass		upper 7 glass	1345
Swivel		lower 7 "	1347
NORTEK	6176	~~6167~~	"
7 x 17" glass		first 4 glass	1405
NORTEK	6743	~~6743~~ nortek & last 3 "	1407
NORTEK	~~6740~~	6747	1427
3 x 17" glass			1449
Swivel			"
NORTEK	6751		"
SBE37 Microcat	3258		1450 ← 1:16 to dep.
SBE37 Microcat	5245		1506
3 x 17" glass			1518
NORTEK	6753		"
SBE37 Microcat	3905		1527
5 x 17" glass			1531
Swivel			"
Release #1	911	Record release codes	"
Release #2	949	Record release codes	"
100m ~~20m~~ Nylon		Needed to be spooled	15:48
5m ½" chain			
Anchor 1400kg			160145

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Anchor Drop Position

Latitude 26° 29.320 **Longitude** 76° 34.823 (76° 34.823)

Uncorrected water depth 4785 (at anchor launch)

Corrected water depth 4824 (at anchor launch)

(26° 29.320)

verifying ~~bottom~~ depth of releases

0.6 nm off declutched motor

		ranging				
911	1631	4805	–			
		–	–			
	1632	–	–			
	1633	–	–			
		4674				
	1636	4673	4674	telem,	vertical,	batt 9V
249	1637	4672	(8643)	telem	–	–
	1638	4669	4670	"	vert,	9.3 V

triangulation

position	lat (N)	lon (W)	range	on s/n 911
eastern	26° 28.274'	76° 33.030'	5559.6	5559.0
	26° 28.270'	76° 33.043'	5551.7	5550.8
northern	26° 31.302'	76° 34.893'	6404.0	6403.3
	26° 31.297'	76° 34.900'	6399.1	6398.2
western	26° 28.255'	76° 36.811'	5852.6	5855.6
	26° 28.254'	76° 36.818'	5861.0	5863.5

RAPID-WATCH MOORING LOGSHEET DEPLOYMENT

Mooring **WBL0** Cruise **OC459-1**

NB: all times recorded in GMT

Date 3/4/10 **Site arrival time** 0001

Start time 0011 **End time** _____

ITEM	SER NO	COMMENT	TIME
10" ~~17~~" glass			0011
Recovery line			
Billings Float with ~~VHF~~ and ARGOS	Y01-028 460801		0013
Light	S01-185		
5m of 3/8" chain			
4 x 17" glass		yellow	0014
15m polyprop			
4 x 17" glass		orange	0015
15m polyprop			
BPR #1 in tripod	0031		
BPR #2 in tripod	0037		
Release #1 in tripod	365	Record release codes	
Release #2 in tripod	246	Record release codes	
Anchor 500 KG			003026

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Anchor Drop Position

Latitude 26 31.5 **Longitude** 76 52.563

Uncorrected water depth 489.8 (at anchor launch)

Corrected water depth 498 (at anchor launch)

Frame to anchor not tight – may end up with noisy BPR records if it more chatters up & down.

	T	R1	R2	
365	0036	489	498	nominal 7V
246	0037	502	503	" 9V

RAPID-WATCH MOORING LOGSHEET DEPLOYMENT

Mooring **WBL3** Cruise **OC459-1**

NB: all times recorded in GMT

Date 2/4/10 **Site arrival time** 0030

Start time 0105 **End time** 0113

ITEM	SER NO	COMMENT	TIME
17" glass			0105
Recovery line			
Billings Float with VHF and ARGOS	Y01-029 IF 46502		0106
Light			
28m of 3/8" chain +	15m poly	Floats upright + stable	
4 x 17" glass			0108
15m polyprop			"
4 x 17" glass			0109
15m polyprop			
BPR #1 in tripod] 26's	0389		0113
BPR #2 in tripod]	0398		"
Release #1 in tripod	265	Record release codes	"
Release #2 in tripod	251	Record release codes	"
Anchor 500 KG			011310

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Anchor Drop Position

Latitude 26° 30.52'N **Longitude** 076° 44.71'W

Uncorrected water depth 3863 (at anchor launch)

Corrected water depth 3882 (at anchor launch)

S/N 265

S/N 251

t	R1	R2	
012240	2743	3666	
2308	—	—	
2425	—		
2610	1539	1551	
012730	1548	1611	] 120 m/min
2800	1656	1667	
2830	1710	1720	] 112m/min

RAPID-WATCH MOORING LOGSHEET DEPLOYMENT

Mooring **WBL4** Cruise **OC459-1**

NB: all times recorded in GMT

Date 30 ~~SEP~~.03.10 **Site arrival time** 0143

Start time 0140 **End time** 0152

ITEM	SER NO	COMMENT	TIME
17 " glass			
Billings Float with VHF	401-014		014847
And light	401-026		
5m of 3/8" chain			
Recovery line			
4 x 17" glass			4907
15m polyprop			
4 x 17" glass			4940
15m polyprop			
BPR #1 in tripod	0400		
BPR #2 in tripod	0399		
Release #1 in tripod	907	Record release codes	
Release #2 in tripod	320	Record release codes	
Anchor 500 KG			5158

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Anchor Drop Position

Latitude 26 21.78 **Longitude** 75° 42.416

Uncorrected water depth 4672 (at anchor launch)

Corrected water depth 4708 (at anchor launch)

ranging

015940	1047	1060
	~~1060~~	
016040	1160	1173
0202	1414	1426
0207	1540	1553

E: Mooring Recovery Logsheets

RAPID-WATCH MOORING LOGSHEET RECOVERY

Mooring **WB1** Cruise **OC459-1**

NB: all times recorded in GMT

Date 2/4/10 **Site arrival time** 1353

Time of first ranging 135530

Time of release ~~1440~~ 1358

Latitude _____ **Longitude** _____

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

ITEM	SER NO	COMMENT	TIME
Recovery line			1439
3 TRYMSYN floats		Heavy biofouling	1440
SBE37 Microcat	3206	Heavy biofouling	1441
30" SYNTACTIC			1452
ARGOS			|
Light			|
1m chain and swivel			|
RCM11	381	Heavy biofouling	
SBE37 Microcat	3219	" "	1454
SBE37 Microcat	6837		1459
45" syntactic buoy			1505
ARGOS			|
LIGHT			|
1m chain and swivel			|
SBE37 Microcat	6838		1522
SBE37 Microcat	6839		1526
RCM11	~~6840~~	383	1530
SBE37 Microcat	6840		"
SBE37 Microcat	6841		1539
SBE37 Microcat	3209		1543
SBE37 Microcat	3215		1547
10 x 17" glass		first 5 glass	1550
RCM11	395	last 5 glass & RCM	1555
SBE37 Microcat	3216		1601
SBE37 Microcat	3221		1605
SBE37 Microcat	3224	upper clamp only at nominal depth	1609
SBE37 Microcat	3225		1614
2 x 17" glass			1618
RCM11	399		"
SBE37 Microcat	3234		"
SBE37 Microcat	3222		1623
10 x 17" glass		~~glass~~	1625
Acoustic release #1	824	Record release codes released	"
Acoustic release #2	318	Record release codes not released	"

wire laid hard ← to port, ship maneuvered to put it astern

, 1611 *1

*1 recover rest of inst, approx 20-30m (!) lower on wire

Ascent rate
Time at end of recovery 1625

Ranging

Time	Range 1	Range 2	Command /comment
s/n 824 13.55 30	—	1420	Diagnostic, vertical 12.7V
s/n 818 13 56 30	1431	1431	Diagnostic, vertical 12.7V
824 13 58	1446	—	Release sent, no answer
5840	1402	1391	ascending
5930	1319	1310	] 44m / min
140030	1225	1216	
			ETA surface 14:14
			for release.

RAPID-WATCH MOORING LOGSHEET RECOVERY

Mooring **WB2** Cruise **OC459-1**

NB: all times recorded in GMT

Date 30/3/10 **Site arrival time** 1335

Time of first ranging 1341 2 cm dist.

Time of release 1408

Latitude _____ **Longitude** _____

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

ITEM	SER NO	COMMENT	TIME
Recovery line			1529
3 x TRYMSYN floats		Heavy bio-fouling	"
SBE 37 MicroCAT	6819		"
30" SYNTACTIC			1534
ARGOS beacon			
Light			
1m chain and swivel			
RCM11	519		1536
SBE 37 MicroCAT	6820		1539
51" syntactic buoy			1544
Argos			
Light			
1m chain with swivel			
RCM11	~~525~~ 515		1546
SBE 37 MicroCAT	~~6820~~ 6821		~~1535~~ 1601
SBE 37 MicroCAT	6822		1608
2 x 17" glass			1611
RCM11	~~519~~ 516		1612
SBE 37 MicroCAT	6823		1621
SBE 37 MicroCAT	6824	missing plastic clamp near connection, which slid down wire to the glass	1629
2 x 17" glass			1634
RCM11	520		1634
SBE 37 MicroCAT	6825		1639
SBE 37 MicroCAT	6826		1648
10 x 17" glass			1654
Swivel			1656
RCM11	443		1656
SBE 37 MicroCAT	6827		1701
SBE 37 MicroCAT	6828		1709
5 x 17" glass			1716
SBE 37 MicroCAT	6829		1718
SBE 37 MicroCAT	3247		1724
RCM11	444		1729
5 x 17" glass			1737
SBE 37 MicroCAT	6831		1740

SBE 37 MicroCAT	6832	clamp @ connection completely missing	1754
2 x 17" glass			1800
RCM11	426	slid down to RCM/glass	1800
5 x 17" glass			1811
SBE 37 MicroCAT	6833	came in tangled, white plastic clamp @ connection missing	1810
SBE 37 MicroCAT	6834	the connection came back	1829
11 x 17" glass			1831
Swivel			
Release #1	281	Record release codes did not release	
Release #2	926	Record release codes	

Ascent rate _____

Time at end of recovery _____

Ranging

	Time	Range 1	Range 2	Command /comment
				281 - no response initially
				926
926	134130	3863		
		–	–	
	1345			release sent
	46	–	–	
	47	–	–	
	48	–	–	
	4930	–	–	
	50	–	–	
	5050	–	–	
	5125	–	–	
	5210	–	–	
				transducer sent 15-25 m deeper
	5430	–	–	
	55	–	–	
	5545	–	–	
	57	–	–	
	5730			
				talk w/ WBL3, ranges of 4003, 4004
281	1403	–	–	
	0450	–	–	Release sent.
	0530	–	–	
	0610	–	–	
	0650	–	–	
926	1408			release sent
	09	–	–	
	0930	–	–	

1410 buoy sighted

(later:) According to Steve, the release signal was sent to both instruments multiple times (at least 2 times for sn 281).

RAPID-WATCH MOORING LOGSHEET RECOVERY

Mooring **WB6** Cruise **OC459-1**

NB: all times recorded in GMT

Date 28/3/10 **Site arrival time** 1216

Time of first ranging 121924 409 4 enables

Time of release ~~125400~~ 125400

Latitude 26 29.45 **Longitude** 070 31.56

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

ITEM	SER NO	COMMENT	TIME
Pick Up float		on surface 1344, grappled 135630	1359
15m polyprop			"
3 x 17" glass			"
Microcat at join	5242		"
100m polyester			
Microcat about halfway	4180	IMP capped	1407
100m polyester			
2 x 17" glass			1410
Microcat at join	5764		"
100m polyester			
Microcat about halfway	4473	imp capped	
100m polyester			
Microcat at join	5765		1417
4 x 17" glass			1418
BPR #1 on tripod			142030
BPR #2 on tripod			"
Release #1 in tripod	361		"
Release #2 in tripod	827		"

Ascent rate 100 m/s

Time at end of recovery 1421

Ranging

	Time	Range 1	Range 2	Command /comment
~~#~~ 361	121924	5465	—	
	2030	—	—	several more no reply
~~#~~ 827	122500	—	—	
	122600	—	—	several more no reply.
				reposition to sit above mooring
827	1237	5425	5425	
	30	—	—	
	3830	—	—	
361	3930	—	—	
	4030	—	—	deploy transducer aft at capstan

deployed at wetlabs,

	TIME	R1	R2		
361	1248	5413	5412		
	30	5413	—		
	4900	5413	5413		
827	125000	—	—		
	5100	5414	—		
	30	5413	—		
	52	5417	5417		
361	1254	5416	Reply OK,	no answer	Release set
	1255	—	—		
	1256	5244	—		
	1257	—	—		
	1258	5049	—		
	1259	—	—		
	1300	4851			

Rise : 100 m / min

ETA surface 1344

RAPID-WATCH MOORING LOGSHEET RECOVERY

Mooring **WBADCP** Cruise **OC459-1**

NB: all times recorded in GMT

Date 2/4/10 **Site arrival time** 0800

Time of first ranging 1229

Time of release 1233

Latitude _____ **Longitude** _____

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

ITEM	SER NO	COMMENT	TIME
1 x glass			125215
15m POLYPROP 24mm			
SYNTACTIC ADCP BUOY			1255
75 KHZ ADCP	5817		
ARGOS BEACON		Record PTT below	
Titanium swivel			
10m 5/8" chain			
Release	825	Heavy rust stains top + bottom, from shackle	1314
5m 5/8" chain			
Anchor 850 KG			

Ascent rate ~180 m/min

Time at end of recovery 1314

Ranging

Time	Range 1	Range 2	Command /comment
123000	976.8	976	
30	981	983	
3130	8.7V Vertical		Diagnostic
1233	1014		Release sent, Reply OK, Release OK
30	1028.6	1027.4	
3400	1037	1033	
3500	1064	1071	

123645 on surface.

Recovered stb side, outboard of A-frame. Deck space + arrangement unsuitable for such large buoys. Dangerous in any weather - no room for deck teams! Once on deck lifted clear by crane.

RAPID-WATCH MOORING LOGSHEET RECOVERY

Mooring **WBH2** Cruise **OC459-1**

NB: all times recorded in GMT 1/APR/2010

Date ~~30/3/10~~ **Site arrival time** ~~0450~~

Time of first ranging 1002 @ 4 cubes 18:07

Time of release 1029 (?)

Latitude ~~26 28.03~~ 26 28.871 **Longitude** ~~76 37.5~~ 76 38.030

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

ITEM	SER NO	COMMENT	TIME
1 x 17" glass			19:20
Recovery line			19:23
Billings float		Tangled with glass spheres	19:29
Light		Bottom pipe of Billings broken	|
14 x 17" glass			|
Swivel			|
NORTEK	5897	Different from deployment diagram	19:30
7 x 17" glass			20:00
NORTEK	5889	Different from deployment diagram	20:02
NORTEK	5879	Different from deployment diagram	20:30
3 x 17" glass			
Swivel		Rope tangled up	
NORTEK	5884	Different from deployment diagram	21:00
SBE37 Microcat	~~6816~~ 6818	~~Rope tangled up~~	~~20:40~~ 20:58
SBE37 Microcat	6817	Different from deployment diagram	21:03
3 x 17" glass			20:54
NORTEK	5890	Different from diagram	|
SBE37 Microcat	6816	Different from diagram	20:40
5 x 17" glass		Rope tangled up	|
Swivel			|
Release #1	497	Came before halfway mooring	20:41
Release #2	819		|
20m Nylon			
5m ½" chain			

Note: Instrument numbers are correct on 200g deployment log sheet

Ascent rate

Time at end of recovery 21:09

Ranging

Time	Range 1	Range 2	Command /comment
1004	- - -	- - -	nothing on either release (deck unit 27)
1010			deeper transducer, new deck unit
1015	can hear returns	ping but no numbers / Deploy x'diver on portside	
1022	✓	✓	nothing at all on either release
1026	try diagnostic. Can hear replies but nothing on deck unit		
1029 00	sent release		
44	"	"	
1030			
1104			
3315	nothing ...	1040 on 497 nothing	

497 819

Try deeper + new deck unit.

497

497/819

497

819

497	1118	4632 4634	4630 4634	moved briefly over mooring
	1119	diagnostic	4634 no answer	These ranges => release is
819	1127			60m above bottom
	Repositioned 3cm to north nothing			
	1156	Declutch engaged		
819	1157	4650 –		
819	1200	release] nothing	search visually until 1230	
497	1201	release] on either lines		
497	123033	– – – –	– – – –	Paul can hear release reply but we get
819	1232	– – – –	– – – –	nothing on declutch
01.04.10	telemetering from wbh2 depolyment site			
819	1641	6615	6613	
		6610	6609	
		6606	6604	telem vert'l 8.3 V
497	1643	6600	6598	telem " 8.5 V
	1645			26° 29.188 76° 34.960
repositioned to	nearby, 0.25 nm away			
819	1719	–	–	
		declutched		
		–	–	
497		–	–	

repositioned to wbh2 deployment site at 26° 29.271
76° 34.840

1801 – –
– –

no response from either

819 1805 6697
good range

1807 – – release sent
180730 – – " "

497 180813 6679 6678 release sent
180920 6591 6577 " "
181020 6510 6497 " "

diff in range of 80 m/min, 60 m/min expected if ascends @ 97 m/min
↓ ~ 12 min rise from release time

ETA 1820

182410 sighted from bridge, as 1 nm ~~off~~ away & steaming towards

RAPID-WATCH MOORING LOGSHEET RECOVERY

Mooring **WBL3** Cruise **OC459-1**

NB: all times recorded in GMT

Date 1/4/10 **Site arrival time** 1026

Time of first ranging 1031

Time of release 1034

Latitude _____ **Longitude** _____

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

ITEM	SER NO	COMMENT	TIME
17" glass			11:29
Recovery line			11:35
Billings Float with VHF and	W03-108		
Light	W03-092		
5m of 3/8" chain			
4 x 17" glass			
15m polyprop			
4 x 17" glass			11:40
15m polyprop			
BPR #1 in tripod	0028		11:42
BPR #2 in tripod	0029		
Release #1 in tripod	0028 163		
Release #2 in tripod	0029 920		

Ascent rate

Time at end of recovery 11:42

Ranging

Time	Range 1	Range 2	Command /comment
920 10311D	3866.6	3866.2	
RT 661 10 3230	3869	3869	
920 10 3400	3873	3874	sent release, release OK
1035	na	na	
36	3729	3721	
3630	3695	3686	
10 3730	3617	3609	
923			

ascent ~ 68 m/min
~ 77 m/min
~ 75 m/min

ETA on surface. 1124
0724

1123 00 First siting

RAPID-WATCH MOORING LOGSHEET RECOVERY

Mooring **WBL4** Cruise **OC459-1**

NB: all times recorded in GMT

Date 29.03.10 **Site arrival time** 1835

Time of first ranging ~~1935~~ ~2003? 1955?

Time of release 1901

Latitude _____ **Longitude** _____

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

ITEM	SER NO	COMMENT	TIME
17 " glass			2009
Billings Float with VHF			2012
And light			2012
3/8" chain			2012
Recovery line			2012
2 x 17" glass			2012
15m polyprop			2016
4 x 17" glass			2015
15m polyprop			2017
BPR #1 in tripod			2017
Release #1 in tripod			2017

Ascent rate 148 m/min

Time at end of recovery 2017

Ranging

Time	Range 1	Range 2	Command /comment
253 18 41 17	–	–	
54	–	–	move ~~tidler~~ ducer to port side
42 36	–	–	
	–	–	lower deeper
4416	4659		
	–	–	
4606	–	–	
44	–	–	
4810	–	–	telemetry
	–	–	
4934	–	–	ranging
5129	–	–	
5205	–	–	
5300	–	–	
5328	–	–	

5420	—	—	bearing to WB4 is dead astern
19: 0143	12198	—	mooring 0.1 nm dead astern release sent
	4538		
0300	4494		
30	—	4434	
0430	—	4357	

77 m/½ min => 160 m/min

ETA ~ 1935

$$160 \overline{)4357} \quad 26.1$$

32

115

96

157

ETA 1930

F: Instrument Setup parameters

WBADCP

RD Instruments 75kHz Workhorse Longranger ADCP – Serial Number **10583**

System frequency: 76.8kHz
Beam angle: 20 degrees
Water salinity: 36ppt
Depth of transducer: 600m
Heading alignment: 0
Heading bias: 0
Depth cell size: 16.00m
Number of depth cells: 40
Blank after transmit: 7.04m
Pings per ensemble: 10
Ambiguity velocity: 170cm/s
Time between ping groups: 3 mins
Time per ensemble: 00:30:00
Start date: 02/04/10
Start time: 18:30:00
Deployment name: OC459

WB1

SBE37 MicroCAT SMP CTD unit, serial number **5764**

Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

Nortek Aquadopp – serial number **5963**

Measurement interval: 1800 s
Average interval: 30 s
Blanking distance: 1.5 m
Compass update rate: 10 s
Speed of sound: measured
Salinity: 35
Co-ordinate system: ENU
Diagnostic interval: 720 min
Diagnostic samples: 20
Target depth: 100 m
Instrument started 02/04/2010

SBE37 MicroCAT SMP CTD unit, serial number **6115**

Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3919**

Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)

Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **6116**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3928**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **301**
Pings per ensemble 600
Temperature range High
Conductivity range 40-50
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 14571
Instrument started 02/04/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **6117**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3930**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **6118**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3931**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **302**
Pings per ensemble 600
Temperature range Low
Conductivity range 33-40
Recording interval 30
No of channels 8

Mode Burst
DSU serial number 14572
Instrument started 02/04/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **6119**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3932**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **6120**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **6324**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **303**
Pings per ensemble 600
Temperature range Low
Conductivity range 32-35
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 13430
Instrument started 02/04/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **6321**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **7723**
Sample interval: 1800 seconds
Start date: 03 04 2010 (DDMMYYYY)
Start time: 12 00 00 (HHMMSS GMT)

WB2

SBE37 MicroCAT SMP CTD unit, serial number **3223**
Sample interval: 1800 seconds

Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **305**
Pings per ensemble 600
Temperature range High
Conductivity range 45-57
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 16213
Instrument started 31/03/10 13:00:00

SBE37 MicroCAT SMP CTD unit, serial number **5239**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **306**
Pings per ensemble 600
Temperature range High
Conductivity range 45-57
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 13860
Instrument started 31/03/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **3228**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **5243**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **445**
Pings per ensemble 600
Temperature range High
Conductivity range 43-50
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 13887
Instrument started 31/03/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **3906**

Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **5244**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **448**
Pings per ensemble 600
Temperature range Low
Conductivity range 33-42
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 14570
Instrument started 31/03/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **3230**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **6113**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **449**
Pings per ensemble 600
Temperature range Low
Conductivity range 32-36
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 14573
Instrument started 31/03/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **3231**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **6114**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

Sontek Argonaut current meter, serial number **D295**
Baud rate: 600
Deployment name: WB2
Start date: 31/03/2010 (DD/MM/YYYY)
Start time: 15:00:00 (HH:MM:SS GMT)
Target depth: 1500 m

SBE37 MicroCAT SMP CTD unit, serial number **3232**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **5247**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **450**
Pings per ensemble 600
Temperature range Low
Conductivity range 32-35
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 14568
Instrument started 31/03/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **3233**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **6112**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

Aanderaa RCM11 – serial number **451**
Pings per ensemble 600
Temperature range Low
Conductivity range 32-34
Recording interval 30
No of channels 8
Mode Burst
DSU serial number 13884
Instrument started 31/03/10 13:30:00

SBE37 MicroCAT SMP CTD unit, serial number **3244**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3907**
Sample interval: 1800 seconds
Start date: 31 03 2010 (DDMMYYYY)
Start time: 14 00 00 (HHMMSS GMT)

WBL3

Seabird SBE26 BPR – serial number **0398**
Tide interval: 30 minutes
Wave burst after every N tide measurements: 9999
Wave samples per burst: 68
No. of 0.25 s periods to integrate waves: 33
Start date: 31/03/2010 (DD/MM/YYYY)
Start time: 16:00:00 (HH:MM:SS GMT)

Seabird SBE26 BPR – serial number **0389**
Tide interval: 30 minutes
Wave burst after every N tide measurements: 9999
Wave samples per burst: 68
No. of 0.25 s periods to integrate waves: 33
Start date: 31/03/2010 (DD/MM/YYYY)
Start time: 16:00:00 (HH:MM:SS GMT)

WBH2

Nortek Aquadopp – serial number **6176**
Measurement interval: 1800 s
Average interval: 30 s
Blanking distance: 1.5 m
Compass update rate: 10 s
Speed of sound: measured
Salinity: 35
Co-ordinate system: ENU
Diagnostic interval: 720 min
Diagnostic samples: 20
Target depth: 1500 m
Instrument started 31/03/2010

Nortek Aquadopp – serial number **6743**
Measurement interval: 1800 s
Average interval: 30 s
Blanking distance: 1.5 m
Compass update rate: 10 s
Speed of sound: measured

Salinity: 35
Co-ordinate system: ENU
Diagnostic interval: 720 min
Diagnostic samples: 20
Target depth: 1500 m
Instrument started 31/03/2010

Nortek Aquadopp – serial number **6747**
Measurement interval: 1800 s
Average interval: 30 s
Blanking distance: 1.5 m
Compass update rate: 10 s
Speed of sound: measured
Salinity: 35
Co-ordinate system: ENU
Diagnostic interval: 720 min
Diagnostic samples: 20
Target depth: 1500 m
Instrument started 31/03/2010

Nortek Aquadopp – serial number **6751**
Measurement interval: 1800 s
Average interval: 30 s
Blanking distance: 1.5 m
Compass update rate: 10 s
Speed of sound: measured
Salinity: 35
Co-ordinate system: ENU
Diagnostic interval: 720 min
Diagnostic samples: 20
Target depth: 1500 m
Instrument started 31/03/2010

SBE37 MicroCAT SMP CTD unit, serial number **3258**
Sample interval: 1800 seconds
Start date: 01 04 2010 (DDMMYYYY)
Start time: 13 00 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **5245**
Sample interval: 1800 seconds
Start date: 01 04 2010 (DDMMYYYY)
Start time: 13 00 00 (HHMMSS GMT)

Nortek Aquadopp – serial number **6753**
Measurement interval: 1800 s
Average interval: 30 s
Blanking distance: 1.5 m
Compass update rate: 10 s
Speed of sound: measured

Salinity: 35
Co-ordinate system: ENU
Diagnostic interval: 720 min
Diagnostic samples: 20
Target depth: 1500 m
Instrument started 31/03/2010

SBE37 MicroCAT SMP CTD unit, serial number **3905**
Sample interval: 1800 seconds
Start date: 01 04 2010 (DDMMYYYY)
Start time: 13 00 00 (HHMMSS GMT)

WBL4

Seabird SBE26 BPR – serial number **0399**
Tide interval: 30 minutes
Wave burst after every N tide measurements: 9999
Wave samples per burst: 68
No. of 0.25 s periods to integrate waves: 33
Start date: 29/03/2010 (DD/MM/YYYY)
Start time: 19:30:00 (HH:MM:SS GMT)

Seabird SBE26 BPR – serial number **0400**
Tide interval: 30 minutes
Wave burst after every N tide measurements: 9999
Wave samples per burst: 68
No. of 0.25 s periods to integrate waves: 33
Start date: 29/03/2010 (DD/MM/YYYY)
Start time: 19:20:00 (HH:MM:SS GMT)

WB6

SBE37 MicroCAT SMP CTD unit, serial number **3207**
Sample interval: 1800 seconds
Start date: 28 03 2010 (DDMMYYYY)
Start time: 15 30 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **5238**
Sample interval: 1800 seconds
Start date: 28 03 2010 (DDMMYYYY)
Start time: 15 30 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3212**
Sample interval: 1800 seconds
Start date: 28 03 2010 (DDMMYYYY)
Start time: 15 30 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3213**
Sample interval: 1800 seconds

Start date: 28 03 2010 (DDMMYYYY)
Start time: 15 30 00 (HHMMSS GMT)

SBE37 MicroCAT SMP CTD unit, serial number **3214**
Sample interval: 1800 seconds
Start date: 28 03 2010 (DDMMYYYY)
Start time: 15 30 00 (HHMMSS GMT)

Seabird SBE53 BPR – serial number **0032**
Header WB6_OC459
Tide sample interval 30 minutes
Tide measurement duration 30 minutes
Frequency of reference measurement
(every N tide samples) 96
Start date 28/03/10
Start time 15:30:00 (GMT)

Seabird SBE53 BPR – serial number **0418**
Header WB6_OC459
Tide sample interval 30 minutes
Tide measurement duration 30 minutes
Frequency of reference measurement
(every N tide samples) 96
Start date 28/03/10
Start time 15:30:00 (GMT)

WBL0

Seabird SBE53 BPR – serial number **0037**
Header WBL0_OC459
Tide sample interval 30 minutes
Tide measurement duration 30 minutes
Frequency of reference measurement
(every N tide samples) 96
Start date 02/04/10
Start time 01:30:00 (GMT)

Seabird SBE53 BPR – serial number **0031**
Header WBL0_OC459
Tide sample interval 30 minutes
Tide measurement duration 30 minutes
Frequency of reference measurement
(every N tide samples) 96
Start date 02/04/10
Start time 01:00:00 (GMT)

G: RAPID cruise report for cruise RB10-09

Introduction

This report is for the UK RAPID participation on cruise RB10-09 aboard the RV *Ronald H. Brown*, on which time was allocated to recover and redeploy one tall mooring (WB4) along with recovery of a lander (WB3L3).

The Principal Scientist for the overall cruise was Al Pluedemann from Woods Hole Oceanographic Institute, but also present were a group from the NOAA Atlantic Oceanographic and Meteorological Laboratory led by Molly Baringer, and a team from the Scripps Institute for Oceanography led by Christian Begler. Two staff from the National Oceanography Centre, Southampton, UK participated; Darren Rayner and Robert McLachlan.

The multiple groupings were present due to the cruise programme being adjusted, with cruises combined as best as possible to complete the moorings operations from the several groups.

Acknowledgements

We are extremely grateful for the help given to us by the WHOI moorings team lead by Jeff Lord. Without them we would not have been able to complete the work so quickly. We're also grateful to the AOML participants who took care of the CTD cal dips meaning that we could get some sleep in what was a very busy few days.

Itinerary

Sailed from Port Canaveral, Florida, USA on the 28th November 2010. NOCS and AOML participants Disembarked by small boat transfer to Marsh Harbour, Abaco, Bahamas on the 1st December 2010. Main cruise docked Charleston, South Carolina, USA on the 19th December 2010.

NOCS Cruise Objectives

1. Recover mooring WB4 deployed in Spring 2009 from cruise RB09-01 on the RV *Ronald H. Brown* (Rayner & Wright, 2009). This mooring was due for recovery in Spring 2010 but there was insufficient time aboard cruise OC459-1 on the RV *Oceanus* (The main part of this cruise report).
2. Redeploy the replacement mooring WB4.
3. Recover lander WB3L3 (previously called WBLB) deployed on cruise SJ08-03 aboard the RV *Seward Johnson*. (Kanzow & Collins, 2009).

Diary of Events

All times are given in GMT unless otherwise stated

26th November 2010

Arrived at ship. Gear already loaded courtesy of WHOI group and the ship's crew as it had turned up a few days earlier, before we had even left the UK. Starting setting up the lab and preparing instruments.

27th November 2010

Sorted out gear on deck and built up syntactic rugby ball floats for WB4. This took a long time with just the two of us doing it. The floats are not uniform in their construction, which resulted in may of the bolts running out of thread before the clamps had secured the wire. Additional washers (courtesy of the WHOI group) were used to overcome this problem. For next year Rob plans to have some packers made, or to replace the bolts with ones with longer threads.

28th November 2010

First meal onboard at breakfast. Set sail. Inserted batteries in Norteks. Got everything ready for the mooring operations, and prepared instruments for the first CTD cast. The MicroCATs were attached using ratchet straps but not setup until just before the CTD cast on the following day. They were setup whilst clamped to the frame.

29th November 2010

Arrived on site at WB4 at 16:39 (11:39 ship time). First ranging at 16:43 using the "superducer". Release fired at 16:48 and spotted on surface by bridge at 16:51. Recovery completed by 21:03. One RCM11 (sn 304) was flooded. Performed a CTD cal-dip and release test in the evening. Rob unwound the mooring wire from the single bay direct pull winch with help from the WHOI team. I downloaded all the MicroCATs and secured the data. Both releases (serial numbers 1200 and 1242) worked on the test.

30th November 2010

On site at WB3L at 10:10 (5:10 ship time). First ranging at 10:18. Release fired at 10:29 with mooring estimating to surface before sunrise but when the light was sufficient to spot it. Difficulty spotting it and VHF beacon not heard. Range checked at 11:52 and was found to be approximately 1150m and not changing – therefore it was on the surface. Ship crept slowly up to directly over anchor site and the mooring was spotted – we were obviously too far away to spot it when it first surfaced. Recovery completed by 12:57. The wire for WB4 was wound on to the winch (again with help from the WHOI team). The instruments were downloaded from the calibration dip – they had previously just been stopped when take off the CTD frame. The RCM11s from WB4 were downloaded along with the BPRs recovered from the lander.

On site for WB4 deployment at approximately 17:00, but still getting things ready. Distance to drop point was 5 miles. Started deployment at 18:24. Started towing with 2 miles to go. Checked the bathymetry and the area is flat so adjusted the drop point to 1.5 miles before the initially planned one. Anchor released at 22:58. Once the ship had stopped and we deployed the "superducer" the anchor was already on the bottom. The anchor seabed position was then triangulated and following that a CTD cast was completed in the evening with the recovered MicroCATs attached.

1st December 2010

Downloaded all MicroCATs from the CTD cast and packed up the lab. Disembarked via small boat transfer to Marsh Harbour at approximately 16:30 (11:30 ship time).

Moorings Summary

Mooring name	NMFD mooring number	Deployment cruise	Deployment date/time	Recovery date/time
WB4	2009/08	RB0901	26/4/09 21:04	29/11/10 16:48
WB3L3 (previously called WBLB)	2008/09	SJ08-03	24/4/08 21:20	30/11/10 10:29

Table 1: Summary of UK mooring recoveries on RB10-09

Mooring name	NMFD mooring number	Anchor drop position		Anchor seabed position		u/c depth (m)	Corr. depth (m)	Deployment date/ time	Duration	Argos ID
		latitude	longitude	latitude	longitude					
WB4	2010/26	26° 21.692'N	75° 44.150'W	26° 21.774'N	75° 44.274'W	4679	4715	30/11/10 22:58	04:34	82895

Table 2: Summary of UK mooring deployments on RB10-09

Instrument Problems

There were only problems with the instruments recovered from the mooring and lander: One RCM11 (serial number 304) was flooded, and two MicroCATS (serial numbers 6806 and 6835) stopped about 3 months early due to the batteries being depleted.

Details of MicroCAT Calibration Casts

Cast number	Serial Number	MicroCAT type	Pre- or post-deployment	Comments
1	3206	SMP	Pre-	
	3215	SMP	Pre-	
	3219	SMP	Pre-	
	3221	SMP	Pre-	
	3222	SMP	Pre-	
	3224	SMP	Pre-	
	3225	SMP	Pre-	
	3234	SMP	Pre-	
	3913	SMP	Pre-	Pump still suspect but not noticed until after deployed.
	6798	SMP	Pre-	
	6799	SMP	Pre-	
	6800	SMP	Pre-	
	6801	SMP	Pre-	
	6802	SMP	Pre-	
	6819	SMP	Pre-	
2	6803	SMP	Post-	
	6804	SMP	Post-	
	6805	SMP	Post-	
	6806	SMP	Post-	
	6807	SMP	Post-	
	6808	SMP	Post-	
	6809	SMP	Post-	
	6810	SMP	Post-	
	6811	SMP	Post-	
	6812	SMP	Post-	
	6813	SMP	Post-	
	6814	SMP	Post-	
	6815	SMP	Post-	
	6832	SMP	Post-	
	6836	SMP	Post-	

Table 3: Summary of CTD calibration casts

Instrument Setup Details

MicroCATs

The MicroCATs deployed on WB4 are those listed as being on CTD cast 1 above. All were setup as below.

Sample Interval = 1800 seconds
Start date = 30th November 2010
Start time = 17:00

Nortek Aquadopps

The only differences in the setups of the Norteks deployed on WB4 are the changes in deployment name – these are detailed in table 4, and a slightly different start time for serial number 5889. Otherwise all settings were as below.

Sample Interval = 1800 seconds
Average Interval = 30
Blanking Distance = 1.5m
Compass Update Rate = 10 seconds
Speed of Sound = measured
Using Fixed Salinity = 35.0
Coordinate system = ENU
Diagnostic Interval = 720 minutes
Number of Diagnostic Samples = 20
Start Date = 30th November 2010
Start Time = 14:00 (14:30 for serial number 5889)

Serial number	Deployment name
6132	WB4_a
5890	WB4_b
5967	WB4_c
5889	WB4_d
5884	WB4_e
6765	WB4_f
6119	WB4_g
5897	WB4_h
5879	WB4_i

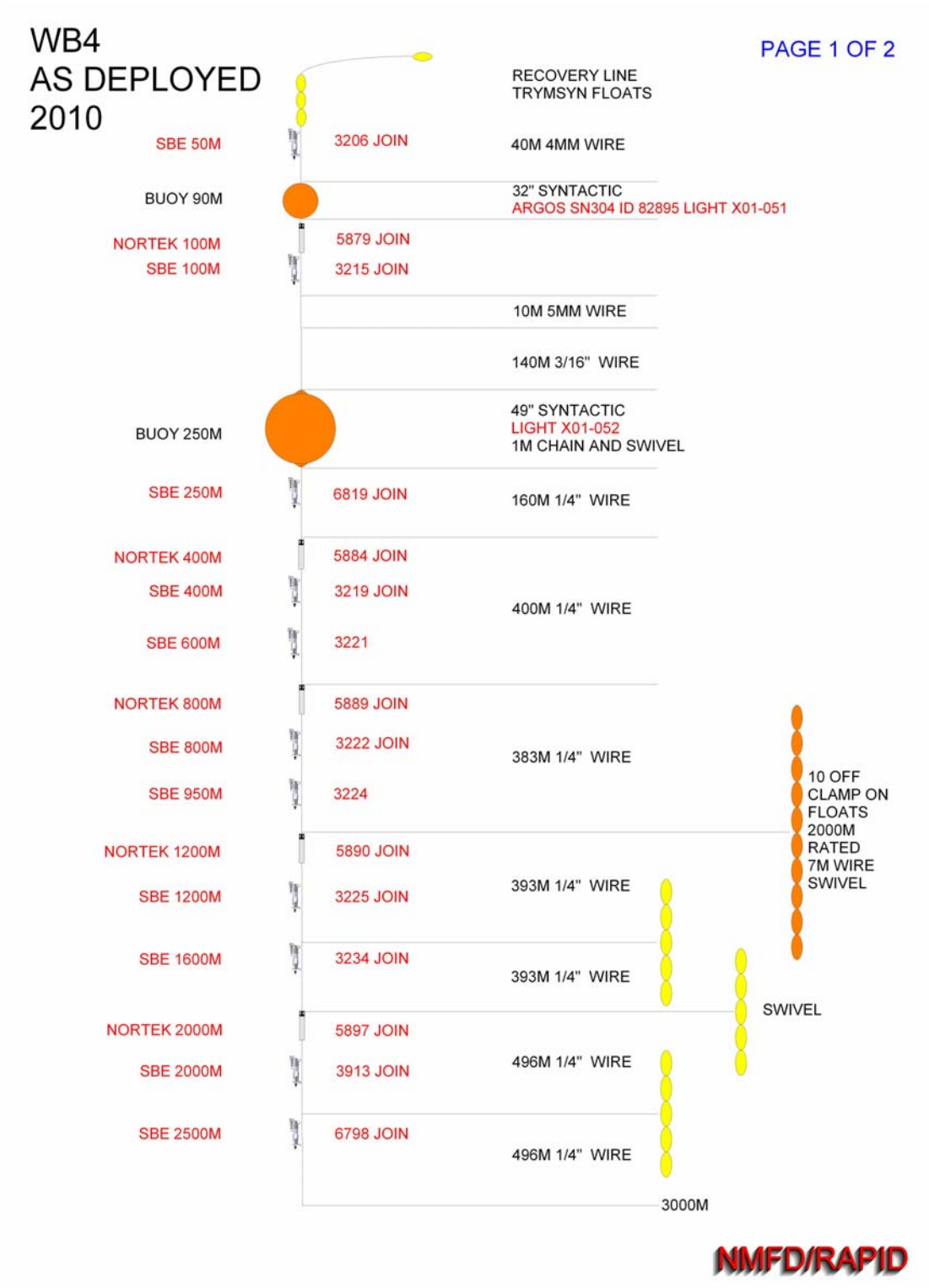
Table 4: Summary of Nortek deployment names

References

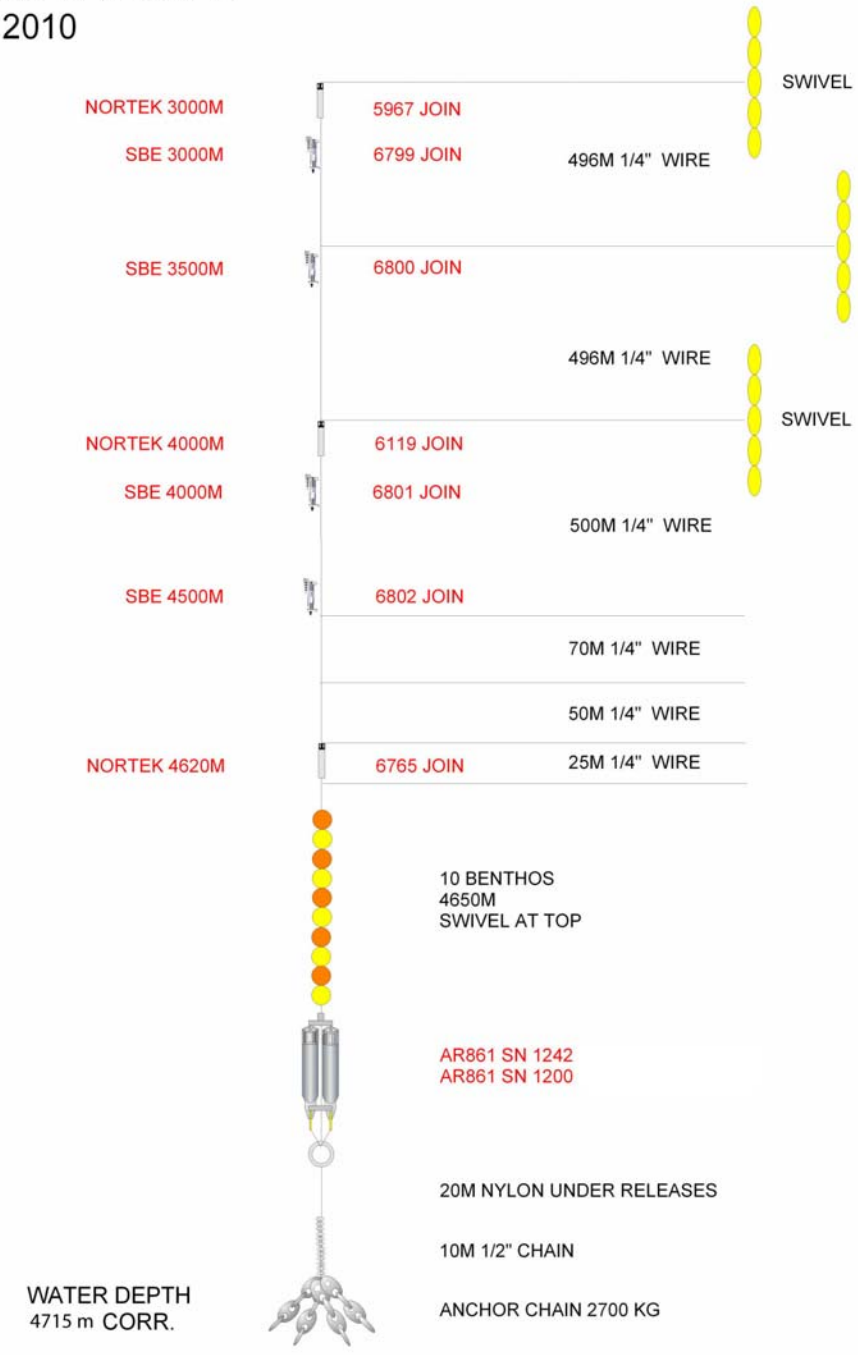
Kanzow, T. O., & Collins, J. L. (2009). "RV *Seward Johnson* Cruise SJ08-03 Leg 2, 22-30 Apr 2008. RAPID-MOC Autumn 2008 Western Boundary moorings refurbishment cruises." National Oceanography Centre Southampton Cruise Report **No. 37**: 73

Rayner, D., & P. G. Wright (2009). "RV *Ronald H. Brown* Cruise RB0901, 15 Apr-06 May 2009. RAPID Mooring Cruise Report." National Oceanography Centre Southampton Cruise Report **40**: 121pp.

Mooring Diagram of WB4 as deployed



WB4
AS DEPLOYED
2010



NMFD/RAPID

Mooring Recovery Logsheets

ANCHOR POSN 26° 21·18 75° 43·32 BRIDGE 12s

ETA 11:30

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WB4** Cruise **RB10-09**

NB: all times recorded in GMT

Date 29/11/10 **Site arrival time** 16:39

Time of first ranging 16:43

Time of release 16:48

Latitude _____ **Longitude** _____

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

3M DAVE OLSEN DRIVING.

ITEM	SER NO	COMMENT	TIME
Recovery line			17:12
3 TRYMSYN floats		momentary loss of propulsion	17:17
SBE37 Microcat	6835	heavy fouling	17:23
32" syntactic buoy			17:40
ARGOS			17:40
LIGHT			17:40
1m Chain and swivel	~~5831~~ ✓		17:40
Nortek	6836 5831		17:42
SBE37 Microcat	~~6803~~ 6836	✓ light fouling	17:45
49" syntactic buoy			17:55
ARGOS			17:56
LIGHT			17:55
1m chain and swivel			17:53
SBE37 Microcat	6803 ✓		18:00
RCM11	304 ✓		18:09
SBE37 Microcat	6804 ✓		18:08
SBE37 Microcat	6805 ✓		18:19
Nortek	5896 ✓		18:28
SBE37 Microcat	6806 ✓		18:26
SBE37 Microcat	6807 ✓		18:34
10x 2000m rated rugby floats	✓	tangled mess	18:54
RCM11	428 ✓	}	18:52
SBE37 Microcat	6808 ✓		18:46
5x 5000m rated rugby floats	✓		19:09
SBE37 Microcat	6809 ✓		19:09
5x 5000m rated rugby floats	✓		19:26
Nortek	5899 ✓		19:29
SBE37 Microcat	6810 ✓		19:28
5x 5000m rated rugby floats	✓		19:47
SBE37 Microcat	6811 ✓		19:45
5x 5000m rated rugby floats	✓		20:02

RCM11	518 ✓		20:05
SBE37 Microcat	6812 ✓		20:06
5x 5000m rated rugby floats	✓		20:21
SBE37 Microcat	6813 ✓	20:35 twisted wire ahead of floats	20:20
5x 5000m rated rugby floats		tangled mess	20:39
Nortek	5885 ✓		20:38
SBE37 Microcat	6814 ✓		20:26
SBE37 Microcat	6815 ✓		20:52
10x Benthos glass			20:57
Acoustic release #1	919		20:57
Acoustic release #2	358 ✓		20:57

Secured 21:03

Ascent rate
Time at end of recovery 21:03

Ranging

Time	Range 1	Range 2	Command /comment
16:43	165 X	805 X	
	1777 X	186 X	
16:44	4780.7	4779.7	ARM + ARM [redacted]
	2991 X	359 X	
16:45	4778.7	3310 X	
16:46	3652 X	6074	ARM + ARM [redacted]
16:46:25	7467 X	4780	
46:50	11129 X	6831	
16:48:10	~~685~~ ✓	6081 ✓	ARM + REL [redacted]
16:49:05	✓	✓	NOT CONFIRMED
16:49:50	~~16~~ ✓	4545	NOT CONFIRMED
16:50:40			

[2kHz Echosounder switched on.]

RELEASE SHOTTEN 16:51

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **B-lander** Cruise **RB10-09**

NB: all times recorded in GMT

Date ~~12~~ 3/11/10 **Site arrival time** 10:10

Time of first ranging 10:18

Time of release 10:29

Latitude _____ **Longitude** _____

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

ITEM	SER NO	COMMENT	TIME
Recovery line			12:44
Billings float			12:50
4 x 17" glass			12:50
4 x 17" glass			12:54
Tripod with dual release &	919 + 498	919 - GARMIN + FLOODED.	12:57
Dual BPR	0417	NOCS BPR	↓
	0005	Bill's BPR	

Ascent rate 75 m/min

Time at end of recovery 12:57

Ranging

FIRE 498 FIRST.

Time	Range 1	Range 2	Command /comment
10:18	—	—	919 ARM + ARM
10:19	—	—	
10:19	—	—	
10:21	—	—	498 ARM + ARM
10:21	—	—	
10:22	—	—	
10:23	4887	—	
10:23	4887	—	
10:25	—	—	919 ARM + ARM
10:25	—	—	
10:26	—	—	
10:27	—	4898	498 ARM + DISC VERIFIED 12-7V
10:29	—	4894	498 ARM + RELEASE NOT CONFIRMED
10:31:00	—	—	
10:31:30	4766	4755	NOT CONFIRMED
10:32:30	—	—	
10:33:50	—	—	
10:34:50	—	—	
10:37:50	4318	4305	78 m/min
10:38:50	4240		

448 m IN 6 MINS => 75 m/min

∴ 65 MINS FROM RECOVERY E.T.A. 11:34

Mooring Deployment Logsheets

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WB4** Cruise **RB1009**

NB: all times recorded in GMT

Date 30/11/10 **Site arrival time** 17:00 ish

Setup distance 5 MILES

Start time 18:22 **End time** _____

Start Position

Latitude 26°23.95N **Longitude** 75°47.98'W

ITEM	SER NO	COMMENT	TIME
Recovery line			18:24
3 TRYMSYN floats			18:25
SBE37 Microcat	3206		18:25
32" syntactic buoy			18:29
ARGOS		Record beacon ID AS PREVIOUS FOR TOP OF WIRE	
LIGHT	NOT SEEN		
1m Chain and swivel			
NORTEK	5879		
SBE37 Microcat	3215	APPROX 5m BELOW NORTEK.	18:33
49" syntactic buoy			18:48
~~ARGOS~~		~~Record beacon ID~~	
LIGHT	NOT SEEN		
1m chain and swivel			
SBE37 Microcat	6819	3-4m DOWN FROM BUOY	18:52
NORTEK	5884	FACING UP	19:01
SBE37 Microcat	3219	FEW METRES DOWN FROM NORTEK	19:04
SBE37 Microcat	3221		19:11
NORTEK	5885	DOWNWARD LOOKING	19:19
SBE37 Microcat	3222	FEW METRES DOWN	19:20
SBE37 Microcat	3224		19:26
10x 2000m rated rugby floats		LINE RESTRICTION STRAPS OF 5	19:39
NORTEK	5890		19:42
SBE37 Microcat	3225	FEW METRES DOWN	19:47
NORTEK	6765	DOWN LOOKING	20:03
5x 5000m rated rugby floats			20:02
SBE37 Microcat	3234	FEW METRES DOWN	20:25
5x 5000m rated rugby floats			20:23
NORTEK	~~5897~~ ?	COULD BE 5967	20:24
SBE37 Microcat	3913	FEW METRES DOWN	20:24
5x 5000m rated rugby floats			20:37
SBE37 Microcat	6798	FEW METRES DOWN	20:40
5x 5000m rated rugby floats			20:55
NORTEK	5897		20:57
SBE37 Microcat	6799		20:58

5.3 miles @ 60.

4x4 miles

37 miles @ 60

3-4 miles @ 60.

5x 5000m rated rugby floats			21:17
SBE37 Microcat	6800		21:18
5x 5000m rated rugby floats			21:35
NORTEK	6119		21:36
SBE37 Microcat	6801		21:38
SBE37 Microcat	6802		21:53
NORTEK	6132		22:00
10x Benthos glass			22:08
Acoustic release #1	1200	Record release codes ✓	
Acoustic release #2	1242	Record release codes ✓	
20m nylon			
10m 1/2" chain			
Anchor 2700 KG			22:58

2.5 miles 2 miles to go

Towing at 1-1.5 knots

Release #1 arm code [redacted]
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID As for WB4 Backhousey.
Argos beacon #2 ID N/A – Recovered units c/s

Anchor Drop Position
Latitude 26°21.692' N **Longitude** ~~75°44.150'~~ W

Uncorrected water depth 4679 m (at anchor launch)
Corrected water depth 4715 m (at anchor launch)

AREA IS FLAT SO GOING TO DROP SLIGHTLY EARLY
1.5 MILES BEFORE PLANNED DROP.

23:28	5082	5082
23:29:00	5083	5084
23:30:00	6912x	13579x
23:32:00	5080	3680

SN 1200 (1)
26° 21.179 N 75° 43.201 W

—	5084	
2373x	1281 x	
2374	503	
	5083	

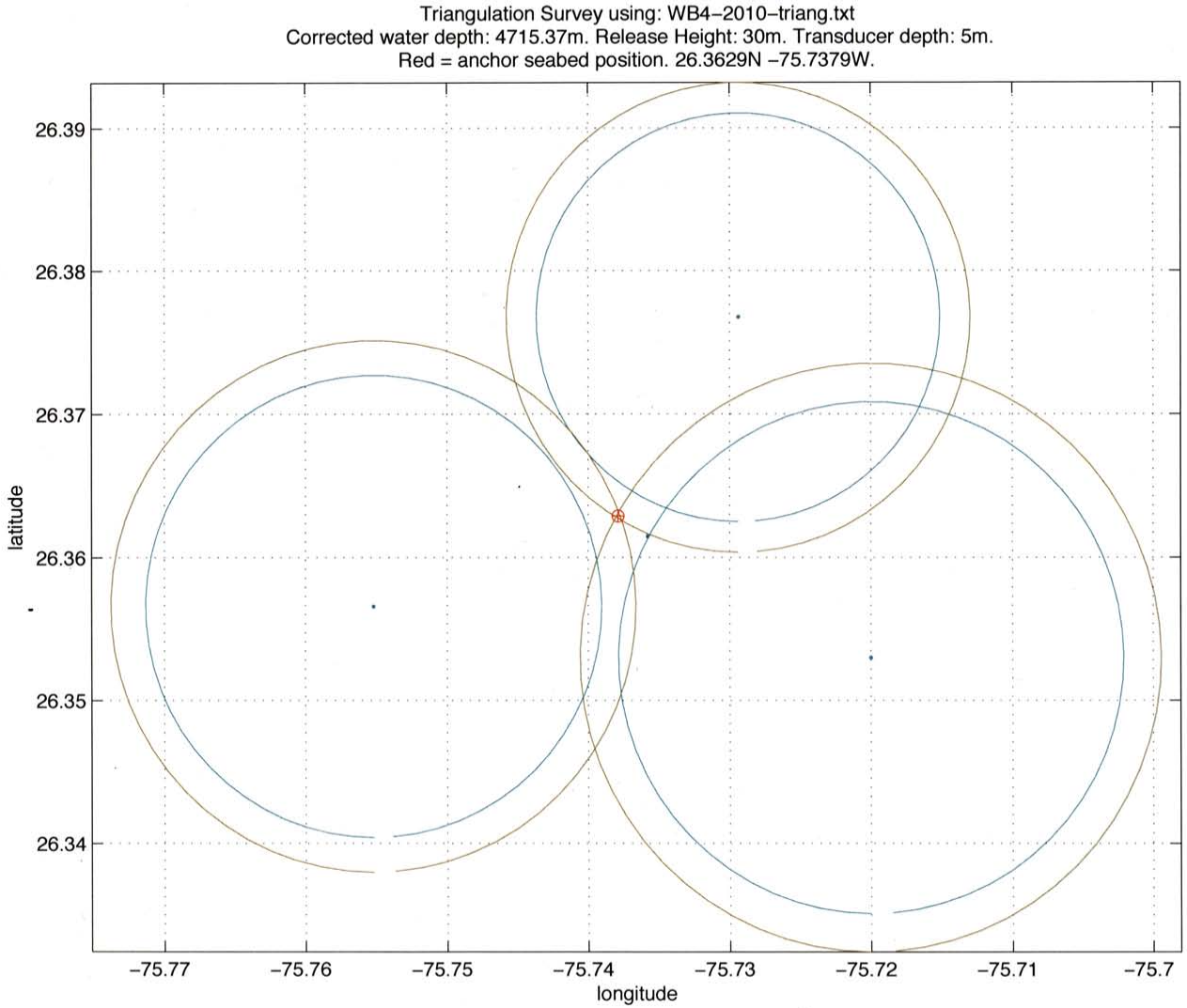
SN 1242

② 5011.5 5010.9
5011.7 5011.8
/ 5013.3

26° 21.396 N 75° 45.309 W

③ 333.2 x 3170.1 x
4939.3 4939.8
4940.6 4940.0

26° 22.610' N 75° 43.766' W



FALLBACK of ~~25~~ 256m